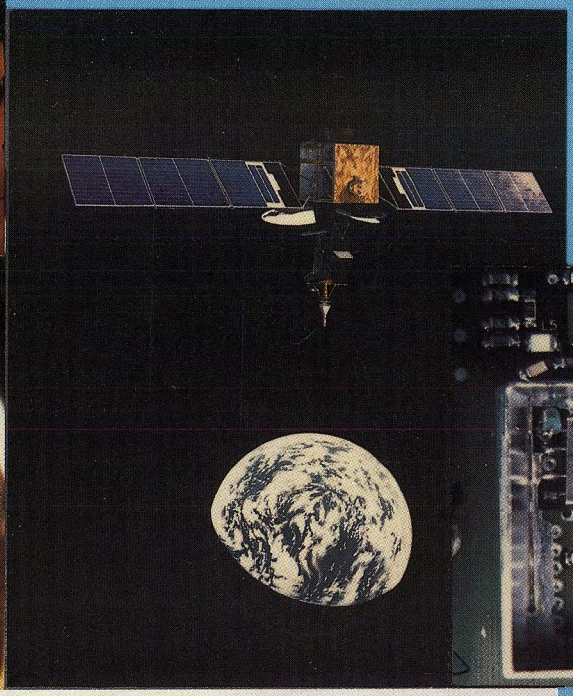
92/93

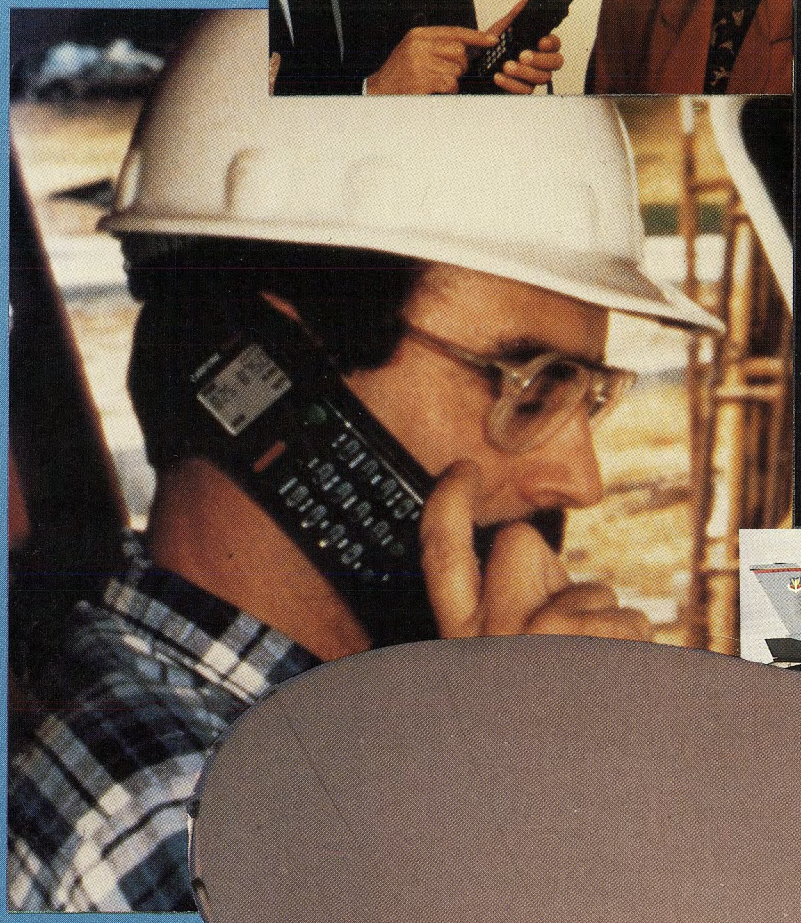
RF/IF Designer's Handbook

finding new ways...
setting higher standards

Mini-Circuits









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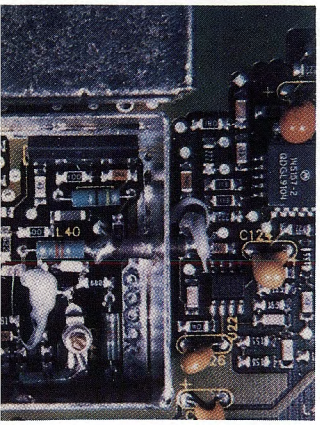

0 General Information
1 Frequency Mixers
2 Power Splitters/Combiners
3 Amplifiers
4 Electronic Attenuators
5 Digital Step Attenuators
6 Fixed Attenuators and Terminations
7 Directional Couplers
8 Filters
9 Frequency Doublers
10 Limiters
11 I&Q and QPSK Modulators/Demodulators
12 Phase Detectors
13 Switches
14 RF Transformers

Mini-Circuits...dedicated to meeting and exceeding customers' expectations.

finding new ways...

15 product lines with more than 1,000 off-the-shelf catalog models, extensive database on all catalog items plus 5,000 custom designs, manufacturing capability to supply high-volume orders on short notice, and consistent flow of new products to support our customers' future designs.

setting higher standards...

Ultra-Rel™ mixers with the industry's only five-year guarantee, unprecedented 4.5-sigma unit-to-unit repeatability on many models, guaranteed one-week shipment of all catalog items, and the most comprehensive array of innovative quality products for signal-processing requirements.

Our committment to you, our customer, never ends.

finding new ways ...
setting higher standards

Mini-Circuits™

"Dedicated to all engineers and scientists
who have contributed
to the growth of the electronics industry and
have made this handbook possible."

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Quality Excellence

Quality Excellence is the foundation for the total operation of our business and the keystone of our goal of customer satisfaction. It is, therefore, our policy to:

- Consistently provide products and services that will exceed the quality expectations of our customers.
- Actively pursue ever-improving quality through process improvement programs that will enable each member to do their job right the first time, and with a continuing level of quality improvement.

Quality will continue to be a major, strategic thrust in Mini-Circuits. It lies at the heart of everything we do.

Through active planning in every function in the company, we will strive to provide products and services that consistently meet all quality, schedule, and cost objectives. Furthermore, we will dedicate ourselves to continually improving the quality of our products and services by focusing on our processes and procedures.

Our ability to develop and administer a disciplined system for achieving continuous quality improvement is at the heart of accomplishing all strategic business objectives and indeed will determine how successful we are in securing our future.

That success will depend on releasing the power of each individual to contribute in a positive, productive working environment through enthusiastic and conscientious efforts for quality excellence and customer satisfaction in everything we do.

Every member is a part of our quality system:

- Each of us will strive to understand and satisfy the quality expectations of our customers (meaning the next internal organization in the process as well as the eventual end-customer).
- Each of us will strive to identify and eliminate the sources of error and waste in our processes and procedures.
- Each of us will aid the quality-planning and improvement efforts of others for the good of the corporation as a whole.
- Each of us will know what is expected individually and then surpass it.
- Each of us will take ownership of problems and resolve them.
- Each of us will voice opinions freely in efforts to overcome obstacles and increase creative contributions to our business.
- Each of us will track progress.

Each leader, manager, and officer is responsible for:

- Communicating our quality policy to each member.
- Clarifying specific responsibilities for quality.
- Developing and reviewing strategic quality plans and objectives on an on-going basis.
- Implementing a quality management system to carry out the plans and achieve objectives.
- Monitoring and continually improving the level of customer satisfaction.
- Monitoring and continually improving the defect and error rate of internal processes and systems.
- Developing joint quality plans with suppliers and other business partners.
- Implementing, funding, and reviewing specific quality improvement programs.
- Providing education and training in quality disciplines for all members.



HARVEY KAYLIE
President and Chief Executive Officer

Table of Contents

0 general information

ordering info and warranty 0-10, 0-11
how to use this handbook 0-5, 0-6
model index . . . . . 0-7 thru 0-9
tape and reel packaging 0-38, 0-39
case styles and outline drawings . . . . 0-40 thru 0-51
designer kits
specially priced model groups 0-52, 0-53

quality

company "quality & excellence" policy 0-3
"Ultra-rel®" mixers 0-14, 0-15
statistical terms 0-12, 0-13
quality defined . . . . . 0-17 thru 0-19
Mini-Circuits' quality environmental specs; Hi-Rel,
Ultra-rel, MIL, -TX-, screening . . . . 0-20 thru 0-22

applications

applications support 0-23
custom components 0-24, 0-25
measurement methods . . . . . 0-28 thru 0-30
CAPD explanation and test examples 0-26, 0-27
automated compression measurements . . .0-31, 0-32
a guide to surface-mount assembly . . . 0-34 thru 0-37

tables

VSWR vs. return loss 0-33
conversion dBm-volts-watts 0-54

1 mixers

table of contents 1-1
technical . . . . . 1-2 thru 1-32
product specifications . . . . . 1-33 thru 1-45
computer data and curves . . . . . 1-46 thru 1-338

2 power splitters/combiners

table of contents 2-1
technical . . . . . 2-2 thru 2-9
product specifications . . . . . 2-10 thru 2-27
computer data and curves . . . . . 2-28 thru 2-120

3 amplifiers

table of contents 3-1
technical . . . . . 3-2 thru 3-13
product specifications . . . . . 3-14 thru 3-21
computer data and curves . . . . . 3-22 thru 3-48

4 attenuators, electronic

table of contents 4-1
technical 4-2, 4-3, 4-10
product specifications 4-4, 4-5
computer data and curves . . . . . 4-6 thru 4-9

5 attenuators, digital step

table of contents 5-1
technical 5-2, 5-3, 5-5
product specifications 5-4
computer data and curves . . . . . 5-6 thru 5-10

6 attenuators/terminations

table of contents 6-1
technical 6-2, 6-3
product specifications 6-4, 6-5
computer data and curves . . . . . 6-6 thru 6-10

7 directional couplers

table of contents 7-1
technical . . . . . 7-2 thru 7-5
product specifications 7-6, 7-7
computer data and curves . . . . . 7-8 thru 7-22

8 filters

table of contents 8-1
technical . . . . . 8-2 thru 8-7
product specifications . . . . . 8-8 thru 8-11
computer data and curves . . . . . 8-12 thru 8-33

9 frequency doublers

table of contents 9-1
technical 9-2, 9-3, 9-9
product specifications 9-4, 9-5
computer data and curves . . . . . 9-6 thru 9-8

10 limiters

table of contents 10-1
technical 10-2, 10-3
product specifications 10-4
computer data and curves 10-5, 10-6

11 I/Q & QPSK modulators

table of contents 11-1
technical . . . . . 11-2 thru 11-10
product specifications . . . . . 11-11 thru 11-13
computer data and curves . . . . . 11-14 thru 11-26

12 phase detectors

table of contents 12-1
technical . . . . . 12-2 thru 12-5
product specifications 12-6
computer data and curves 12-7, 12-8

13 switches/drivers

table of contents 13-1
technical . . . . . 13-2 thru 13-5
product specifications . . . . . 13-6 thru 13-10
computer data and curves . . . . . 13-11 thru 13-15

14 RF transformers

table of contents 14-1
technical . . . . . 14-2 thru 14-5
product specifications 14-6, 14-7
computer data and curves . . . . . 14-8 thru 14-22

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Using This Handbook

Over 1000 Mini-Circuits IF/RF/Microwave Signal-Processing components are completely specified and described in this Handbook. These products are *all* available with guaranteed shipment of one week.

The large number of available models is offered so that the design engineer may select a model that closely fits the application requirement. In situations where there is a need for special electrical performance, mechanical configurations, environmental screening, or very low cost units, please contact our Applications Department. See page 0-23. In many cases, we produce special components in less than two weeks.

table of contents

The table of contents lists product groups and shows the thumb tabs assigned to each group.

product group table of contents

The table of contents, on page one of each product group section, lists product sub groups with corresponding specification pages and product group technical information including articles, definition of terms, most often asked questions, and a specifications checklist.

model number index

In each product group, model numbers are listed in alphanumeric order with page references to electrical specifications and data tables and curves. All surface-mount models are highlighted with an indicator. See page 0-7.

SMD

Surface-mount devices are included in almost every product group. See model number index page 0-7. Product group specification sections indicate non-hermetic and tape and reel package availability. Technical articles are listed in Section 0.

tape and reel packaging

Designers applying automated assembly procedures for surface-mount components will find a listing for tape width, reel size, package number, and number of devices on a reel; "footprints" for the various packages are shown.

designer kits index

An assortment of models within a product group are listed and offered at discounted prices for breadboard and prototype designs. See page 0-52.

specifications

The specification pages in each section include, for every model, a photo, complete electrical specifications, price, schematic diagram, pin connections (for pc board models) or connector markings, and reference designations for the case style and outline drawing. Each model within a series has the same case style and outline drawing unless otherwise indicated. Any exceptions or comments applicable to the specifications are listed under Notes.

Using the latest industry criteria for specifying mixer and I and Q modulator performance, "typical" conversion loss has been deleted and replaced with $\bar{X}$ and σ (sigma) average value and standard deviation of values for conversion loss. A discussion of these new parameter listings is given. See page 0-12.

Using This Handbook (cont.)

case style outline drawings

Case Style and Outline Drawings include information on case dimensions, tolerances, case material and finish, bracket options and "footprint" sketches for pc board design using surface-mount units. See page 0-40.

The information is arranged in tabular form with alphanumeric reference designations. Each alpha designation refers to a particular outline drawing. A photo of each case style is shown and designated on the model specification page.

computer-automated performance data (CAPD)



This symbol signifies that computer-automated performance data, CAPD, is available. A significant number of pages in this Handbook are devoted to Mini-Circuits' exclusive computer-automated performance data. These pages describe the most complete detailed data and performance curves ever available on characteristics of over 1000 catalogue products.

ULTRA-REL™ MIXERS
5-YR. GUARANTEE*

This symbol identifies products that are manufactured with extra reliability. See page 0-14 for a complete explanation.

prices

The prices shown are U.S. unit list prices for the quantity indicated. For unit prices in higher quantities, and for a formal quote, contact our nearest distribution center, authorized local distributor, sales office or the factory. See inside back cover page.

ordering information and warranty

For warranty, terms of payment, shipping instructions, and one-week guaranteed shipment conditions. See page 0-10

technical assistance

For literature requests, assistance in selecting models, understanding model specifications, requesting additional model performance data, contact our Applications Engineering Department. See page 0-23.

sales assistance

For assistance in purchasing products, obtaining quotes, opening up an account, requesting order status information, assistance in obtaining same or next day delivery, contact our Sales Department.

NSN numbers

Specification pages contain a listing of Mini-Circuits' models that have been assigned a National Stock Number (NSN).

listing of reps, authorized distributors distribution centers

A complete list of Mini-Circuits's sales representatives, local distributors, and major Distribution Centers puts you in immediate contact with our Sales Support team to answer questions, assist in component selection, and expedite orders. See inside back cover page.

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Model Index

Mini-Circuits

Please add the section number as a prefix to page number listed

● Blue dot indicates surface mount models.

1 mixers

model	spec pages (1-)	data pages (1-)
ASK-1	35	76
ASK-1-KK81	34	76
ASK-2	35	248
ASK-2-KK81	34	248
GRA-1	36	92
GRA-1H	42	150
GRA-3	36	46
GRA-3H	42	156
GRA-6	36	48
GRA-6H	42	162
GRA-8	36	50
LMX-3	35	68
LMX-113	35	78
LMX-123	40	130
LMX-123MH	41	298
LMX-124	35	80
LMX-125MH	41	142
LMX-148	40	132
LMX-149	35	82
LMX-156	35	214
LMX-1481	40	208
● LRMS-1	34	218
● LRMS-1H	43	306
● LRMS-1LH	40	220
● LRMS-1MH	41	222
● LRMS-1R	34	218
● LRMS-1W	34	282
● LRMS-1WH	43	308
● LRMS-2	34	224
● LRMS-2D	34	284
● LRMS-2H	43	310
● LRMS-2L	33	210
● LRMS-2LH	40	226
● LRMS-2MH	41	228
● LRMS-2R	34	224
● LRMS-2U	34	230
● LRMS-2UH	43	312
● LRMS-5	34	232
● LRMS-5H	43	250
● LRMS-5L	33	210
● LRMS-5LH	40	294
● LRMS-5MH	41	234
● LRMS-5R	34	232
● LRMS-11A	34	212
● LRMS-860	34	286
PAM-42	35	84
RAY-1	44	176
RAY-2	44	178
RAY-3	44	180
RAY-6	44	182
RAY-6U	44	216
RAY-11	44	314
● RMS-1	34	218
● RMS-1H	43	306
● RMS-1LH	40	220
● RMS-1MH	41	222
● RMS-1W	34	282
● RMS-1WH	43	308
● RMS-2	34	224
● RMS-2D	34	284
● RMS-2H	43	310
● RMS-2L	33	210
● RMS-2LH	40	226
● RMS-2MH	41	228
● RMS-2U	34	230
● RMS-2UH	43	312
● RMS-5	34	232
● RMS-5H	43	250
● RMS-5L	33	210
● RMS-5LH	40	294
● RMS-5MH	41	234
● RMS-11A	34	212
● RMS-860	34	286
ROK-186MH	41	112
ROSE-1	37	100
ROSE-2	37	—
SAM-1	37	102
SAM-2	37	66
SAM-3	37	106
SAM-4	37	108
SAM-5	37	110
SAY-1	45	184
SAY-2	45	186
SAY-11	45	188
SBL-1	36	62
SBL-1-1	36	116
SBL-1-1LH	40	256
SBL-1LH	40	252
SBL-1MH	41	144
SBL-1X	36	64
SBL-1XLH	40	258
SBL-1Z	36	114
SBL-1ZMH	41	260
SBL-2LH	40	262
SBL-3	36	118
SBL-3LH	40	264
SBL-11	36	58
SBL-11LH	40	254
● SCM-1	34	236
● SCM-1LH	40	—
● SCM-2	34	238
● SCM-2LH	40	—
● SCM-5	34	196
● SCM-5LH	40	—
● SCM-2500	34	266
● SCM-2500LH	40	—
SIMA-5	36	198
SIMA-5H	42	202
SIMA-5MH	41	204
SRA-1	36	92
SRA-1-1	36	52
SRA-1H	42	150
SRA-1MH	41	146
SRA-1TX	36	92
SRA-1W	36	54
SRA-1WH	42	152
SRA-11	36	58
SRA-11H	42	158
SRA-12	36	74
SRA-149	36	240
SRA-173H	42	160
SRA-2	36	56
SRA-2CM	36	96
SRA-2CR	40	242
SRA-2H	42	154
SRA-215	40	134
SRA-220	40	136
SRA-2000	36	60
SRA-2010MH	41	98
SRA-2400	36	266
SRA-3	36	46
SRA-3H	42	156
SRA-3MH	41	148
SRA-3500	36	244
SRA-4	36	122
SRA-5	36	120
SRA-6	36	48
SRA-6H	42	162
SRA-8	36	50
● SYM-2	34	66
● SYM-11	34	288
● SYM-11H	42	304
● SYM-11LH	40	296
● SYM-11MH	41	300
● SYM-860	34	292
TAK-1H	43	164
TAK-1WH	43	168
TAK-3H	43	172
TAK-5	37	86
TAK-5R	37	88
TAK-6	37	90
TAK-6R	37	90
TAK-7	37	56
TFM-1H	43	164
TFM-1MH	41	138
TFM-2	35	66
TFM-2H	43	166
TFM-2LH	40	262
TFM-2P	35	66
TFM-3	35	68
TFM-3H	43	170
TFM-3MH	41	140
TFM-4	35	70
TFM-4H	43	174
TFM-5	35	268
TFM-11	35	72
TFM-12	35	74
TFM-12MH	41	104
TFM-15	40	126
TFM-42MH	41	94
TFM-150	40	128
TFM-2400	35	266
TFM-4300	35	246
TSM-1	37	102
TSM-2	37	66
TSM-3	37	106
TSM-5	37	268
TUF-1	35	192
TUF-1H	43	164
TUF-1LH	40	316
TUF-1MH	41	138
● TUF1SM	34	192
TUF-2	35	194
TUF-2H	43	166
TUF-2LH	40	262
TUF-2MH	41	326
● TUF-2SM	34	194
TUF-3	35	200
TUF-3H	43	170
TUF-3LH	40	318
TUF-3MH	41	140
● TUF-3SM	34	200
TUF-5	35	206
TUF-5H	43	334
TUF-5LH	40	320
TUF-5MH	41	328
● TUF-5SM	34	206
TUF-11A	35	290
TUF-11AH	43	336
TUF-11ALH	40	322
TUF-11AMH	41	330
● TUF-11ASM	34	290
TUF-860	35	292
TUF-860H	43	338
TUF-860LH	40	324
TUF-860MH	41	332
● TUF-860SM	34	292
UNCL-L1	31	278
UNCL-L1H	31	270
UNCL-R1	30	272
UNCL-R1H	30	274
UNCL-X1	30	280
UNCL-X1MH	30	276
VAY-1	45	190
ZAD-1	38	92
ZAD-1-1	38	52
ZAD-1H	42	150
ZAD-1SH	43	164
ZAD-1W	38	54
ZAD-1WH	42	152
ZAD-1WSH	43	168
ZAD-2	38	56
ZAD-2H	42	154
ZAD-3	38	46
ZAD-3H	42	156
ZAD-3SH	43	172
ZAD-4	38	122
ZAD-6	38	48
ZAD-8	38	50
ZAD-11	38	58
ZAD-11H	42	158
ZAD-12	38	74
ZAM-42	39	85
ZAY-1	44	176
ZAY-2	44	178
ZAY-3	44	180
ZEM-2B	39	66
ZEM-4300	39	246
ZEM-4300MH	41	302
ZFM-1H	43	164
ZFM-1W	39	54
ZFM-2	39	66
ZFM-2H	43	166
ZFM-3	39	68
ZFM-3H	43	172
ZFM-4	39	70
ZFM-4H	43	174
ZFM-11	39	72
ZFM-12	39	74
ZFM-15	40	126
ZFM-150	40	128
ZFM-2000	39	60
ZFM-4212	39	84
ZFY-1	45	184
ZFY-2	45	186
ZFY-11	45	188
ZLW-1	38	92
ZLW-1W	38	54
ZLW-1-1	38	52
ZLW-1H	42	150
ZLW-1SH	43	164
ZLW-1WH	42	152
ZLW-1WSH	43	168
ZLW-2	38	66
ZLW-2H	42	154
ZLW-3	38	46
ZLW-3H	42	156
ZLW-35H	43	172
ZLW-5	38	120
ZLW-6	38	48
ZLW-8	38	50
ZLW-11	38	58
ZLW-11H	42	158
ZLW-12	38	74
ZMY-1	44	176
ZMY-2	44	178
ZMY-3	44	180
ZP-10514	38	124

2 power splitters/combiners

model	spec pages (2-)	data pages (2-)
LPS-109	10	84
● LRPQ-70	14	119
● LRPQ-700	14	119
● LRPQ-980	14	120
● LRPS-2-1	10	118
● LRPS-2-4	10	120
MSC-2-1	11	89
MSC-2-1W	11	89
MSC-2-5	11	29
MSC-2-11	11	94
PMT-1	17	83
PMT-1-75	17	83
PRSC-2050	13	95
PSC-2-1	10	84
PSC-2-1-75	10	87
PSC-2-1-75A	10	97
PSC-2-1V-75	10	96
PSC-2-1W	10	85
PSC-2-1W-75	10	97
PSC-2-2	10	85
PSC-2-2-75	10	96
PSC-2-4	10	86
PSC-2-4-752	10	88
PSC-2-45	10	86
PSC-2-5	10	29
PSC-2375	10	87
PSC-3-1	18	46
PSC-3-1A	18	104
PSC-3-1-75	18	48
PSC-3-1-75-2	18	48
PSC-3-1W	18	46
PSC-3-2	18	105
PSC-3-13	18	47
PSC-3-13-39	18	105
PSC-4-1	20	54
PSC-4-1-75	20	62
PSC-4-1W	20	106
PSC-4-1W-75	20	—
PSC-4-3	20	55
PSC-4A-1W-75	20	107
PSC-4A-4	20	54
PSC-4A-475	20	62
PSC-4-5	20	106
PSC-4-6	20	55
PSC-5-1	22	64
PSC-5-1-75	22	64
PSC-6-1	23	67
PSC-6-1-75	23	65
PSC-8-1	24	68
PSC-8-1-75	24	73
PSC-8-6	24	69
PSC-8A-4	24	68
PSC-8A-4-75	24	72
PSC-10-1	25	74
PSC-12-1	25	75
PSCJ-2-1	16	43
PSCJ-2-1-75	16	45
PSCJ-2-2	16	43
PSCQ-2-0.455	14	99
PSCQ-2-1.25	14	36
PSCQ-2-1.5	14	36
PSCQ-2-3.4	14	36
PSCQ-2-4.0	14	100
PSCQ-2-6.4	14	37
PSCQ-2-7.5	14	37
PSCQ-2-10.5	14	37
PSCQ-2-13	14	38
PSCQ-2-14	14	38
PSCQ-2-17.5	14	38
PSCQ-2-21.4	14	39
PSCQ-2-26	14	100
PSCQ-2-40	14	100
PSCQ-2-50	14	39
PSCQ-2-70	14	39
PSCQ-2-70N	14	101
PSCQ-2-90	14	40
PSCQ-2-120	14	40
PSCQ-2-160	14	101
PSCQ-2-180	14	40
PSCQ-2-250	14	41
PSCQ-2-300	14	101
PSCQ-2-400	14	41
PSCQ-2-450	14	41
PSCQ-2-550	14	42
PSCQ-2-1000	14	109
● SCP-2-1	11	92
● SCP-2-1A	11	92
● SCP-3-1	18	104
● SCPQ-21.4	14	98
● SCPQ-90	14	98
● SCPQ-180	14	98
● SCPQ-400	14	99
● SYPQ-21.4	14	98
● SYPQ-70	14	119
TO5SC-2-1	11	95
TSC-2-1	11	90
ZAPD-1	12	34
ZAPD-2	12	34
ZAPD-21	12	35
ZAPD-4	12	35
ZAPDJ-2	16	102
ZAPDQ-2	15	42
ZAPDQ-4	15	42
ZA3PD-1	19	52
ZA3PD-1.5	19	52
ZA3PD-2	19	53
ZA3PD-4	19	53
ZA4PD-2	21	58
ZA4PD-4	21	58
ZB4PD-4	21	59
ZB4PD-42	21	59
ZB4PD1-930	21	111
ZB4PD1-930W	21	111
ZB6PD1-900	23	114
ZB6PD1-960	23	114
ZB6PD1-1900	23	115
ZB8PD-2	24	71
ZB8PD-4	24	71
ZBSC-413	20	57
ZBSC-611	23	66
ZBSC-615	23	66
ZC2PD-900	12	109
ZC4PD-900	21	118
ZC6PD-960	23	112
ZC6PD-960W	23	112
ZC6PD-1900	23	113
ZC6PD-1900W	23	113
ZC8PD-900	24	115
ZC10PD-900	25	120
ZC16PD-900	26	117
ZC16PD-960	26	116
ZC16PD-960W	26	116
ZC16PD-1900	26	117
ZC16PD-1900W	26	—
ZESC-2-11	12	94
ZFRSC-42	13	90
ZFRSC-2050	13	95
ZFRSC-2075	13	88
ZFSC-2-1	12	91
ZFSC-2-1-75	12	91
ZFSC-2-1W	12	28
ZFSC-2-2	12	28
ZFSC-2-4	12	29
ZFSC-2-5	12	29
ZFSC-2-6	12	30
ZFSC-2-6-75	12	30
ZFSC-2-9G	12	93
ZFSC-2-10G	12	93
ZFSC-2-11	12	94
ZFSC-2-2500	12	94
ZFSC-3-1	19	50
ZFSC-3-1W	19	50
ZFSC-3-4	19	51
ZFSC-3-13	19	47
ZFSC-4-1	20	56
ZFSC-4-1W	20	56
ZFSC-4-2-75-1	20	63
ZFSC-4-3	20	57
ZFSC-4375	20	63
ZFSC-4-175	20	61
ZFSC-5-1	22	64
ZFSC-6-1	23	67
ZFSC-6-1-75	23	65
ZFSC-6-110	23	67
ZFSC-8-1	24	68
ZFSC-8-1-75	24	73
ZFSC-82-75	24	73
ZFSC-8375	24	72
ZFSC-8-4	24	70
ZFSC-84-75	24	72
ZFSC-8-6	24	69
ZFSC-8-43	24	70
ZFSC-10-1	25	74
ZFSC-12-1	25	75
ZFSC-12-1-75	25	76
ZFSC-12-11	25	75
ZFSC-12-175	25	76
ZFSC-16-1	26	78
ZFSC-16-1-75	26	77
FSC-16-3	26	78
ZFSC-16-12	26	79
ZFSC-16-675	26	77
ZFSC-24-1	27	80
ZFSC-24-6	27	81

In Stock...Immediate Delivery

Model Index

Please add the section number as a prefix to page number listed

● Blue dot indicates surface mount models.

power splitters/ combiners cont.

model	spec pages (2-)	data pages (2-)
ZFSC-24-11	27	80
ZFSC-24-11-75	27	—
ZFSC-48-1	27	82
ZFSC-48-1-75	27	82
ZFSCJ-2-1	16	44
ZFSCJ-2-2	16	43
ZFSCJ-2-3	16	44
ZFSCJ-2-4	16	102
ZMSC-2-1	12	32
ZMSC-2-1W	12	32
ZMSC-2-2	12	33
ZMSC-3-1	19	51
ZMSC-3-2	19	47
ZMSC-4-1	21	60
ZMSC-4-2	21	60
ZMSC-4-3	21	61
ZMSCJ-2-1	16	45
ZMSCJ-2-2	16	43
ZMSCQ-2-21.4	15	39
ZMSCQ-2-50	15	39
ZMSCQ-2-90	15	40
ZMSCQ-2-120	15	99
ZMSC-2-180	15	40
ZN2PD-920	12	108
ZN2PD-920W	12	108
ZN3PD-900	18	103
ZN3PD-900W	18	103
ZN4PD-920	21	110
ZN4PD-920W	21	110
ZSC-2-1	12	32
ZSC-2-1-75	12	31
ZSC-2-1W	12	32
ZSC-2-2	12	33
ZSC-2-2-75	12	96
ZSC-2375	12	31
ZSC-2-4	12	33
ZSC-3-1	19	51
ZSC-3-1-75	19	48
ZSC-3-2	19	47
ZSC-3-2-75	19	49
ZSC-4-1	21	60
ZSC-4-1-75	21	62
ZSC-4-2	21	60
ZSC-4-3	21	61
ZSC-4-3-75	21	107
ZSCJ-2-1	16	45
ZSCJ-2-2	16	43
ZSCQ-2-50	15	39
ZSCQ-2-90	15	40
ZSCQ-2-180	15	40

3 amplifiers

model	spec pages (3-)	data pages (3-)
AMP-3G	19	38
AMP-11-2	16	27
AMP-15	16	27
AMP-74	19	36
AMP-75	16	27
AMP-76	16	35
AMP-77	16	28
AMP-2000	20	38
MAN-1	19	36
MAN-1AD	18	34
MAN-11AD	18	34
MAN-1HLN	16	28
MAN-1LN	16	28
MAN-2	19	36
MAN-2AD	18	34
MAR-1	14	22
MAR-2	14	22
MAR-3	14	22
MAR-4	14	23
MAR-6	14	23
MAR-7	14	23
MAR-8	14	24
MAV-1	15	24
MAV-2	15	24
MAV-3	15	25
MAV-4	15	25
MAV-11	15	25
● RAM-1	14	—
● RAM-2	14	—
● RAM-3	14	—
● RAM-4	14	—
● RAM-6	14	—
● RAM-7	14	—
● RAM-8	14	—
TIA-900-10	2	—
TIA-1000-4	2	—
TIA-1000-IR8	2	—
TO-0812LN	17	30
TO-1217LN	17	30
TO-1724LN	17	30
● VAM-3	15	26
● VAM-6	15	26
● VAM-7	15	26
ZEL-0812LN	17	31
ZEL-1217LN	17	31
ZEL-1724LN	17	31
ZFL-1HAD	18	35
ZFL-2AD	18	34
ZFL-11AD	18	34
ZFL-500	19	37
ZFL-500HLN	16	29
ZFL-500LN	16	29
ZFL-750	19	37
ZFL-1000	19	37
ZFL-1000G	18	33
ZFL-1000GH	18	33
ZFL-1000H	20	39
ZFL-1000LN	16	29
ZFL-1000VH	20	39
ZFL-2000	20	40
ZHL-0812HLN	17	32
ZHL-1000-3W	21	46
ZHL-1042J	20	40
ZHL-1217HLN	17	32
ZHL-1724HLN	17	32
ZHL-1A	21	41
ZHL-1HLD	18	35
ZHL-1-2W	21	46
ZHL-1-50P3	19	47
ZHL-2	21	43
ZHL-2-8	21	43
ZHL-2-12	21	43
ZHL-2-50P3	19	47
ZHL-3A	21	42
ZHL-32A	21	42
ZHL-42	21	44
ZHL-42W	21	44
ZHL-4240	21	45
ZHL-4240W	21	45
ZHL-5W-1	21	48
ZHL-6A	20	41
ZHL-7-2W	21	46
ZHL-900-10W	21	48

4 attenuators/ electronic

model	spec pages (4-)	data pages (4-)
GAS-1	5	6
GAS-2	5	6
GAS-3	5	7
● LRAS-2-75	5	—
PAS-1	4	6
PAS-2	4	6
PAS-3	4	7
PAS-2000	4	7
● RAS-2-75	5	—
● SYAS-1	4	8
● SYAS-2	4	8
● SYAS-860	4	9
TFAS-1	4	8
TFAS-2	4	8
TFAS-860	4	9
ZAS-1	5	6
ZAS-3	5	7
ZFAS-2000	4	7
ZMAS-1	5	6
ZMAS-3	5	7

5 digital step attenuators

model	spec pages (5-)	data pages (5-)
TOAT-R512	4	6
TOAT-124	4	7
TOAT-3610	4	8
TOAT-4816	4	9
TOAT-51020	4	10
ZFAT-R512	4	6
ZFAT-124	4	7
ZFAT-3610	4	8
ZFAT-4816	4	9
ZFAT-51020	4	10

6 attenuators/ terminations

model	spec pages (6-)	data pages (6-)
AT-1	4	6
AT-2	4	6
AT-3	4	6
AT-3-75	4	6
AT-4	4	6
AT-5	4	7
AT-6	4	7
AT-6-75	4	7
AT-7	4	7
AT-8	4	7
AT-9	4	8
AT-10	4	8
AT-10-75	4	8
AT-12	4	8
AT-15	4	8
AT-15-75	4	9
AT-20	4	9
AT-20-75	4	9
AT-30	4	9
AT-40	4	9
BTRM-50	5	10
BTRM-75	5	10
CAT-1	5	6
CAT-2	5	6
CAT-3	5	6
CAT-3-75	5	6
CAT-4	5	6
CAT-5	5	7
CAT-6	5	7
CAT-6-75	5	7
CAT-7	5	7
CAT-8	5	7
CAT-9	5	8
CAT-10	5	8
CAT-10-75	5	8
CAT-12	5	8
CAT-15	5	8
CAT-15-75	5	9
CAT-20	5	9
CAT-20-75	5	9
CAT-30	5	9
CAT-40	5	9
MAT-1	4	6
MAT-2	4	6
MAT-3	4	6
MAT-4	4	6
MAT-5	4	7
MAT-6	4	7
MAT-7	4	7
MAT-8	4	7
MAT-9	4	8
MAT-10	4	8
MAT-12	4	8
MAT-15	4	8
MAT-20	4	9
MAT-25	4	—
MAT-30	4	9
MAT-40	4	9
NAT-1	5	6
NAT-2	5	6
NAT-3	5	6
NAT-4	5	6
NAT-5	5	7
NAT-6	5	7
NAT-7	5	7
NAT-8	5	7
NAT-9	5	8
NAT-10	5	8
NAT-12	5	8
NAT-15	5	8
NAT-20	5	9
NAT-30	5	9
NAT-40	5	9
NTRM-50	5	10
SAT-1	5	6
SAT-2	5	6
SAT-3	5	6
SAT-4	5	6
SAT-5	5	7
SAT-6	5	7
SAT-7	5	7
SAT-8	5	7
SAT-9	5	8
SAT-10	5	8
SAT-12	5	8
SAT-15	5	8
SAT-20	5	9
SAT-30	5	9
SAT-40	5	9
STRM-50	5	10

7 directional couplers

model	spec pages (7-)	data pages (7-)
● LRDC-20-2	6	20
P4DC-30A-2	6	22
PDC-10-1	6	9
PDC-10-1-75	6	16
PDC-10-1BD	6	19
PDC-10-2	6	9
PDC-10-5	6	9
PDC-10-6	6	10
PDC-10-6-75	6	16
PDC-10-21	6	10
PDC-10-22	6	10
PDC-10-54	6	11
PDC-15-6	6	11
PDC-15-6-75	6	16
PDC-15-21	6	11
PDC-20-1	6	12
PDC-20-1BD	6	19
PDC-20-1W	6	12
PDC-20-3	6	12
PDC-20-3-75	6	17
PDC-20-3BD	6	19
PDC-20-6-75	6	17
PDC-20A-5	6	15
● SCDC-11-2	6	18
● SCDC-25-2	6	18
TDC-6-1	6	8
TDC-10-1	6	8
TDC-10-2	6	8
TODC-10-1	6	13
ZDC-10-1	7	9
ZDC-10-1-75	7	16
ZDC-10-2	7	9
ZDC-15-2	7	20
ZDC-15-6	7	11
ZDC-15-6-75	7	16
ZDC-20-1	7	12
ZDC-20-3	7	12
ZDC-20-3-75	7	17
ZDC-20-3-75-1	7	22
ZDC-2375	7	17
ZEDC-10-2B	7	15
ZEDC-15-2B	7	15
ZFDC-10-1	7	9
ZFDC-10-1-75	7	21
ZFDC-10-2	7	14
ZFDC-10-21	7	10
ZFDC-10-21-75	7	21
ZFDC-10-22	7	10
ZFDC-10-5	7	9
ZFDC-10-6	7	10
ZFDC-15-5	7	14
ZFDC-15-6	7	11
ZFDC-15-6-75	7	16
ZFDC-20-1H	7	13
ZFDC-20-3	7	12
ZFDC-20-3-75	7	21
ZFDC-20-4	7	14
ZFDC-20-5	7	20
ZFDC-3375	7	18
ZMDC-10-1	7	9
ZMDC-10-2	7	9
ZMDC-15-6	7	11
ZMDC-20-1	7	12
ZMDC-20-3	7	12
ZMDC-30-1	7	13

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8 filters

model	spec pages (8-)	data pages (8-)
BBLP-39	11	31
BBLP-117	11	31
BBLP-156	11	31
BBLP-200	11	32
BBLP-300	11	32
BBLP-467	11	32
BBP-10.7	10	24
BBP-21.4	10	24
BBP-30	10	24
BBP-60	10	25
BBP-70	10	25
BHP-25	9	26
BHP-50	9	26
BHP-100	9	26
BHP-150	9	27
BHP-175	9	27
BHP-200	9	27
BHP-250	9	28
BHP-300	9	28
BHP-400	9	28
BHP-500	9	29
BHP-600	9	29
BHP-700	9	29
BHP-800	9	30
BHP-900	9	30
BHP-1000	9	30
BIF-21.4	10	22
BIF-30	10	22
BIF-40	10	22
BIF-50	10	23
BIF-60	10	23
BIF-70	10	23
BLP-5	8	12
BLP-10.7	8	12
BLP-21.4	8	12
BLP-30	8	13
BLP-50	8	13
BLP-70	8	13
BLP-90	8	14
BLP-100	8	14
BLP-150	8	14
BLP-200	8	15
BLP-300	8	15
BLP-450	8	16
BLP-550	8	16
BLP-600	8	16
BLP-750	8	17
BLP-800	8	17
BLP-850	8	17
BLP-1000	8	18
BLP-1200	8	18
NBLP-39	11	31
NBLP-117	11	31
NBLP-156	11	31
NBLP-200	11	32
NBLP-300	11	32
NBLP-467	11	32
NBLP-933	11	33
NBLP-1870	11	33
NBP-10.7	10	24
NBP-21.4	10	24
NBP-30	10	24
NBP-60	10	25
NBP-70	10	25
NHP-25	9	26
NHP-50	9	26
NHP-100	9	26
NHP-150	9	27
NHP-175	9	27
NHP-200	9	27
NHP-250	9	28
NHP-300	9	28
NHP-400	9	28
NHP-500	9	29
NHP-600	9	29
NHP-700	9	29
NHP-800	9	30
NHP-900	9	30
NHP-1000	9	30
NIF-21.4	10	22
NIF-30	10	22
NIF-40	10	22
NIF-50	10	23
NIF-60	10	23
NIF-70	10	23
NLP-5	8	12
NLP-10.7	8	12
NLP-21.4	8	12
NLP-30	8	13
NLP-50	8	13
NLP-70	8	13
NLP-90	8	14
NLP-100	8	14
NLP-150	8	14
NLP-200	8	15
NLP-300	8	15
NLP-450	8	16
NLP-550	8	16
NLP-600	8	16
NLP-750	8	17
NLP-800	8	17
NLP-850	8	17
NLP-1000	8	18
NLP-1200	8	18
PBLP-39	11	31
PBLP-117	11	31
PBLP-156	11	31
PBLP-200	11	32
PBLP-300	11	32
PBLP-467	11	32
PBP-10.7	10	24
PBP-21.4	10	24
PBP-30	10	24
PBP-60	10	25
PBP-70	10	25
PHP-25	9	26
PHP-50	9	26
PHP-100	9	26
PHP-150	9	27
PHP-175	9	27
PHP-200	9	27
PHP-250	9	28
PHP-300	9	28
PHP-400	9	28
PHP-500	9	29
PHP-600	9	29
PHP-700	9	29
PHP-800	9	30
PHP-900	9	30
PHP-1000	9	30
PIF-21.4	10	22
PIF-30	10	22
PIF-40	10	22
PIF-50	10	23
PIF-60	10	23
PIF-70	10	23
PLP-5	8	12
PLP-10.7	8	12
PLP-21.4	8	12
PLP-30	8	13
PLP-50	8	13
PLP-70	8	13
PLP-90	8	14
PLP-100	8	14
PLP-150	8	14
PLP-200	8	15
PLP-250	8	15
PLP-300	8	15
PLP-450	8	16
PLP-550	8	16
PLP-600	8	16
PLP-750	8	17
PLP-800	8	17
PLP-850	8	17
PLP-1000	8	18
PLP-1200	8	18
SBLP-39	11	31
SBLP-117	11	31
SBLP-156	11	31
SBLP-200	11	32
SBLP-300	11	32
SBLP-467	11	32
SBLP-933	11	33
SBLP-1870	11	33
SBP-10.7	10	24
SBP-21.4	10	24
SBP-30	10	24
SBP-60	10	25
SBP-70	10	25
● SCLF-21.4	8	19
● SCLF-30	8	19
● SCLF-45	8	19
● SCLF-135	8	20
● SCLF-190	8	20
● SCLF-380	8	21
● SCLF-420	8	21
SHP-25	9	26
SHP-50	9	26
SHP-100	9	26
SHP-150	9	27
SHP-175	9	27
SHP-200	9	27
SHP-250	9	28
SHP-300	9	28
SHP-400	9	28
SHP-500	9	29
SHP-600	9	29
SHP-700	9	29
SHP-800	9	30
SHP-900	9	30
SHP-1000	9	30
SIF-21.4	10	22
SIF-30	10	22
SIF-40	10	22
SIF-50	10	23
SIF-60	10	23
SIF-70	10	23
SLP-5	8	12
SLP-10.7	8	12
SLP-21.4	8	12
SLP-30	8	13
SLP-50	8	13
SLP-70	8	13
SLP-90	8	14
SLP-100	8	14
SLP-150	8	14
SLP-200	8	15
SLP-300	8	15
SLP-450	8	16
SLP-550	8	16
SLP-600	8	16
SLP-750	8	17
SLP-800	8	17
SLP-850	8	17
SLP-1000	8	18
SLP-1200	8	18

9 frequency doublers

model	spec pages (9-)	data pages (9-)
AK-2	4	6
AK-3000	4	8
FD-2	4	6
FK-5	4	7
FK-3000	4	8
GK-2	5	6
GK-3	5	6
GK-5	5	7
LK-3000	5	8
MK-2	5	6
MK-3	5	6
MK-5	5	7
RK-2	4	6
RK-3	4	6
RK-5	4	7
RK-6	4	8
RK-3000	4	8
SK-2	4	6

10 limiters

model	spec pages (10-)	data pages (10-)
PLS-1	4	5
PLS-2	4	5
PLS-6	4	6

11 I/Q & QPSK modulators/demodulators

model	spec pages (11-)	data pages (11-)
FPQ-76	11	14
FPQ-331	11	14
FPQ-440	11	15
FPQ-475	11	15
MIQA-10D	13	24
MIQA-10M	12	—
MIQA-70M	12	20
MIQA-70ML	12	26
MIQA-91M	12	22
MIQA-100M	12	22
MIQA-108M	12	23
MIQA-195M	12	23
MIQC-88M	12	20
MIQC-176M	12	21
MIQC-895D	13	24
MIQC-895M	12	21
MIQY-70M	12	20
MIQY-70D	13	25
MIQY-140M	12	26
MIQY-140D	13	25
PMQ-94	11	16
PMQ-330	11	16
PMQ-440	11	18
PMQPW-150	11	18
PMQPW-250	11	17
QMC-100	11	17
QMC-170	11	19
QMC-1050	11	19
ZFMIQ-91M	12	22
ZMQ-1050	11	19

12 phase detectors

model	spec pages (12-)	data pages (12-)
LPD-1	6	7
MPD-1	6	7
MPD-2	6	8
MPD-21	6	7
RPD-1	6	7
RPD-2	6	8
● SYPD-1	6	7
● SYPD-2	6	7
ZRPD-1	6	7

13 switches

model	spec pages (13-)	data pages (13-)
● KSW-2-46	8	15
● KSWA-2-46	8	15
● KSWHA-1-20	9	11
PSW-1111	10	13
PSW-1211	10	13
TOSW-230	6	12
TOSW-425	6	12
● VSW-2-50DR	7	14
● VSWA-2-50DR	7	14
● YSW-2-50DR	7	14
● YSWA-2-50DR	7	14
ZFSW-2-46	8	15
ZFSWA-2-46	8	15
ZFSWHA-1-20	9	11
ZMSW-1111	10	13
ZMSW-1211	10	13
ZSDR-230	6	12
ZSDR-425	6	12
ZYSW-2-50DR	7	14
ZYSWA-2-50DR	7	14

14 transformers

model	spec pages (14-)	data pages (14-)
FT1.22-1	7	21
FT1.5-1	7	21
FTB1-1	7	18
FTB1-1-75	7	18
FTB1-6	7	18
T1-1	6	14
T1-1H	6	16
T1-1T	6	8
T1-6	6	14
T1-6T	6	8
T1.18-3	6	14
T1.5-1	6	14
T1.5-6	6	14
T2-1	7	19
T2-1T	6	8
T2-613-1	7	22
T2.5-6	6	15
T2.5-6T	6	8
T3-1	7	19
T3-1T	6	8
T4-1	6	9
T4-1H	6	10
T4-2	7	19
T4-6	6	15
T4-6T	6	9
T5-1T	6	9
T8-1	7	19
T8-1T	6	9
T9-1	6	15
T9-1H	6	16
T13-1T	6	9
T14-1	7	19
T16-1	6	15
T16-1H	6	16
T16-6T	6	10
T36-1	6	15
T-622	7	22
T-626	7	22
TMO 1-02	6	16
TMO 1-1	6	17
TMO 1-1T	6	10
TMO 1.5-1	6	17
TMO 2-1	7	20
TMO 2-1T	6	10
TMO 2.5-6	6	17
TMO 2.5-6T	6	10
TMO 3-1	7	20
TMO 3-1T	6	11
TMO 4-1	6	11
TMO 4-2	7	20
TMO 4-6	6	17
TMO 5-1T	6	11
TMO 6-1	6	17
TMO 8-1	7	20
TMO 9-1	6	18
TMO 13-1T	6	11
TMO 14-1	7	20
TMO 16-1	6	18
TO-75	6	16
TT1-6	6	12
TT1.5-1	6	12
TT2.5-6	6	12
TT4-1	6	12
TT4-1A	6	12
TT16-1	6	13
TT25-1	6	13
TTMO 1-1	6	13
TTMO 4-1A	6	13
TTMO 25-1	6	13

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Federal supply code: 15542

how to order

Your local representative or distributor is the contact for both sales and service assistance for products listed in this catalog. These local offices have the latest price and delivery information on all models. They can also provide details on ordering procedures, service information and application engineering data. Your order may be sent directly to Mini-Circuits or to any of the local sales offices listed.

Prices listed in this catalog are domestic F.O.B. Brooklyn, New York. Mini-Circuits reserves the right to change specifications, models, prices, or designs without prior notice and without liability for such changes. Minimum order $50.00.

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Net 30 days from date of invoice. If credit is not established with Mini-Circuits, shipments will be made C.O.D. (cash on delivery) or prepaid. We also accept most major credit cards. If prepaying, please include freight.

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Scientific Components Corporation, Mini-Circuits division, warrants each product manufactured by Mini-Circuits to meet all published specifications and to be free from defects in material and workmanship. The Company's liability under this warranty is limited to repair, adjustment and/or replacement of defective parts returned, freight paid by Buyer, to the factory within a period of one year from date of shipment from the factory unless a shorter period is specified. International customers may ship to the Company's nearest Distributor.

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All Mini-Circuits' components listed in the latest published catalog, in all configurations and connector types, will be processed and shipped within one week after an order is received, or if the order calls for scheduled shipments, we will ship on or before the due date. If we're late, we'll deduct one percent per day from your bill (maximum deduction up to 25%, as allowed by law): but don't count on this discount since we intend to meet each and every scheduled shipment.

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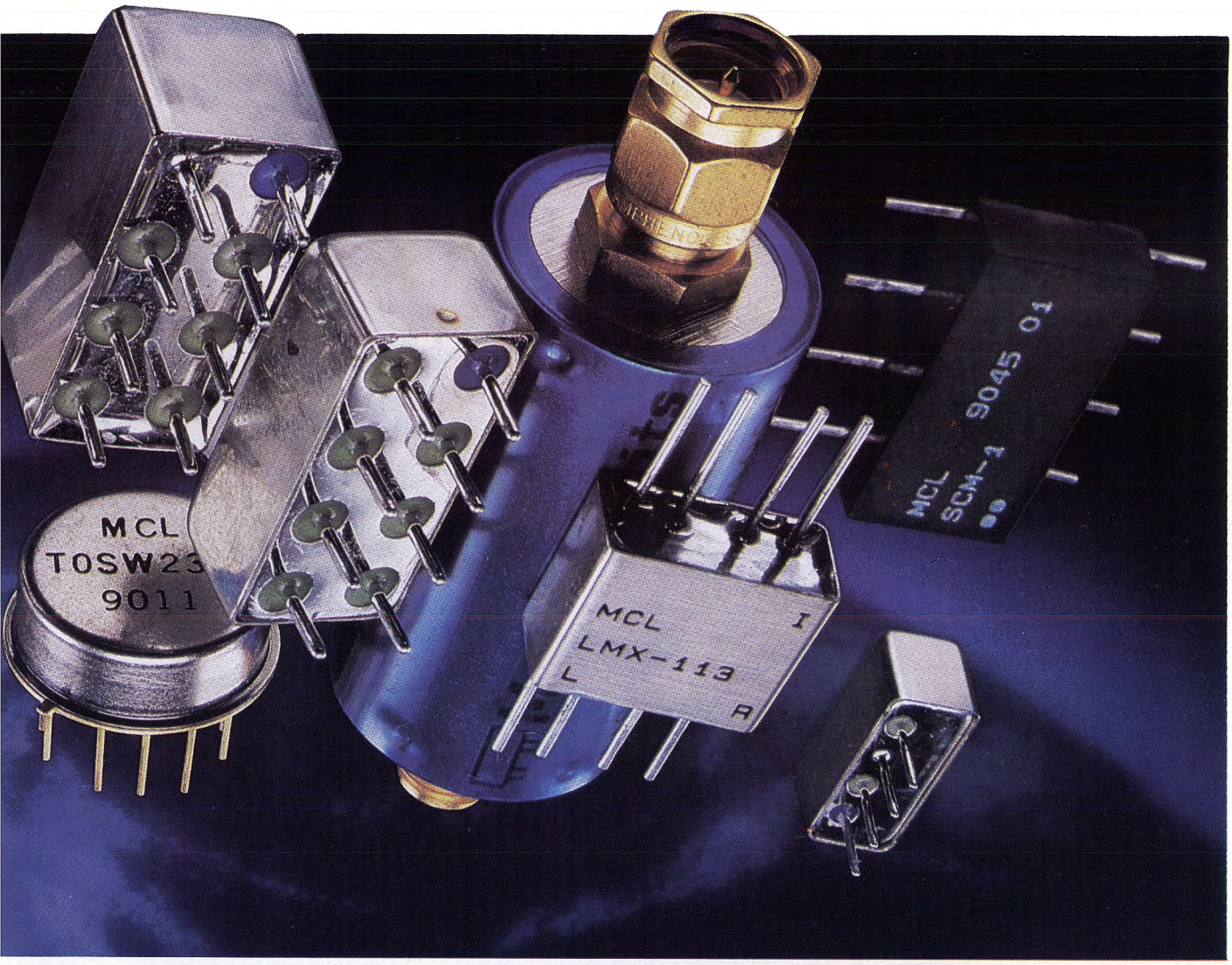

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Statistical Process Control - Key to Competitive Manufacturing

In today's tough world market environment, the need to be better is more demanding, and the need to be more competitive is a necessity to survive. A company cannot rest on the success of past performance and expect to continue to remain successful. There are many well known examples of companies both large and small that were once leaders in their field and now are skeletons of themselves or just plain dead and buried.

How does one get more competitive? The answer is simple. Exceed your customers' needs and expectations ...provide, in the manner required by the customer, a quality product, at low cost, on time, every time. In most manufacturing organizations a significant cost factor is attributed to the cost of purchased materials and they may range from 25% to 80% of the cost of the entire product. Because of the significance of purchased material to total cost, the quality of the purchased material is important and essential to the competitiveness of the manufacturing organization.

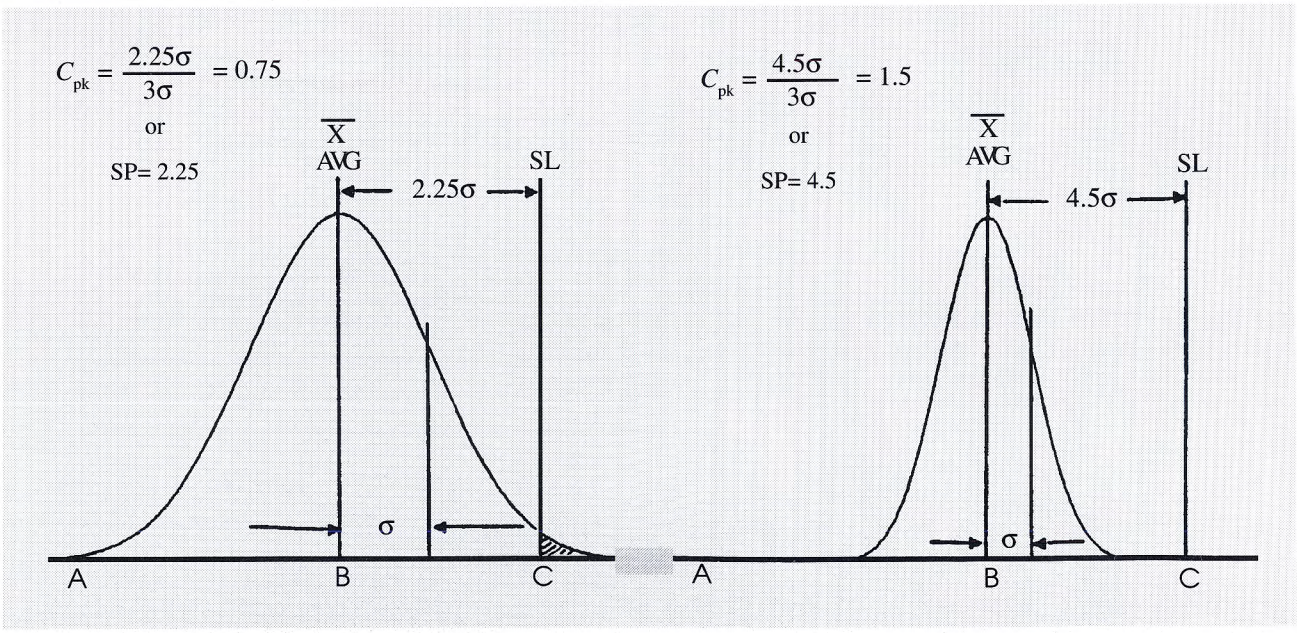
This paper will discuss the effects of quality on the direct and indirect causes that contribute to the real cost of the purchased material. A measure of the quality of the material will be described by a quality factor, Cpk. The higher the value of Cpk, the better the quality of the product. Cpk is a measure of the repeatability of material performance. The higher the number, the better is the consistency of performance or the less is the variation in performance. Therefore, once designed in, the material should be consistent enough so that its variations are not transparent to the final product.

In manufacturing, variation is evil! If the value of Cpk for a purchased part is low, and Cpk varies from production lot-to-lot, then it can be projected the process for manufacturing the part is not in control, performance will be inconsistent, rejects can be expected, and the true cost of the purchased part will be significantly higher than the price shown on the purchase order.

With the abundance of low cost computers and hand held scientific calculators, the ability to calculate Cpk is easily attainable. Cpk is a quality factor that is based on the statistical calculation of mean value, $\overline{x}$ and standard deviation, sigma. Cpk is the difference in value between the mean value and the closest spec limit divided by 3 sigma.

$$Cpk = \frac{(\text{spec limit} - \text{mean value})}{3 \text{ sigma}}$$

At Mini-Circuits we use SP (Sigma Performance) = 3 times Cpk. We must measure variation to control it. If we can measure it we can tell when it gets better or worse. We need to know what works and what doesn't work. How much a manufacturing process varies is measured by Sigma (σ). In the figures below, the average (AVG) tells us where the process is centered. The spread or width is measured by sigma. The figures below show how the product is distributed. The height of the graph measures how often values occur. The spread measures how far the values are from the



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AVG. If the product is well controlled, there will be little variation, more values of units will occur nearer the target, $\overline{x}$, and sigma will be small.

Manufactured products are either good or bad depending on whether they do what the customer wants them to do. Specification limits were the measure of success, where product within spec was good and out of spec bad. It is not enough in today's market place to just meet spec! In the figures below, a spec limit (SL) is compared to the product distribution. Product built outside, or to the right of the spec limit, is very bad; even product built just to the left of the spec limit is not good. Small (skinny) Sigma means the product will be far from the spec limit and close to the AVG value (very good product, what today's customers demand).

We can compare different processes by measuring variation and the distance from the average to the spec limit. But only if we measure the distance in terms of sigma, as shown in the figures. The real distance is the same for both figures (C-B), meaning both processes are centered and the AVG values are equal. But, in terms of product quality, the figure on the right is far superior (4.5 > 2.25) because the variation between units is much less as given by the skinnier value of sigma.

For convenience, we normalize by dividing the distance (C-B) by sigma (considered a relative ideal), and get the capability index, Cpk, a figure of merit. The skinnier the σ is, the higher the Cpk, and the less variation, unit-to-unit.

The "goodness" of the purchased parts, Cpk, will affect the actual real cost of the purchased material. This real cost can vary and will depend on the original design and the specifications describing the purchased material. The real cost depends on the sum of both direct and indirect costs. These are:

Costs additive to the cost of purchased parts:

A. Direct costs of poor quality parts:

1. Warranty
2. Scrap and repair
3. Inspection/test

B. Indirect costs of poor quality parts:

1. Lost sales - customers switching to competition
2. Field trips, retrofits, settlements
3. Downtime, line shut downs, delinquencies, rescheduling
4. Inventory build-up, obsolete material, MRB, material expediting, material shrinkage
5. Engineering changes and redesign, documentation changes, material selection and separation.

C. Indirect costs, demands of the manufacturing system on company's resources

1. Space
2. Manpower, receiving, production control, manufacturing, sales, finance, engineering, QA, accounting, maintenance, house cleaning.
3. Utilities (lighting, heating, air conditioning, telephone)
4. Capital equipment (testing, incoming inspection and production, data processing)
5. Finances, cost to maintain higher inventory of all material
6. Data processing and data entry

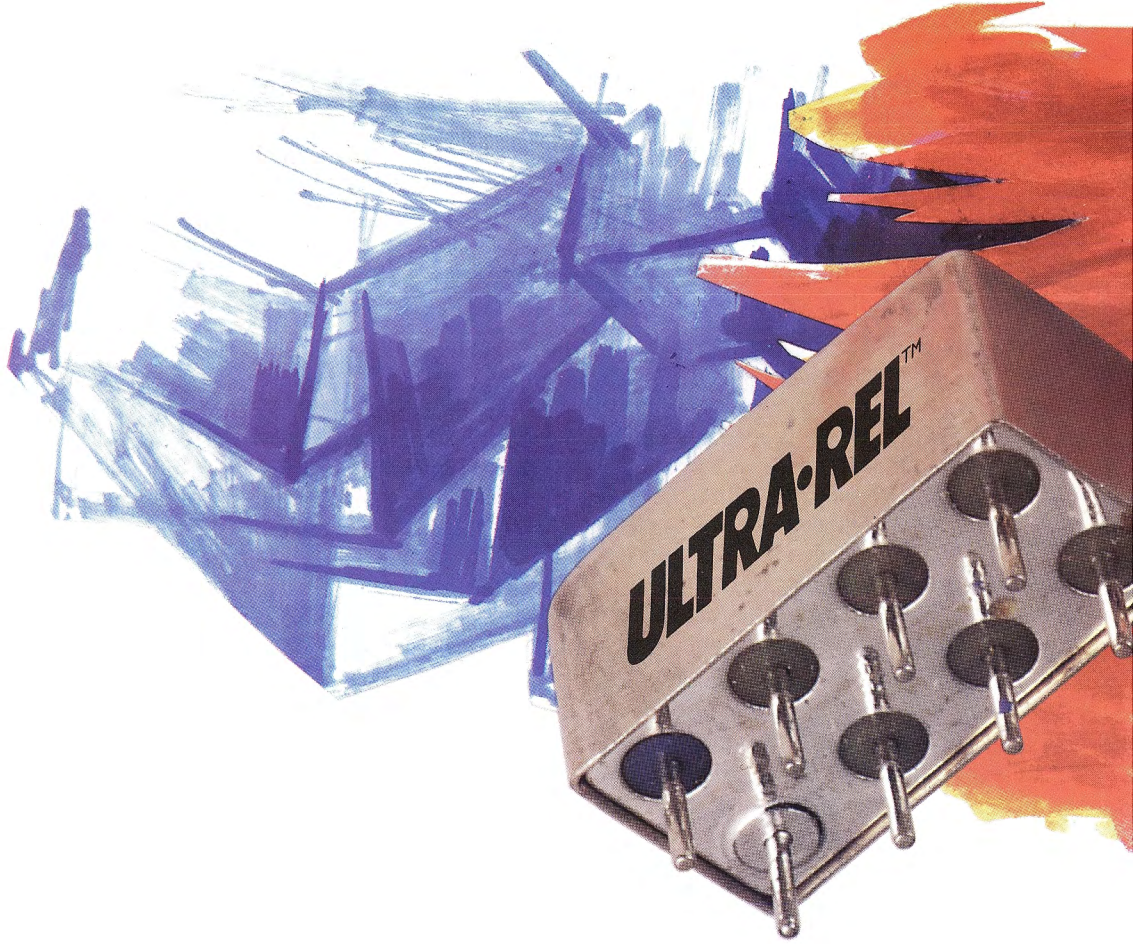
Description of costs to the manufacturer of poor quality parts received.

When poor quality parts are received, the manufacturer must maintain an incoming inspection department to check parts for conformance to specifications. If all parts were received with a Sigma Performance = 4.5 or, Cpk = 1.5, then the demands for incoming inspection would evaporate. However, this is not the case in the real world today. Therefore, the cost of the inspection department is visually spread out and amortized as a percentage of the total cost of all material received. However, when poor quality parts are received, there are direct additional costs that are incurred by the manufacturing organization. These costs include additional testing and inspection so that additional manpower and capital equipment are required. In addition, there are added costs associated with documents DMR, RTV etc.; MRB meetings; purchasing costs, such as expediting, search for alternatives, rescheduling and issuing of p.o. change orders; and engineering costs for evaluation and test.

In addition to incoming inspection costs, the delays of incoming material to the production floor will generate additional manufacturing costs. These include rescheduling and smaller production runs (less parts available); inefficiency of resources, such as manpower and machines, increased space requirements and WIP; increased material shrinkage, and increased manufacturing throughput time.

The results of these manufacturing delays and costs will cause shipment delays and increased manufacturing costs that may be passed on to customers. Both factors contributing to a less competitive position!

To pursue Mini-Circuits' goal to exceed our customer's expectations, Mini-Circuits is striving to achieve an SP of 4.5 or, Cpk = 1.5. All mixer and I & Q modulator conversion loss is specified in statistical terms. We are vigorously pursuing statistical process control and statistical specifications on all our products to enable our customers to receive the highest quality and value, at the lowest cost ... the key to competitive manufacturing.

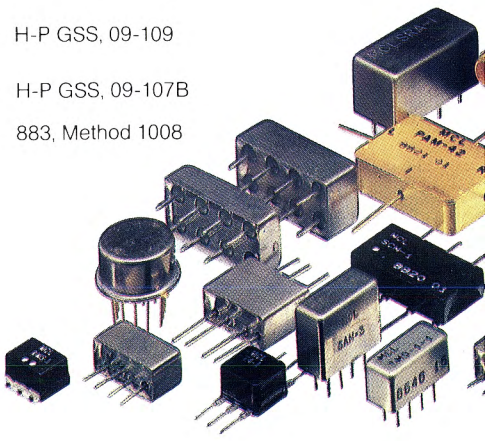


ULTRA·REL™ MIXERS

ULTRA-REL DIODE TEST PROGRAM*

TYPE OF TEST	CONDITIONS	MIL-STD- or H-P
LIFE	1,000 hrs, T_A +125°C 50mA ac	750, Method 1026
THERMAL SHOCK	-65°C to +125°C, 200 cycles 5 min. dwell	883, Method 1011
MECHANICAL SHOCK	1.5Kg's, 0.5μsec pulse	883, Method 2002
VIBRATION	variable frequency 20 to 2,000 Hz	750, Method 2056
TEMPERATURE CYCLE	-65°C to +125°C 200 cycles, 10 min. dwell	883, Method 1010
AUTOCLAVE (pressure pot)	14.7psi, T_A +121°C, 96 hr.	H-P GSS, 09-109
85/85	85°C @ 85% humidity 168 hr., no bias	H-P GSS, 09-107B
ACCELERATED HI-TEMPERATURE STORAGE	300°C, 325°C, 350°C storage until 50% failures	883, Method 1008

*Stringent Mini-Circuit/Hewlett-Packard Qualification Tests



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There are no mixers more reliable than Mini-Circuits' new Ultra-Rel™ mixers. Go ahead, expose Mini-Circuits' Ultra-Rel™ mixers to scorching heat, subzero freezing, soggy humidity, and severe mechanical shock and vibrations. They will survive and perform perfectly.

The secret to this reliability breakthrough is an Ultra-Rel diode capable of withstanding considerably more torture than specified by MIL-STD-883. These diodes achieve an order of magnitude improvement over currently-available Schottky diodes due to an improved monolithic processing technique, resulting from an intensive two-year, one million dollar joint development program by Mini-Circuits and Hewlett-Packard.

Take a look at the eight harsh tests these Ultra-Rel diodes are qualified to pass. To put it bluntly, these new Ultra-Rel diodes can meet and exceed MIL-STD-883 tests with ease. For example, MIL-STD-883 temperature stresses diodes for 25 cycles from -65°C to +125°C; Ultra-Rel diodes (unpackaged) have no trouble with 200 cycles from -65°C to +175°C. No problems with the other tests either.

These diodes when exposed to a brutal accelerated high-temperature test of 250°C for 981 hours, didn't fail; even at 300°C for 168 hours, none failed. Could diodes other than Ultra-Rels survive such stresses? Hardly. And, for extra measure, Ultra-Rel devices can withstand up to ten times the mechanical pull test requirements of MIL-STD-883.

And since mixer reliability is primarily determined by the reliability of the diodes in the assembly, the more reliable the diodes, the more reliable the mixer. So now all of our Standard Level (+7dBm LO) mixers* are built with Ultra-Rel diodes...and are guaranteed for five years.

Most likely your application does not require such demanding levels of endurance. But high product reliability and quality are demanded in today's marketplace. Consider how enhanced reliability of your products will strongly influence your reputation and customers' satisfaction.

Don't settle for "imitations" or "equivalents"...***insist on Ultra-Rel™ mixers, available only from Mini-Circuits.***

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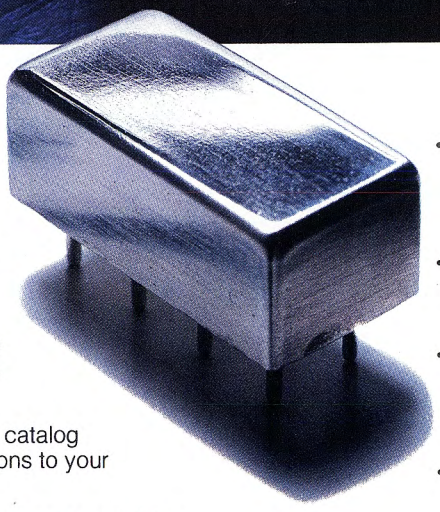

In today's tough competitive military and commercial markets, Mini-Circuits provides you that extra edge. From your initial design to full-scale production, we offer total support to satisfy or exceed your specific requirements.

- **WIDEST SELECTION OF COMPONENTS** 14 product lines with more than 1,000 off-the-shelf catalog models.
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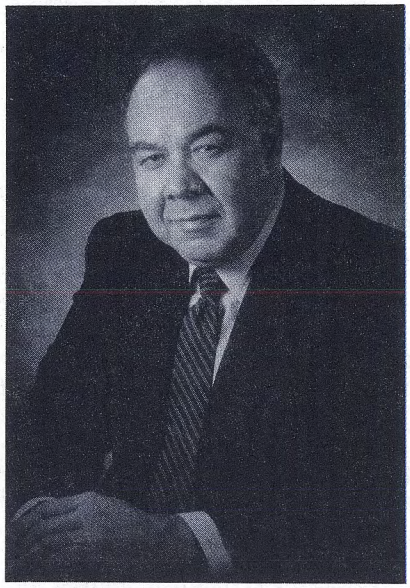
For detailed specs on all Mini-Circuits products refer to • THOMAS REGISTER Vol. 23 • MICROWAVES PRODUCT DIRECTORY • EEM • MINI-CIRCUITS' 740-pg HANDBOOK.

F138 RE

Quality ... World Class Definition



Harvey Kaylie
President
Mini-Circuits Laboratory
Brooklyn, New York

The message of the 80's to U.S. manufacturers was loud and clear. Deliver quality products or slip into obscurity. It's now up to manufacturers to take action, from the shipping clerk responsible for getting the right address on a shipping label to top management for implementing a workable quality assurance program. Customers don't merely want quality, they strongly insist on it. Deliver it and flourish; ignore it and lose business.

What does quality mean to you?

But what exactly is quality? Even the experts can't agree on a common definition. Some maintain that a quality product is defect-free. Others note this isn't enough, it must also meet specs.

We need a new definition, one for "world class quality"

A more encompassing definition, to which Mini-Circuits strongly adheres, is that a quality product must not only be defect-free and meet specs, it must satisfy the customer's expectations, even under adverse field conditions, and do so in a very consistent manner. Let's call this *world class quality*.

Of profound concern to design engineers is the need for consistency, that is, lot-to-lot and unit-to-unit repeatability. Suppose an engineer checks out a prototype system or subsystem design using a dozen samples provided by a vendor, and all goes well. Then a production order is placed, and 2,500 units arrive several months later. But while these too meet data sheet specs and all applicable control drawings, there is a wide variation from one unit to the next. Depending on their resulting interaction with other components in the system, such variation could produce disappointing consequences.

Contrast that case with a production shipment of 2,500 units which exhibit minimal unit-to-unit variation, units which show a high degree of consistency both among themselves and with the samples provided earlier for the prototype tests. Obviously this production lot instills much more customer confidence in the vendor's control over manufacturing.

Part uniformity means lower costs for the customer and high esteem for the vendor.

The customer should find that parts received today perform the same as parts furnished a year ago to the same part identification. Such product uniformity reduces problems on the customer's production floor, reduces his need for inspections, re-work, work space, trouble-shooting, test personnel and equipment. The customer also expects parts to continue working even under adverse field conditions. To do so they must be conservatively rated.

Conservatively rated, consistent parts provide better value to the customer. They have world class quality and from them both vendor and customer derive enormous "rewards."

The vendor enjoys gains similar to the customer's for consistency — reduced inspection labor and personnel, diminished needs for specialized test equipment, fewer manufacturing personnel and less production space, less downtime during production, less work in progress, and

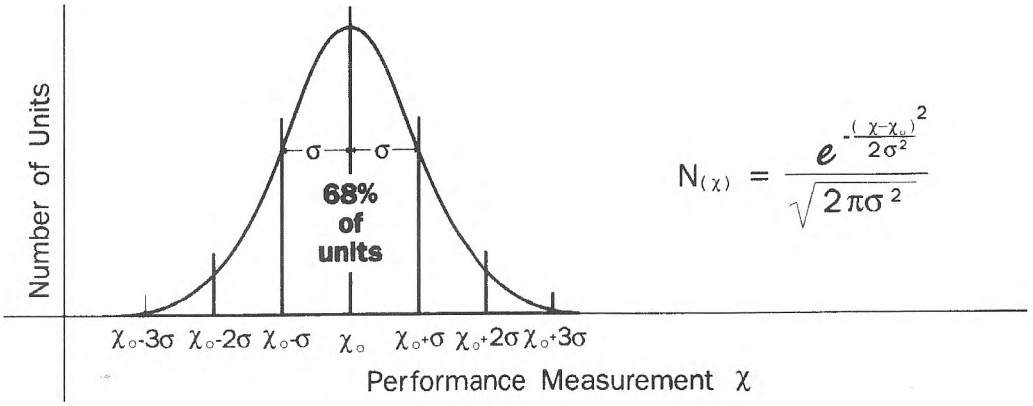


Figure 1. The normal curve, or Gaussian distribution of units, having a standard deviation of sigma, σ.

faster throughput. The benefits are interactive and multiplicative in scope. Together they produce enormous reductions in the vendor's manufacturing costs, placing him in a more competitive and profitable position.

The customer's benefits go on. Parts that are low-cost, defect-free, that offer high consistency and reliable performance even under adverse field conditions, assure the customer of a smooth flow of complex system production runs. What better "super-salesperson" can a vendor find than having its components on the customer's assembly line which meets this *world class* definition?

Good yesterday isn't good enough today.

How does a company produce highly consistent, reliable, high performing products? By the dedication of its people and resources to this lofty objective. By religiously applying statistical process control (SPC), pre-control, design of experiments (DOE), and test of its manufacturing processes and product quality. By the ongoing re-evaluation of its designs, manufacturing methods and test techniques, no matter how time proved they are thought to be. Being good enough yesterday is just not good enough for today's market. You've got to be better. It's necessary to apply religious zeal to the learning of new ways and their application to world clas quality.

Achieving world class quality requires a religious pursuit of design and manufacturing control

Of course, it's easy and convenient to live with old, established methods that everyone finds familiar; it's both difficult and an investment of time to learn new tricks. But the quest for quality improvements demands changes. New or revised references and criteria will be required for many steps in the manufacturing process. All details and drawings relating, for example, to such procedures as dispensing epoxy to seal a package or performing a wire-to-metal conductor weld must be closely examined, and the criteria to be met for each operation carefully specified. Then, means to monitor performance must be devised. When it is found that the criteria are not met, steps must follow immediately to improve the manufacturing procedure. Sure, it's a long, demanding undertaking; but that's how you really learn how to control your manufacturing processes. It's an investment that pays off.

The Sigma Connection

At Mini-Circuits, a ±4.5-sigma criterion defines acceptable unit-to-unit repeatability. Let's discuss what this means. Sigma is a statistical measure of the Gaussian variability around a mean value (as many measurements fall above as below the mean value). In a "normal distribution," described by the familiar bell-shaped Gaussian curve (Figure 1), the number of units which fall within one standard deviation (a 1-sigma) is 68 percent of the total number. Accordingly, 32 percent fall outside (either above or below) the 1-sigma limits. Measurements of components that have equal chances of being higher than a given measurement and lower often can be approximated by a Gaussian distribution, which is symmetrical about a mean value. Also, due to symmetry, the mean and average values for Gaussian distributions are identical.

With 99.7% acceptability (a 3-sigma criterion) of everyday events, expect 18 airplanes crashing per day, 8,000 pieces of mail lost per hour.

Thus, if a lot consists of parts which meet a 1-sigma acceptance criterion, then 68 percent of them, the integrated area under the curve between the + and - one sigma along the x coordinate, are acceptable. Tightening the process control such that the usable parts meet a 3-sigma limit means that 99.7 percent of the lot are acceptable. Sounds good? Not today. By this measure there would be 2,700 rejects in a 1 million piece lot. Keep in mind that you would be required to locate those 2,700 bad ones by screening the million (or live with this many rejected parts in the application for which they are intended). The goal of Motorola, Mini-Circuits and other quality-conscious firms is +6-sigma, translating to a non-centered distribution of less than 3.4 rejects in a one million piece lot.

Someone might ask: what's wrong with a 99.7 percent defect free process? Good question. Consider these applications of that criterion and decide how comfortable we might be with its implications. Expect about 18 airline crashes each day, expect the Postal service to lose 18,000 pieces of mail each hour, and think of pharmicists mixing 3,700

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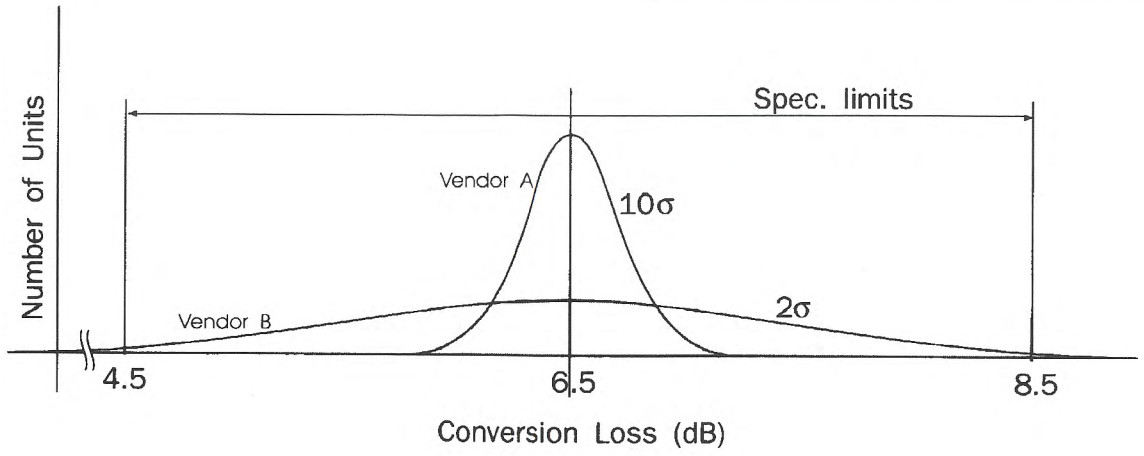


Figure 2. A comparison of mixers with 2σ and 10σ conversion loss distributions.

incorrect prescriptions daily. Then how does 99.7 percent defect-free sound? Not good enough.

Let's return to the concept of quality, repeatability and sigma. But first a word of caution. Real manufacturing processes can be approximated by Gaussian distributions, but this may not always be exact. For example, in making 1dB average insertion loss switches, it might be possible to experience a loss in one unit of 2dB (1dB above spec), but it's not equally likely to measure an insertion loss of 0dB (1dB below spec). Discretion must be used to limit the Gaussian model to excursions about the mean (or average), for which the Gaussian's symmetry and shape are applicable.

Now consider an example. Assume that two vendors are advertising mixers with the same conversion loss spec: 6.5 dB typical, 8.5 dB maximum. Vendor A provides its customers with product which has a standard deviation of 0.2 dB, Vendor B provides 1dB (Figure 2). The conversion loss variation from the average value to the spec limit is $10\sigma_A$.

It's obvious from Figure 2 that Vendor A's parts will have a better repeatablitiy than those of Vendor B,

$$\text{SP (Sigma Performance)} = \frac{\text{Spec. Limit - Average}}{\text{Standard Deviation}}$$

$$= \frac{8.5 - 6.5}{0.2} = 10$$

and that therefore Vendor A's parts will be of greater value. The fact that Vendor A supplies 0.2dB standard deviation is clear evidence that it has better control over its manufacturing process than does Vendor B. The two curves in Figure 2 have been drawn so that their total areas are equal, corresponding to the same number of parts built by both vendors.

Consider another example. One of our components has a VSWR spec corresponding to an input impedance between 25 ohms (min) and 50 ohms (max). To assure close unit-to-unit repeatability, we set our criterion of 4.5-sigma. Since the average is 37.5 ohms and the total variation is 12.5 ohms either way, the standard deviation is 2.8 ohms (12.5/4.5). Thus, even though the specification allows a variation from 25 to 50 ohms, the majority (68%) of the units will be within 2.8 ohms of the average value of 37.5 ohms, that is from 34.7 - 40.3 ohms.

If unit-to-unit repeatability is indeed critical, shouldn't engineers include sigma limits in the specifications that they write. Absolutely. We have been delivering production orders for quite some time with sigma limits specified. In fact, we are presently updating our data sheets and ads to include guaranteed sigma levels. That's how important we feel sigma specifications are to the design community. We at Mini-Circuits have dedicated ourselves to achieve the goal of sigma performace (SP) of 4.5.

The sigma limits, to define unit-to-unit repeatability, offer a new opportunity horizon for competitiveness

---

The concept of sigma and statistical process control opens a new horizon of requirements and opportunities for communicationg and measuring product performance and reliability. More importantly, it is the new playing field of competition. I strongly advise managers to become familiar with these concepts, and to invest in in-house training seminars to teach them to all personnel.

Convince your staff that you welcome their inputs to achieve world class quality for your products. Then listen attentively to their suggestions for process refinements, and encourage active participation by all levels of personnel in quality enhancements.

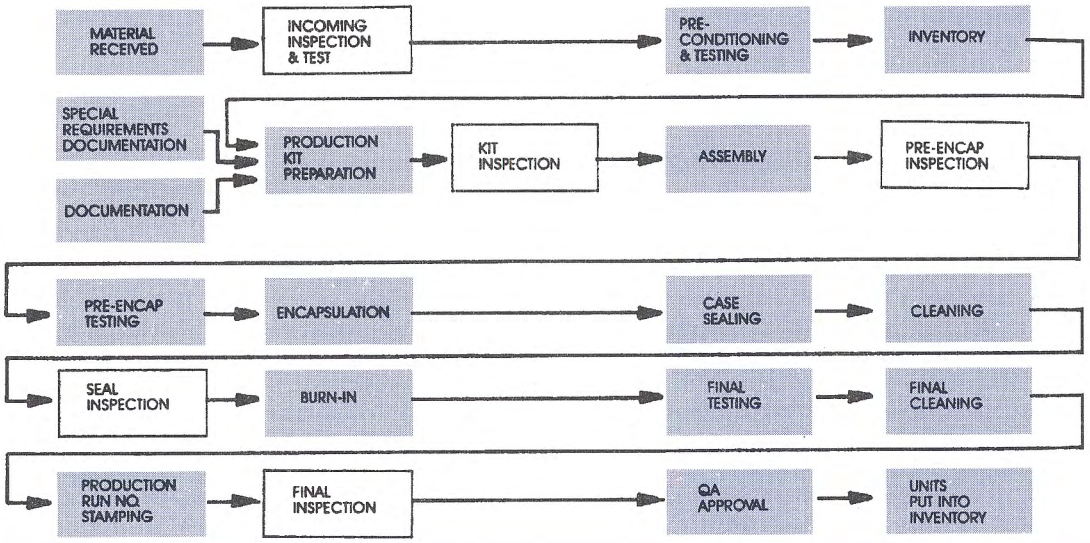
I'm damn mad and won't take it anymore.

The recent hit song *Be happy, don't worry* carries a pleasant and joyful message. But the philosophy expressed doesn't apply to recapturing lost market share or to restoring lost profits. More appropriate is the proposition expressed in the movie *Network* by which parties are urged to stand up and shout, "I'm damned mad and won't take it anymore." There has been enough talk about trade imbalances and restrictions. Let's get back to the basics. Learn how to produce products better than the competition, with world class quality. That is the way to restore our leadership position.

Mini-Circuits Guarantees Quality

Although we have gone beyond our past objective of exceeding 0.1% AQL- no rejects, not even one per 1000 units - this is not satisfactory anymore. Our present commitments are to achieve a Cpk of 1.5, or 4.5 sigma: not even 4 rejects per million units. Mini-Circuits' process controls using SPC, pre-control and design of experiments reduce variability of performance. "Skinny Sigma" is our way of life and it can be yours. Specify Mini-Circuits RF signal processing components to reduce your inspection costs and improve your production yields.

How Mini-Circuits achieves high reliability



Environmental Specifications

Description

All MCL products are manufactured under exacting quality assurance and control standards. As a minimum they will meet published specifications over the operating temperature range of -55° to +100°C after being subjected to any or all of the following physical and environmental tests of MIL-STD 202E, unless otherwise noted.

Absolute Maximum Ratings

Operating and storage temperature	-55° to 100° C
pin temperature (10 secs)	+260°

Connector Specifications

All coaxial connectors used in MCL products meet applicable requirements of MIL-C-39012 including mating compatibility, coupling proof torque, contact retention, materials and finish durability.

Test	Method
Altitude 150,000 feet Condition E	105
Humidity: 90% RH, 65° C (note 1)	106
Thermal shock -65° C to +125° C Condition B (note 2)	107
Seal: less than 10^{-5} Atm cc/sec Conds. C&D (note 3)	112
Drop: random, 45 minutes	203
Vibration: 2 to 2000 cps, 20g, 12 hrs. Condition D	204
Solder heat: 260° C, 10 sec Condition B (notes 4 & 5)	210
Solderability: 95% coverage (notes 4 & 5)	208
Terminal tensile strength: 4 1/2 lbs., 10 sec Condition A (note 5)	211
Terminial fatigue: 2 lbs., 3 cycles Condition C (note 5)	211
Mechanical shock: 100g, 6 ms Condition I	213
Solvent resistance	215

Notes

1. Not applicable to plastic-encased models. Other non-hermetic models may require bake-out after test to restore full performance.
2. Models with metal cases and headers. For other models, -55° C to + 100° C.
3. Not applicable to connectorized and other non-hermetic models.
4. For models intended for surface mounting, a guide to acceptable temperature profiles can be found in the article Surface-Mount Components, see Table of Contents.
5. Not applicable to coaxial connectors.

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Reliability and Quality Control

All Mini-Circuits's RF signal-processing components are subjected to rigid procedures starting from raw material procurement through product production and final inspection; the objective - to supply our customers with the finest RF signal-processing components available. Here's a list of some of the procedures and methods taken to insure high-quality performance and product reliability:

A. 100% testing of each unit in process.
B. 100% testing of each completed unit.
C. 100% inspection of every solder connection.
D. All transformers bonded to the header for protection against severe shock and vibration.
E. All resistors and capacitors bonded to the header for severe shock and vibration protection.
F. Welded joints for all surface mount components.
G. All components rated for greater than +125°C.
H. All transformer leads double wrapped.
I. Heavy coated wire insulation for HiPot/altitude.
J. Completely encapsulated for protection against mechanical shock/vibration and temperature shock.
K. Permanent case marking of model number.
L. All pin units have a Cupor-Nickel case for long-lasting finish especiallyunder salt atmosphere conditions.

Product Testing For High Reliability Ultra-Rel

Mini-Circuit's mixers, phase detectors, frequency doublers and limiters are "Ultra-Rel": They carry a five-year guarantee, a reliability breakthrough attributed mainly to unique Ultra-Rel diodes that easily meet and exceed MIL-STD-883 tests. Each type of diode must pass the following grueling tests:

LIFE	1000 hrs. T_A + 125°C 50 mA ac
THERMAL SHOCK	-65° to +125°C, 200 cycles, 5 min. dwell
MECHANICAL SHOCK	1.5k G's, 0.5 usec pulse
VIBRATION	variable frequency 20 to 2,000 Hz.
TEMPERATURE CYCLE	-65°C to +125°C, 200 cycles, 10 min. dwell
AUTOCLAVE (pressure pot)	14.7 psi, T_A + 121°C, 96 hr.
85/85	85°C/@85% humidity 168 hr., no bias
ACCELERATED HI-TEMPERATURE STORAGE	300°C, 325°C, 350°C storage until 50% failures

HTRB Testing

Certain models, identified individually in the catalog, instead have their diodes subjected to high-temperature, reverse-bias (HTRB) testing. This is an accelerated-life screening test generally reserved for space applications. Here the Schottky and PIN diodes are subjected to a one-volt negative bias at 150°C for 168 hours. The objective of this accelerated aging stress is to force time/temperature-related failures and thus screen out potentially unreliable devices.

/MIL, TX, and Hi-Rel Products

All hermetically sealed MCL models can be subjected to screening and to environmental testing. These tests are designed to eliminate early failures and to ensure performance in hostile environments. Many models having such testing performed are available from stock parts, designated by a /MIL, TX or Hi-Rel suffix to the model number. For your convenience, the table below summarizes availability and applicable MIL Spec by product line. A brief description of the test procedures follows the table.

Of course, if you have a specific screening requirement for any model, which is not available from a stock item, or for a non-hermatic model, contact our Applications Engineering staff and they will suggest the most cost-effective means of satisfying your reliability needs.

Product Line	Applicable Suffix			Applicable Std. or Specification for reference
	*TX	*Hi-Rel	*/MIL	
Amplifiers	Not applicable	No	No	MIL-STD-883
Digital Step Attenuators	Not applicable	No	No	MIL-STD-883
Directional Couplers	Not applicable	Yes	No	MIL-C-15370
Electronic Attenuators/ Switches	No	Yes	Yes	MIL-M-28837
Filters	Not applicable	Yes	No	MIL-F-18327
Fixed Attenuators	Not applicable	Yes	No	MIL-A-3933
Frequency Doublers	Yes	Yes	Yes	MIL-M-28837
I & Q Modulators and Demodulators	No	No	No	MIL-M-28837
Limiters	No	No	No	MIL-M-28837
Mixers	Yes	Yes	Yes	MIL-M-28837
Phase Detectors	No	Yes	Yes	MIL-M-28837
Phase Modulators	No	No	No	MIL-M-28837
Power Splitter/ Combiners	Not applicable	Yes	Yes	MIL-P-23971
Switches	Not applicable	Yes	No	MIL-STD-883
Terminations	Not applicable	No	No	MIL-D-39030
Transformers	Not applicable	Yes	No	MIL-T-55631

*Check with our Sales Department for specific models available as Hi-Rel, /MIL or TX..

/MIL Models

Mixers, Frequency Doublers and Phase Detectors are tested in accordance with MIL-M-28837. Pre-conditioning, Group A (screened) and Group B are performed on each inspection lot.

Power Splitters are tested in accordance with MIL-P-23971. Group A and Group B are performed on each inspection lot.

These models may be ordered by adding the suffix /MIL to the model number.

TX Models

TX Models employ hermetically sealed diodes which have passed the following tests in accordance with MIL-STD-750:

1) HIGH TEMP. STORAGE	Method 1032
2) TEMP. CYCLING	Method 1051, Cond. C
3) CONSTANT ACCELERATION	Method 2006 (Y1 Orientation, 20,000 G's
4) FINE AND GROSS LEAK	Method 1071, Cond. C and H
5) BURN-IN	Method 1038, Cond. B

The end product is then further screened by being subjected to:

1) THERMAL SHOCK	MIL-STD-202, Method 107, Cond. A (100°C)
2) BURN-IN	96 hours at 100°C with 8mA at 1kHz
3) FINE AND GROSS LEAK	MIL-STD-202, Method 112, Cond. C and D

These models may be ordered by adding the suffix TX to the model number. Also, some models in the product lines having a "No" entry in the TX column of the table may be available with similar screening on special order.

Hi-Rel Models

Mixers, Phase Detectors, Frequency Doublers and Electronic Attenuators/Switches are tested to the following per MIL-STD-202:

1) THERMAL SHOCK	Method 107, Cond. A (100°C)
2) BURN-IN	Method 108, Cond. A (100°C, 8mA ac)
3) FINE AND GROSS LEAK	Method 112, Cond. C and D

Power splitter/combiners, Directional Couplers, Transformers, Fixed Attenuators, Filters and Limiters are tested to the following per MIL-STD-202:

1) BAKE-IN	Method 108, Cond. A (100°C, no excitation)
2) THERMAL SHOCK	Method 102, Cond. A (100°C)
3) FINE & GROSS LEAK	Method 112, Cond. C and D

Switches incorporating PIN diodes are tested to the following per MIL-STD-202, as a minimum:

1) THERMAL SHOCK	Method 107, Cond. A (100°C)
2) BURN-IN	Method 108, Cond. A (100°C, diode current applied)

For additional tests applicable to specific switch models, please consult our Sales Department.

These models may be ordered by adding the suffix Hi-Rel to the model number.

Meeting Customer Needs

The following table outlines generic types of tests we do to satisfy customer's needs per specific contractual requirements. Each entry encompasses one or more QCPs (Quality Control Procedures) which are particularized as to test conditions. The principal MIL standards referenced in the QCPs are listed.

QCP GROUP	TEST	METHODS OF MIL-STD -202	-810	-883
02-00	THERMAL SHOCK	107	503	1010
03-00	RANDOM VIBRATION	214		
04-00	MECHANICAL SHOCK	207,213	516	
05-00	CONSTANT ACCELERATION	212		2001
06-00	BAKE-IN/BURN-IN	108		1015
07-00	SEAL TESTS	112		
08-00	MOISTURE RESISTANCE	106	507	
09-00	RADIOGRAPHIC	209		2012
10-00	SINE VIBRATION	201	514	
11-00	HIGH FREQUENCY VIBRATION	204		
12-00	HUMIDITY	103		
13-00	ALTITUDE (BAROMETRIC PRESSURE)	105	500	
14-00	SALT-SPRAY	101	509	
15-00	TERMINAL STRENGTH	211		
16-00	RESISTANCE TO SOLVENTS	215		
17-00	SOLDERABILITY	208		
18-00	RESISTANCE TO SOLDERING HEAT	210		
19-00	IMMERSION	104		
20-00	EXPLOSION	109	511	
21-00	SAND AND DUST	110	510	
22-00	FUNGUS TEST		508	
25-00	PARTICLE IMPACT NOISE DETECTION (PIND)			2020

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Mini-Circuit's Applications Support Team

Mini-Circuit's is dedicated to providing our customers world class quality of service, support, and products. This handbook, with over 740 pages of technical data, represents one element of our program to support our customers. Another very important and dynamic element is our Applications Support team.

Our team of dedicated Applications engineers are prepared to respond courteously, promplty, knowledgeably, and patiently to questions and challenges posed by customers.

Whether on the phone to provide customers with immediate answers to specifications; or helping customers select the best cost/performance component for their particular application; or engaging in serious discussions on creating custom devices that are currently not available in the marketplace; or visiting customer facilities for technical meetings and seminars, our engineers will always be available to help you.

... guide the customer through decision making on spec requirements ...

Despite our wide variety of over 1,000 signal-processing components listed in this Handbook and our catalogs, there is often a need to meet a spec somewhat different than one listed for a standard catalog item; perhaps a mixer with a slightly lower conversion loss, or an amplifier with just a little more gain, or a filter with a cutoff frequency a trifle higher than a catalog model. Here's how our Applications engineer proceeds:

1) Each section of this Handbood includes a Specifications Check List which customers are asked to review. This sheet includes the pertinent parameters for the product and is intended to guide the customer through decision making on spec requirements and the most critical parameters for the intended publication.
2) Our Applications engineer will work with our Design Engineering team to check the feasibility of designing a new product to meet the specific spec; of course, if modification of an existing product is possible, this approach can slash development time and costs.
3) If the design is indeed feasible, samples will be fabricated, tested to assure they meet the intended design goals, and then shipped to the customer for final evaluation in the intended application.

Here is a brief summary of services available from our Applications Support team:

- respond to technical questions regarding specs and performance of catalog components and applications of our products.
- provide more detailed CAPD (computer-automated performance data) than published in our catalogs, product data sheets, and Handbook. Although our published CAPD data is quite comprehensive, we strongly urge our customers to request more detailed data when their application needs (very narrow bandwidth, tight IM specs, linear filter phase response, etc.) dictate a closer look at specific measurement points. Our enormous database on catalog and custom models is offered, at no extra charge, to eliminate any need for guesswork on the part of design engineers striving to deliver a cost-effective and reliable system.
- analyze customer specifications and recommend, wherever possible, a catalog component that provides the optimum cost/performance selection.
- discuss, in detail, MIL-specs that may appear confusing to customers first encountering them. What they mean, definitions of terms, and how to be in conformance are explained to lighten the load at the customer's site.
- correlate customer's test requirements with those of our Computer Test department.
- review customer's environmental requirements and suggest, where applicable, cost-effective solutions.

... offer test procedures and statistical data ...

- after determining critical parameters dictated for a customer's requirement, offer test procedures and statistical data to most effectively focus on those parameters.
- keep customers aware of our latest new products during discussions of applications and new system designs.
- interface with customers requesting Return Merchandise Approval (RMA). Quite often a courteous and thorough discussion relating to a component's failure to meet specs may be traced to improper test setup, poor matching, or other problems at the customer site; suggested solutions often negate the need to return the product.
- respond to customer requests for literature. Quickly send catalogs, notes, computerized test data, statistical data, or new product data.

We encourage our customers to take full advantage of our Applications Support group's expertise. Contact us with any questions you may have, problems we may be able to solve for you, and assistance on recommending products in our catalog line or in developing new designs for your next generation system. We promise a prompt, courteous, and perceptive response.

custom components capability

• Our expertise in design and production techniques made us the leader in RF/microwave components. Now let it work for you.

• The on-going pressure for "smaller, lighter" low-cost systems with more-detailed specs often dictates the need for custom devices or super components to minimize pc board area to eliminate connectors, to reduce the number of connections to improve quality, and to lower cost of manufacturing. Not an easy task even for experienced systems engineers.

• Turn to Mini-Circuits for your custom designs . . . we've got the experience and talent. As the world's largest manufacturer of RF/microwave signal-processing components ranging from dc to 8GHz, our design team has mastered computer-aided design, test, and production as well as advanced statistical process-control techniques, established an awesome design database, and solved a wide variety of application-oriented problems. Our engineers design and combine mixers, splitters, switches, transformers, filters, couplers, amplifiers, attenuators, and QPSK and IQ modulators on a routine basis. A recent design is a 12-way power divider, well matched in phase and amplitude from port-to-port with specified repeatability from one unit to another and from one production run to the next.

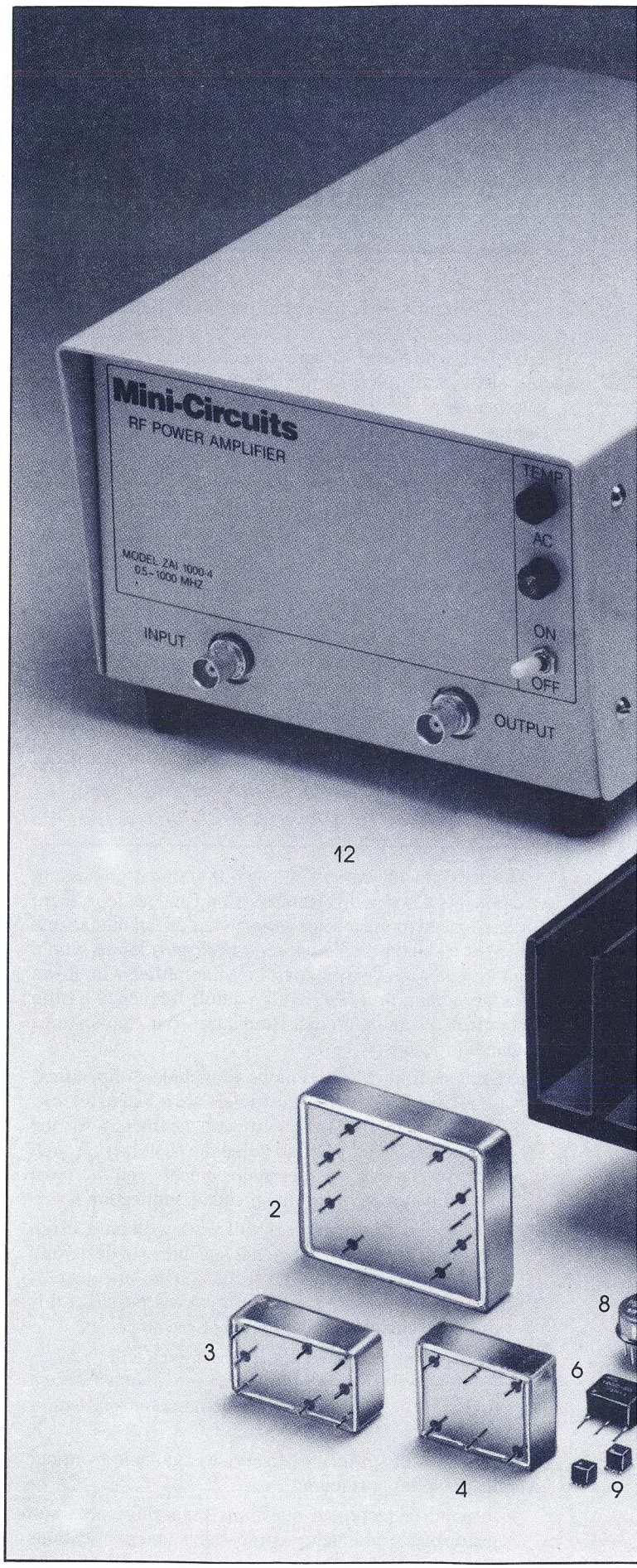
• Take advantage of Mini-Circuits' expertise for your custom design needs whether it be a filter with a very linear phase characteristic or a four-coupled port directional coupler or a sophisticated I-Q modulator . . . in the package you specify. We encourage you to contact our Applications and Design engineers with your systems and subsystems requirements. We'll provide a solid and reliable design, with typically four to six weeks turnaround.

• Mini-Circuits . . . fast, reliable, affordable custom designs.

RF Instrumentation Amplifiers, available now!

Model	Freq. Range (MHz)	Gain dB min	Power min. out (1 dB comp) dBm	Power min. out (1 dB comp) W	NF dB	Price $ ea.
TIA-900-10	100-900	28	+40	10	13	3695.00
TIA-1000-4	100-1000	19	+36	4	12	1995.00
TIA-1000-1R8	0.5-1000	35	+32	1.6	8	1495.00

All models operate from 110/220V ac.



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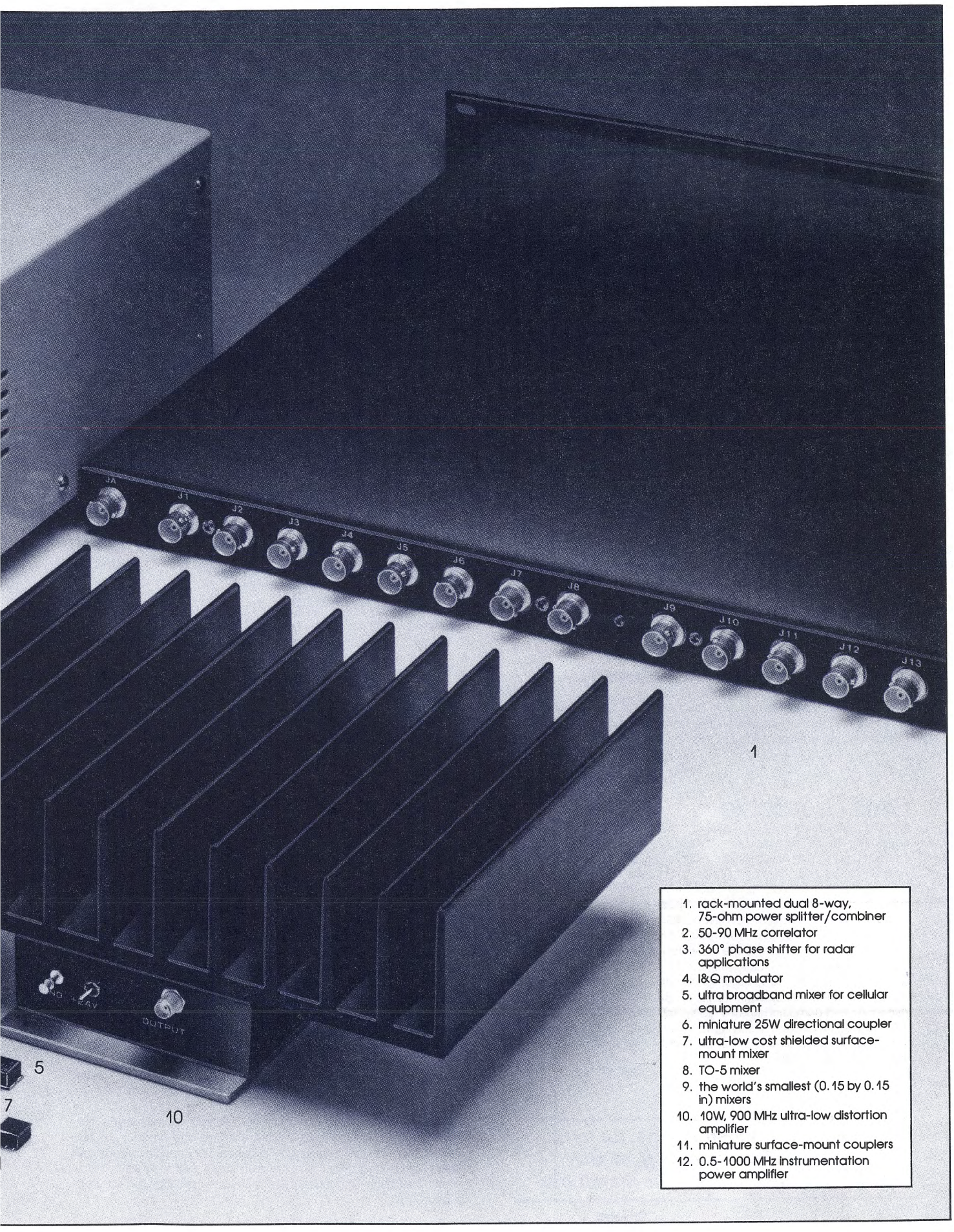

1. rack-mounted dual 8-way, 75-ohm power splitter/combiner
2. 50-90 MHz correlator
3. 360° phase shifter for radar applications
4. I&Q modulator
5. ultra broadband mixer for cellular equipment
6. miniature 25W directional coupler
7. ultra-low cost shielded surface-mount mixer
8. TO-5 mixer
9. the world's smallest (0.15 by 0.15 in) mixers
10. 10W, 900 MHz ultra-low distortion amplifier
11. miniature surface-mount couplers
12. 0.5-1000 MHz instrumentation power amplifier



computer-automated performance data

Eliminate guesswork in systems design. Why extrapolate specs from data sheets when Mini-Circuits provides the most detailed data (CAPD) ever made available for off-the-shelf catalog products?
Traditionally, the system designer selected his RFmicrowave components, such as mixers, power splitters, and amplifiers, using manufacturers' spec sheets to provide spec limits, and environmental ratings. Indeed, the design engineer did receive a workable package of information to see how his design might proceed . . . but it was not a detailed, close-up look. The reason is simple-it has just been too expensive to take comprehensive data at a considerable number of specific frequencies, tabulate the results and then repeat at other parameter levels.
Mini-Circuits' major commitment to customer service is evidenced by this new handbook of computer-automated performance data (CAPD), over 600 pages of data. Based on over 25 years of RF test experience, the CAPD data provides detailed performance characteristics not previously available; specific details will be discussed.

CAPD is a powerful tool

A profound question to address: is CAPD merely a higher stack of paper loaded with numbers or is it really a significant innovation of enormous value to design engineers?
If you are a design engineer, you have been (or will be) troubled by such challenges as: how will a selected +7dBm LO level mixer perform with less than +7dBm LO available, how will a power amplifier designed for +15V operation function with only +12V supplied, are there any narrow-band resonances in a particular filter, to what extent will harmonic and intermod signals plaque your design, and what is the out-of-band performance of an amplifier?
More of the same traditional paperwork won't provide answers to the above issues. You can, by using CAPD.
CAPD is provided for all models in this handbook. Several examples of truncated data are shown on the facing page in order to show samples of the data contained in this handbook.

CAPD is reliable

A heavy investment by Mini-Circuits in computer-controlled HP test equipment, as well as years of engineering time, allows highly precise measurements to be made rapidly. Accuracy is ensured by the use of instruments and standards subjected to rigorous calibration.
Here is an example of the stringency with which the computer-automated setup operates: for the critical measurement of mixer harmonics and intermodulation products, each point is measured three times, with a maximum allowable deviation of less than 0.05 dB between the three; otherwise the test is repeated. Before each measurement is taken, the computer checks the reference voltage level for any variation due to line voltage, temperature, etc., and then makes changes and compensates as required. Such continuous and rapid inspection and correction ensure highly- reliable CAPD data. And, by using a large number of closely- spaced frequency points for component measurement, effects of narrow-band suck-outs or resonances are immediately identified.

See the opposite page for an easy-to-view sampling of our data pages found in this handbook

a close-up view of performance



frequency mixers

Assume you are specifying a double-balanced mixer for a wideband front-end design. Here are some questions you may face:

- In a wideband design, the local oscillator (LO) output might vary over the band and could fall below the level required by the mixer spec. Should you spend additional money to flatten LO output or boost LO output if it is not sufficient? . . . Wouldn't it be valuable to know exactly how performance will be affected, since you might find performance acceptable without any additional investment? With CAPD, a close point-by-point printout of key parameters as a function of LO levels lets you make your decision based on a close-up view of LO drive effects on mixer performance.
- How will mixer conversion loss and VSWR affect receiver sensitivity over the full frequency range? CAPD pin-points the details.
- Harmonic and intermod signals invariably may plague your system design. Questions such as the spurious level of a 4th harmonic of the LO mixing with the 5th harmonic of the RF can easily be determined for the particular mixer you have chosen. In addition, by providing harmonic charts at the mid-band LO, and RF input frequencies, the data is extremely useful and realistic.
- In a phase detector, it may be critical to know how DC offset voltage varies with frequency. Most mixer specs list DC offset at only one frequency; with CAPD, this parameter is given over the full range of frequency.

directional couplers and power splitters

If you are specifying directional couplers or power splittercombiners in your system, you can now closely examine how VSWR, insertion loss, isolation and amplitude phase unbalance vary at closely-spaced points over the frequency range of interest.

filters

Filters particularly benefit from the availability of finely- stepped data, because by design they have sharp variations in response with frequency. CAPD provided in this handbook, at 40 frequency points, tabulate amplitude, phase, group delay, and group-delay variation data, as well as VSWR in both passband and stopband.

amplifiers

Amplifier performance is clearly shown with CAPD as a function of DC power supply changes. You'll quickly spot how VSWR, compression point and gain are influenced by DC supply fluctuations; this could reduce your power-supply costs by indicating the degree of voltage regulation required to meet amplifier performance needs. Power output vs. frequency is measured at three values of gain compression: 0.5 dB, 1.0 dB, and 1.5 dB. (The specification table lists the 1dB values.)
Variability from one unit to another is a critical factor in estimating production yields. Such statistical processing information is contained in the handbook with sigma (standard deviation) values listed for amplifier gain and VSWR.

transformers

As an industry first, RF transformer characteristics are now described with CAPD data. The significance . . . providing VSWR and insertion loss data. With closely-spaced CAPD test points, even slight variations which could affect systems performance become apparent.

CAPD was innovated with one uppermost objective-to assist you, the design engineer, in producing a more effective end product. To accomplish this, you may require CAPD data at very specific frequency points not provided by our programmed steps. Not to worry . . . just furnish us with precise needs for your specific application. Be assured we will comply.

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Illustrative Samples of CAPD

mixer, level 7: model SRA-3500

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
500.000	530.000	5.96	5.49	5.22	500.000	43.39	44.57	45.11	34.16	34.18	33.63
676.471	646.471	5.06	4.86	4.80	676.471	42.23	45.01	47.85	32.90	32.1	31.39
852.941	822.941	5.62	5.14	4.87	852.941	40.34	44.31	49.20	31.84	30	
1000.000	970.000	6.31	5.49	5.05	1000.000	39.09	43.00	48.01	31.65		
	1087.647		6.31		1117.647		41.48	44.70	31.38		

see pages 1-46 thru 1-268 of section 1

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. output mV	mV
500.000	2.20	1.82	1.55	1.92	2.52	3.19	5.000	1.40	1.20	1.08	500.000	+151.79	−.87
576.923	1.44	1.20	1.12	2.00	2.56	3.19	30.513	1.41	1.20	1.08	676.471	+185.23	−.63
730.769	1.16	1.33	1.51	2.27	2.66	3.18	56.026	1.42	1.21	1.09	852.941	+127.03	−.52
884.615	1.51	1.64	1.79	2.62	2.80	3.14	81.539	1.43	1.21	1.09	1000.000	+112.30	−.32
1038.462		1.89	1.99	2.73	2.68	2.82	107.054	1.44	1.21	1.08	1117.647		−.28

power splitter/combiner, 2 way-0°: models ZFSC-2-11, ZESC-2-11, MSC-2-11

FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1
10.000	3.48	3.48	0.00	16.77	10.000	2.06	1.54
20.000	3.48	3.48	0.00	18.92	20.000	2.06	1.55
50.000	3.45	3.45	0.00	18.76	50.000	2.06	1.52
100.000	3.49	3.49	0.00	18.08	100.000	2.06	1.49
200.000	3.52		0.00		200.000	2.05	

see pages 2-28 thru 2-118 of section 2

amplifier: model ZHL-1HLD

FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (dB)	P_{out} (dBm) @ 1 dB COMPR)
225.0	28.50	28.49	28.49	.74	32.2	32.4	31.7	1.48	.11	1.84	.16	1.8	
237.3	28.38	28.37	28.37	.73	32.3	33.0	32.2	1.50	.14	1.78	.16	1.8	
254.7	28.20	28.19	28.18	.74	33.1	33.2	33.2	1.54	.15	1.71	.16	1.94	
273.5	28.01	28.00	28.00	.76	33.9	33.0	34.0	1.56	.16	1.65	.15	1.97	
293.3	27.92	27.91	27.90	.76		35.5	35.2	1.57	.16	1.60			

see pages 3-22 thru 3-46 of section 3

filter, low pass: model LP-5 series

FREQ. (MHz)	I. LOSS x̄ (dB)	σ (dB)	R.L. x̄ (dB)	FREQ. (MHz)	G. DELAY x̄ (nxec)
1.0	0.08	0.1	25.1	1.9	147.473
2.0	0.13	0.1	32.4	2.0	150.986
3.0	0.34	0.1	15.6	3.0	158.958
3.5	0.69	0.1	14.2	3.5	164.573
4.0	0.71	0.1	15.8	4.0	173.418
4.5	0.73	0.1	25.1	4.5	192.059
5.0	0.91	0.1	25.5	5.0	215.975
5.8	2.41	0.7	15.8	5.3	253.980
6.0	3.35	0.8	7.2	5.8	294.321
6.3	9.49	1.3	2.0	6.0	326.824
6.8	11.67	1.1	1.2	6.3	305.701
7.0	16.87	1.2	0.9	6.8	223.890
7.3	23.49	1.1	0.5	7.0	180.770
7.8	29.30	1.0	0.4	7.3	106.737
8.0	34.55	1.0	0.3	7.8	73.246
8.3	39.27	1.0	0.3	8.0	54.493
8.5	41.68	1.1	0.3	8.3	38.639
8.8	42.05	1.1	0.2	8.5	31.119
9.0	42.44	1.1	0.2	8.8	29.126
9.5	43.73	1.1	0.2	9.0	28.459
10.0	47.90	1.1	0.2	9.5	27.231
12.0	63.04	1.6	0.1	10.0	26.011
16.0	75.52	4.1	0.1	12.0	26.682
22.0	75.62	9.9	0.1	13.0	25.945
35.0	74.63	3.9	0.1	14.0	25.338
	77.85	6.6	0.1	16.0	24.483
		8.6	0.1	18.0	24.079
		2.3	0.1	20.0	23.998
		6.8	0.1	22.0	23.815
			0.1	24.0	

see pages 8-12 thru 8-33 of section 8

fixed attenuator: AT-3 series

FREQUENCY (MHz)	ATTENUATION x̄ (dB)	σ (dB)	RETURN LOSS x̄ (dB)	σ (dB)
	3.07	0.00	53.83	0.75
	3.07	0.01	48.68	0.74
	3.08	0.01	42.96	0.36
	3.11	0.00	42.11	0.69

see pages 6-6 thru 6-10 of section 6

mixer harmonic intermodulation: model SRA-1

Harmonic RF Order	RF CAL	LO at +4 dBm						
0	0	—	36	17	24	24	29	33
1	0	18	—	33	18	35	31	45
2	74	42	49	41	63	45	57	57
9	80	72	72	68	70	71	71	72
10	80	71	72	71	70	72	71	71
11	79	71	72	72	72	71	70	70
12	79	71	71	72	71	72	71	71
13	78	71	71	71	70	72	71	71
14	80	72	71	72	71	71	71	71

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Measuring the Electrical Performance Characteristics of RF/IF and Microwave Signal Processing Components

The treatment given here is introductory, and will assist the reader who wishes to consult the standard texts for further detail on measurement techniques. For measurements on mixers and frequency doublers, please refer to the respective product sections of this Handbook.

Linear Measurements, Passive and Active Devices

The instrumentation shown in Figure 1 can be used for a broad range of measurements on devices having one port, two ports, or many ports. Three representative devices are indicated. Properly calibrated per the instrument

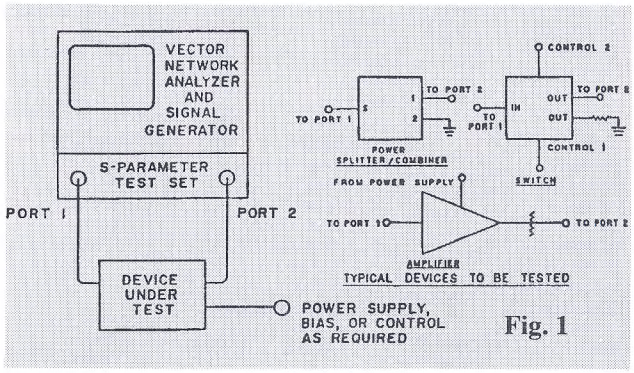

Fig. 1

manufacturer's instructions, the setup will measure the following characteristics as functions of frequency:

Insertion Loss, VSWR, Gain, Isolation,
Directivity, Amplitude Unbalance,
Phase Unbalance, Group Delay

The S-parameter test set measures four sets of magnitude-and-phase quantities. When the network analyzer commands a signal to be outputted by Port 1, the signal reflected back to Port 1 by the D.U.T. (device under test) is detected and displayed as S11, while the signal passing through the D.U.T. and detected at Port 2 is displayed as S21. Similarly, a signal outputted by Port 2 yields S22, and that portion of the signal originating at Port 2 which passes through the D.U.T. to Port 1 becomes S12.

Before connecting the D.U.T., the test set is calibrated by storing reference reflection and transmission data in the network analyzer. For reflection, each cable which will later go to the D.U.T. has precision short, open, and matched load terminations successively connected to it. For transmission, the two cables are joined directly together for a "through" connection.

Now, consider a two-port D.U.T. Suppose the "input" port of the D.U.T. is connected to Port 1 of the test set, and the "output" is connected to Port 2. The magnitudes of S11 and S22, expressed in dB, will be negative or zero because the reflected power is less than, or at most equal to, the incident power. Dropping the minus sign the S11 and S22 dB values equal the return losses at the D.U.T. input and output ports. From there, VSWR can be calculated. A one-port D.U.T. such as a termination is tested for VSWR the same way, but with only S11 being measured.

Insertion loss is measured directly as S21, and so is isolation of passive components such as switches, power splitter/combiners, and directional couplers. For amplifiers, gain is measured as S21 and reverse isolation as S12. Gain testing may require a fixed attenuator at the amplifier output to avoid overloading the detector in the S-parameter test set; suitable MCL models for this purpose are the SAT and NAT series.

Directivity of a coupler can be measured as a direct quantity by first normalizing the network analyzer for a 0 dB insertion loss reference using the main-line-input to coupled-port path through the D.U.T. The cable connected to the main-line input is then moved to the main-line output for the actual measurement. Each unused port should be connected to a matched termination, such as the MCL BTRM, STRM and NTRM series. Amplitude and phase unbalance of power splitter/combiners and multi-throw switches is measured by first normalizing insertion loss through one path, and making the actual measurement through another path. It is important to note here that whenever a D.U.T. with three or more ports is being tested, each port not actually connected to the test set must have a matched termination. This entire method requires the characteristic impedance of the S- parameter test set to be the same as that specified for the D.U.T.

Compression Measurements

Measurement of insertion-loss compression or gain compression is sufficiently similar to the corresponding linear measurements, that the same setup still applies. Usually the quantity of interest is the input power (for passive devices) or output power (for amplifiers) at which the insertion loss or gain is 1 dB less than the low-power value.

When input power at 1 dB compression is the specified characteristic,the input power is set at the specified 1 dB compression value, and a 10 dB fixed attenuator is placed at the output of the D.U.T. The network analyzer is normalized for transmission response in this configuration. The 10 dB attenuator is then moved to the input of the D.U.T., and insertion loss is measured. The results show directly the amount of compression; if less than 1 dB, the device meets its specification.

The method used for testing 1 dB output power compression of amplifiers is described in the article in this handbook entitled "Automatic Compression Measurement Using Network Analyzers."

Intermodulation Measurements, Two-Tone Third-Order

The test setup is shown in Figure 2. Generator frequencies ("tones") are commonly set 1 MHz apart, near the low end of the specified frequency band. The test is repeated in mid-band and near the high end. Output power of each RF generator and the net path gain or loss up to the D.U.T. are chosen to yield a specified D.U.T. output power for each tone. When the intercept point is to be calculated from the

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measured data, the tone levels are set so as not to saturate the D.U.T., 15 dB below the 1 dB compression point as a guide. It is advisable to repeat the test with 5 dB less input for each tone and recalculate the IM intercept point; agreement within 1 dB lends confidence that the setup is yielding valid data. To meet this criterion care must be taken to ensure that

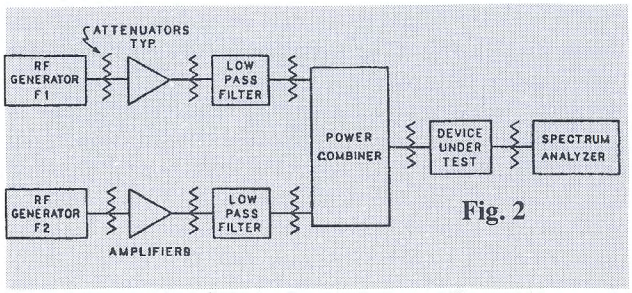

Fig. 2

the test equipment itself does not contribute too much of its own IM. The power combiner and the amplifiers and attenuators ahead of it all promote isolation between the RF generators, which could otherwise produce IM internally. The low pass filters reduce harmonics which could add to any distortion generated by the D.U.T. The attenuators before and after the filters ensure matched terminations so that the filter have their prescribed responses. The attenuator ahead of the spectrum analyzer must ensure that the analyzer is not overloaded.

To perform the measurement, set the spectrum analyzer to obtain a display like that in Figure 3. The applied tones and the IM products shown are 1 MHz apart. The tones should be at equal amplitude, and the two third-order products should be nearly equal to one another. IM suppression is read as the dB difference between the applied tones and the third-order products.

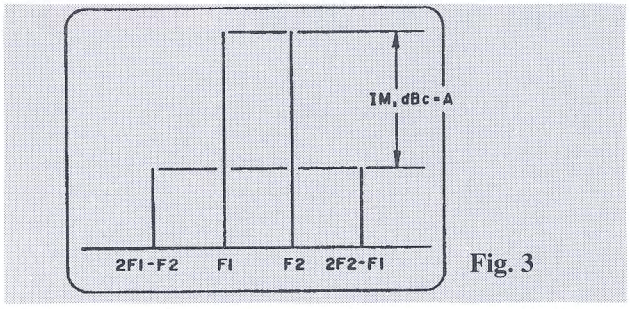

Fig. 3

Third order intercept point is computed from this measurement as $IP_3 = P + A/2$. If P is input power to the D.U.T., this yields input IP3 and if P is output power, output IP3 is computed.

Noise Figure Measurements

The test setup for amplifiers using an automatic noise figure meter is simple, as shown in Figure 4, although much sophistication is implemented in such an instrument. Noise figure and gain readings can be obtained by following instructions furnished by the instrument manufacturer.

For mixers an LO signal is introduced as shown in Figure 5. The band pass filter, tuned to the LO frequency, suppresses any noise sidebands falling at an IF-separation from the LO frequency. The IF commonly used is 30 MHz. During the meter calibration sequence the noise source

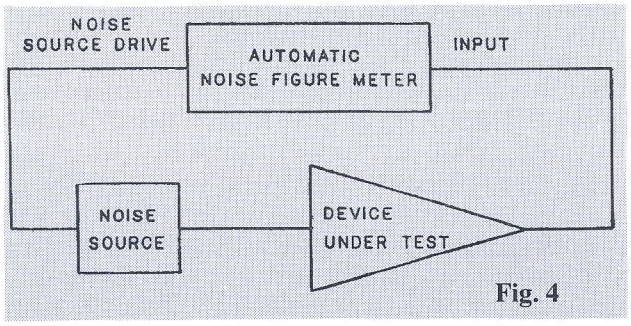

Fig. 4

must be connected directly to the input port of the noise figure meter. The 10 dB attenuator improves impedance match and measurement consistency; its value has to be subtracted from the noise figure reading. When SSB (single sideband) noise figure is the required result, 7 dB is subtracted instead.

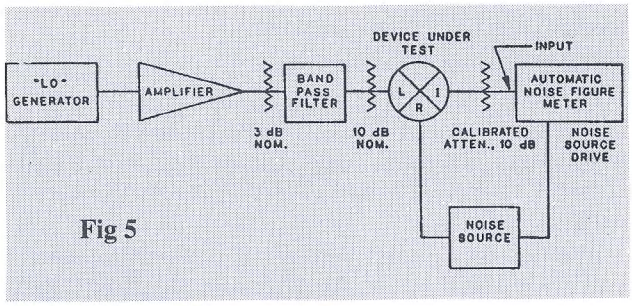

Fig 5

Phase Detector Measurements

Phase detectors behave similarly to mixers, but are specified for common-frequency input to the LO and RF ports. They therefore yield DC output at the port which would be the IF in a mixer. Measurements particular to phase detectors therefore pertain to the DC output: the "maximum voltage" when LO and RF signals are in- phase, and the DC offset occurring when only the LO signal is applied.

Figure 6 illustrates the test set-up. A 0-degree power splitter such as Mini-Circuits' model ZFSC-2-1 applies in-phase signals at +7 dBm each to the LO and RF inputs of the D.U.T. The Maximum DC Output is measured across a 500-ohm load on the output port. To measure DC Offset, disconnect the power splitter from the RF port, place matched terminations on both the D.U.T. RF port and the unused splitter output, and read the DC voltage.

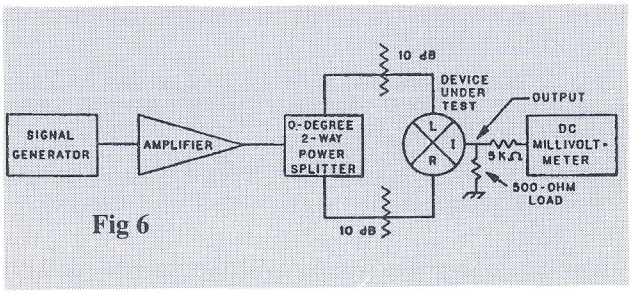

Fig 6

Limiter Measurements

The principal limiter tests — output power and phase change with variation of input power — are readily done with the network analyzer setup in Figure 1, with these

additions ahead of the D.U.T.: an amplifier having 1 dB output compression point of 30 dBm or more, followed by a variable attenuator with 14 dB or greater range in 1 dB steps. To ensure good impedance match a fixed attenuator of at least 3 dB is advisable before and after the variable attenuator.

The limiter output power depends upon the value of control current applied externally. The current is held constant during a test run, usually at the "typical" specified value, and can be of either positive or negative polarity. To run the test, the power input to the D.U.T. is first set at the minimum value to be used and a reference of 0 dB amplitude and 0 degree phase is obtained. Then, the D.U.T. input power is increased by means of the variable attenuator and the changes in amplitude and phase are read.

I&Q Modulators and Demodulators

Please refer to the article in this Handbook entitled "Novel Measurement Schemes Serve I/Q Applications" for a description of measurement methods.

QPSK Modulator Measurements

Insertion loss, VSWR, amplitude and phase unbalance are the most important characteristics. The test set-up at the beginning of this article is used, with the addition of 50-ohm current sources supplying ± 20mA bias to the two control ports.

Insertion loss is measured at all four control-current states: +20 & +20, +20 & -20, -20 & +20, and -20 & -20mA. The worst of the readings represents the insertion loss of the device. The dB difference of the maximum and minimum insertion loss among the four states represents the amplitude unbalance. Phase unbalance is measured by normalizing the insertion phase to 0 degrees with +20 & +20 mA control current. Then, the actual phase is measured at each of the other control-current states, and the deviation from the desired phase value (90°, 180°, 270°) represents the phase unbalance. VSWR is measured the same way as for any two-port device, but at all four control-current states. The worst case represents the VSWR performance of the QPSK modulator.

Switching Speed Measurements

Switching speed is an important characteristic of components which change their transmission state in response to control signals. For PIN diode and GaAs switches, the change of state is from fully OFF to fully ON, and vice-versa. The quantities related to switching speed which are most often specified are:

(1) Rise time and fall time, defined as the intervals between 10% and 90%, and between 90% and 10% of the RF output amplitude respectively.

(2) Turn-on and turn-off time, defined from 50% of the control waveform transitions to 90% and 10% of the RF respectively.

For digital step attenuators, switching speed is defined similarly, but 10% and 90% are taken as fractions of the RF amplitude step resulting from a change in the control signal state.

Testing technique is determined mainly on the basis of the range of switching speeds expected, and the frequency range of the RF signal. For devices using PIN diodes as the switching elements, the time intervals to be measured are typically one microsecond or more. Referring to the setup in Figure 7, the pulse generator has to furnish repetitive transitions between control levels, whether TTL or other voltage/current values as the D.U.T. requires. Control transition times should be at least an order of magnitude shorter than the D.U.T. RF transitions. Where a D.U.T. has two or more control inputs, all must be supplied by the pulse generator with the correct polarities. The RF Generator is set to as high a level as will not cause compression in the D.U.T., so that the detector operates in its linear range and there is enough detected signal amplitude displayed on the oscilloscope. If the D.U.T. has more than one switched port (as in an SPDT or SP4T switch), each port not presently being tested should be terminated with a matched load. An oscilloscope bandwidth of at least 10 MHz should ensure good waveform fidelity, and its input should furnish a 50-ohm load to the detector so that the latter's own turn-off response time does not limit the measurement. If a very wideband oscilloscope is used or if the RF is at a low frequency, a lowpass filter may be needed after the detector to attenuate any RF leaking through the detector. Also, if video leakage (control break-through) at the D.U.T. output causes distortion in the observed waveform, the effect can be reduced by inserting a highpass filter ahead of the detector. This filter should pass the RF and attenuate signals below about 5 MHz; a model from Mini-Circuits SHP or NHP series can be selected for this application.

Some differences in the test setup are necessary for measuring the speed of GaAs switches, which operate in the nanosecond range. Still referring to Figure 7, an oscilloscope with greater than 500 MHz bandwidth should be used. The detector is eliminated and the switched port of the D.U.T. is connected directly to the 50-ohm oscilloscope input. The oscilloscope must be externally triggered by the pulse generator. What results is a modulated RF waveform, with a stable envelope "filled in" by the RF carrier which is not synchronized. To measure turn-on or turn-off time, a dual-trace display also showing the control signal is required, and this may involve using a wideband high-impedance probe. In any case, great care must be exercised to compensate for instrumentation path-length differences including cables (about 1.5 nanoseconds per foot), and inter-channel time skew in the oscilloscope itself. Digital storage oscilloscopes have a calibration adjustment to make this compensation.

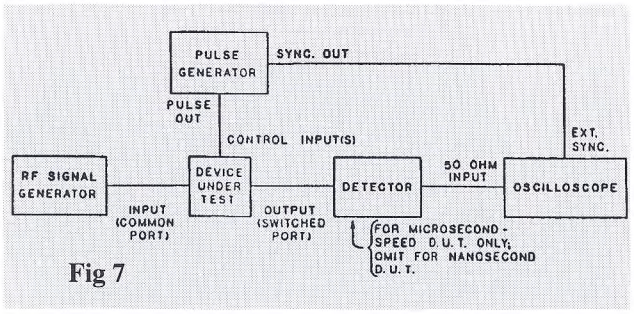

Fig 7

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Automatic Compression Measurement Using Network Analyzers

Introduction

The dynamic range of an amplifier is determined by noise figure and compression. In multicarrier applications third order intercept point is also essential. Conventional compression measurements are error prone and tedious. Multichannel and power sweep capability of modern network analyzers can be used to perform automated compression measurements. Power sweep feature also enables compression measurement of any arbitrary value. This is very useful in multistage amplifier design and comparison of amplifiers with similar output powers. One powerful feature of this automated measurements is, that amplifiers can now be tuned for compression by semi-skilled operators. The ease of measurements can enhance the quality and increase production.

1 dB Compression

Compression is a measure of the linearity of a device. 1 dB compression is normally used as a standard of this measure. For an amplifier it is defined as the output power at which the gain decreases by 1 dB from the small signal gain.

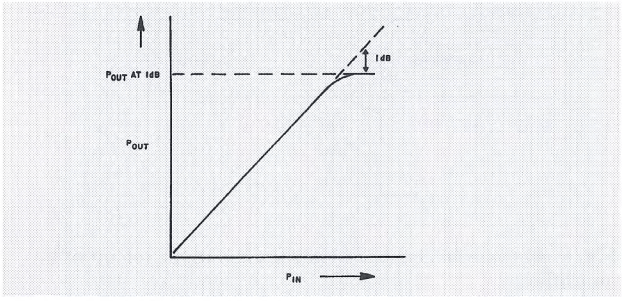

Fig. 1. Definition of 1dB compression.

1dB compression is universally specified by amplifier vendors. This seemingly simple parameter is very tedious to measure and is error prone.

Conventional Compression Measurement

Conventional compression measurements are performed by switching a 10 dB attenuator from input to output and noting the gain change. The output power at which the gain differs by 1 dB is called output power at 1 dB compression.

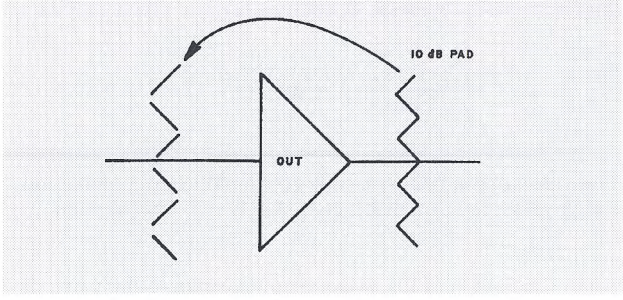

Fig. 2. Conventional compression measurement.

This set up eliminates the need for computing gains, but the input power has to be adjusted till the gains differ by 1 dB. This measurement needs few iterations and also involves twice as many connect, disconnect operations. When measurement over a band of frequencies are required, it takes innumerable iterations and connect, disconnect operations and the final results are basically a reflection of operators skill or fatigue.

Modern Compression Measurements

Thanks to advances in instrumentation, now power sweep is available in modern network analyzers and sweep oscillators. This feature enables compression measurements much more faster and accurate.

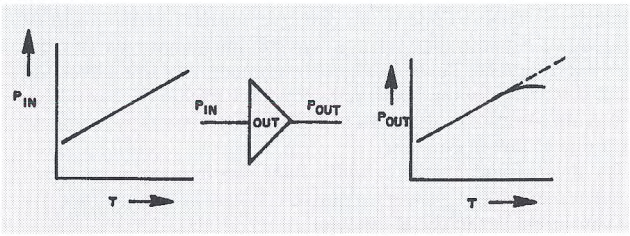

Fig. 3. Compression measurement using power sweep.

As shown in Figure 3, input power to the DUT is swept at a fixed frequency. In the linear range of the device, the output power rises linearly and starts deviating from linearity at compression. It is difficult to determine compression parameters in this mode. If the network analyzer is normalized with a through, then linear gain and compression can be seen clearly, as shown in Figure 4. But the troubles are far from over. One has to determine the output power at 1 dB compression. This is normally done by placing a marker at the compression point and returning the network analyzer to absolute power measurement mode and determine the output power.

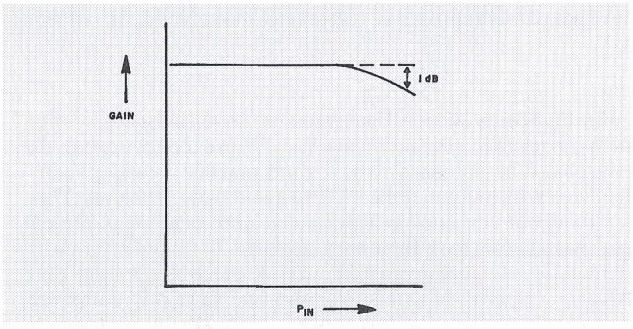

Fig. 4. Gain compression measurement with power sweep.

Normally the output of the DUT is padded to prevent analyzer saturation and damage; in which case the attenuation of the pad has to be added to determine output power at 1 dB compression. When compression measurements are needed at several frequencies, this procedure is tedious as normalization has to be done at each frequency which again involves connect and disconnect operations.

Automated Compression Measurements

Power sweep feature of automatic network analyzers can be utilized in a novel way to accomplish accurate, automated compression measurements. Figure 5 shows the setup for automatic compression measurement. In this set up input power to the DUT is sampled and measured at the same time with the output power. If the coupler is precalibrated, the input to the DUT can be

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computed in the computer and this enables gain to be computed as a function of the input power. From the computed gain values 1 dB compression can be determined.

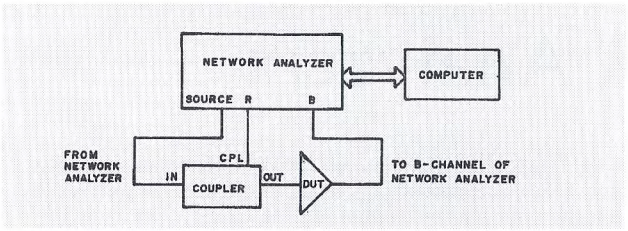

Fig. 5. Automatic compression measurement.

Where Do You Get A Coupler

It is hard to get a coupler which covers the frequency range of the analyzer. Surprisingly, is is not necessary to look for one. All vector analyzers need a sample of the input signal to accomplish phase lock. This is done using resistive splitters and are part of Bridges or S-parameter set ups and are an integral part of the network analyzer. These bridges/S-parameter set ups cover the frequency range of the instrument and have excellent return loss. The sample output is also used in ratio measurements to eliminate error due to power changes.

By pre-calibrating the coupler over the frequency range of measurement input power to the DUT can be determined by measuring power in the R-channel.

Effect of Bad Return Loss of DUT

Network analyzer couplers have good directivity. When the device return loss is bad, the reflected signal from the DUT gets sampled due to the finite directivity of the coupler and can result in errors of the order of magnitude of few tenths of a dB. This comes as error in gain. To increase the accuracy, an input attenuator can be added between the coupler and DUT. This increases the apparent directivity of the coupler by twice the value of the input attenuator or the return loss of the input attenuator, whichever is less. When they are comparable the vectorial sum of the signals reflected from attenuator and that reflected by the DUT and attenuated by the input attenuator arriving the coupler have to be considered. Normally 6 to 10 dB attenuator will do the job. The draw back of this approach is, it decreases the available drive to the DUT.

Safe Attenuator At Output

With high drives, network analyzers are driven into compression which can result in measurement errors. With excessive drives the analyzer can be damaged. It is a good practice to add a "safe" attenuator at the output of the DUT to avoid these problems. This, even though it is a good practice, adds additional measurement steps. Attenuators have frequency response. To avoid errors with assumed safe attenuator values it is a good practice to measure the frequency response of safe attenuators and store it in computer. Normally this is done at low powers. Care should be taken to choose an attenuator which does not change attenuation value at high power.

Calibration Of Network Analyzer

Network analyzers are not basically designed for absolute power measurments. So, they have to be calibrated with power meters. It is a good practice to calibrate both B & R channels to avoid errors.

Step By Step Measurement Of Compression

Figure 6 shows the complete set up for compression measurement of an amplifier using HP8753A automatic vector network analyzer. Step by step measurement of compression is as follows:

1. Calibrate B & R channels with power meter, store the correction factors in computer.

2. Connect B channel to input of Bridge. Keep network analyzer in frequency sweep. The difference in B & R channel readings gives the correction to be applied to R Channel power to obtain input to DUT. If DUT return loss is bad, have input attenuator while performing these measurements.

3. Connect Safe attenuator after input attenuator and measure its frequency response and store it.

4. Connect DUT as shown in figure 6. Set up instrument for CW frequency and power sweep. Apply power sweep. Read R & B channel powers. Apply correction factors to determine input and output powers as described above. Compute gain. Fine the output power at which gain drops by a dB from the lowest power. If 1 dB point is not found increase drive level. Repeat measurement. If drive levels at low and at 1 dB compression point are less than 10 dB decrease lower end of drive level, repeat measurement.

5. Repeat step 4 at each frequency of interest.

All the decisions in steps 4 can be done automatically in the computer. These measurements do not involve repeated connect, disconnect operation and hence are very reliable.

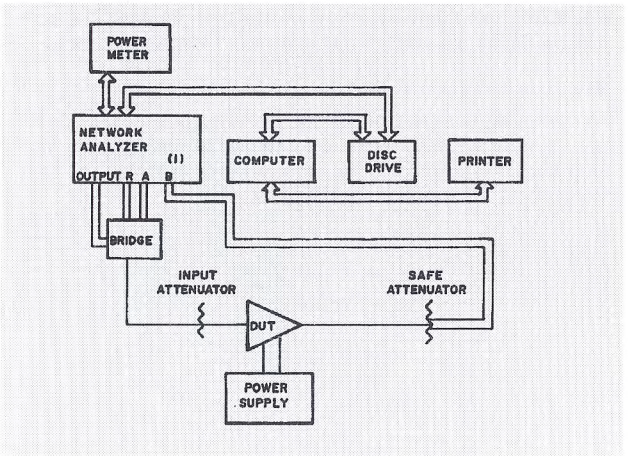

Fig. 6. Automatic compression measurement set-up of an amplifier.

Uses Of Arbitray Compression Measurements

The strength of this procedure is compression point of any arbitrary value can be determined without an execessive number of measurements. This is useful in cascaded amplifier design when the contribution of each stage to the overall compression can be accurately determined.

Compresssion measurement at arbitrary values of compression is also useful for system analysis. One important parameter called figure of merit of compression is defined as the ratio of change of power output to change in compression. For example, if the ouput power is 32 dBm at 0.5 dB compression and 33dBm at 1.0 dB compression, then the figure of merit.

$$F = \frac{\triangle \text{ Pow.}}{\triangle \text{ Comp.}} = \frac{33-32}{1.0-0.5} = 2$$

Low values of F indicates that unit goes rapidly into compression and high values indicate that it goes slowly into compression.

Conclusion

A novel adoption of the existing components of the network analyzer and the power sweep feature is used to automate compression measurements. Figure of merit is defined for compression which can be used to compare amplifiers of same output power for a particular application.

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return loss Vs. VSWR

table of return loss vs. voltage standing wave ratio

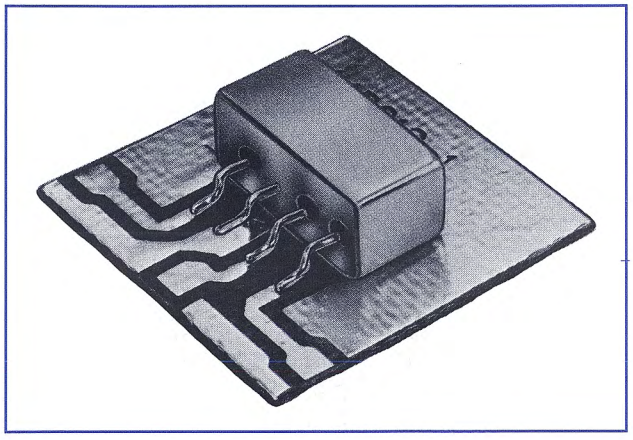
RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)	VSWR
46.064	1.01	13.842	1.51	9.485	2.01	7.327	2.51	5.999	3.01
40.086	1.02	13.708	1.52	9.428	2.02	7.294	2.52	5.97	3.02
36.607	1.03	13.577	1.53	9.372	2.03	7.262	2.53	5.956	3.03
34.151	1.04	13.449	1.54	9.317	2.04	7.230	2.54	5.935	3.04
32.256	1.05	13.324	1.55	9.262	2.05	7.198	2.55	5.914	3.05
30.714	1.06	13.201	1.56	9.208	2.06	7.167	2.56	5.893	3.06
29.417	1.07	13.081	1.57	9.155	2.07	7.135	2.57	5.872	3.07
28.299	1.08	12.964	1.58	9.103	2.08	7.105	2.58	5.852	3.08
27.318	1.09	12.849	1.59	9.051	2.09	7.074	2.59	5.832	3.09
26.444	1.10	12.736	1.60	8.999	2.10	7.044	2.60	5.811	3.10
25.658	1.11	12.625	1.61	8.949	2.11	7.014	2.61	5.791	3.11
24.943	1.12	12.518	1.62	8.899	2.12	6.984	2.62	5.771	3.12
24.289	1.13	12.412	1.63	8.849	2.13	6.954	2.63	5.751	3.13
23.686	1.14	12.308	1.64	8.800	2.14	6.925	2.64	5.732	3.14
23.127	1.15	12.207	1.65	8.752	2.15	6.896	2.65	5.712	3.15
22.607	1.16	12.107	1.66	8.705	2.16	6.867	2.66	5.693	3.16
22.120	1.17	12.009	1.67	8.657	2.17	6.839	2.67	5.674	3.17
21.664	1.18	11.913	1.68	8.611	2.18	6.811	2.68	5.654	3.18
21.234	1.19	11.818	1.69	8.565	2.19	6.783	2.69	5.635	3.19
20.828	1.20	11.725	1.70	8.519	2.20	6.755	2.70	5.617	3.20
20.443	1.21	11.634	1.71	8.474	2.21	6.728	2.71	5.598	3.21
20.079	1.22	11.545	1.72	8.430	2.22	6.700	2.72	5.579	3.22
19.732	1.23	11.457	1.73	8.386	2.23	6.673	2.73	5.561	3.23
19.401	1.24	11.370	1.74	8.342	2.24	6.646	2.74	5.542	3.24
19.085	1.25	11.285	1.75	8.299	2.25	6.620	2.75	5.524	3.25
18.783	1.26	11.202	1.76	8.257	2.26	6.594	2.76	5.506	3.26
18.493	1.27	11.120	1.77	8.215	2.27	6.567	2.77	5.488	3.27
18.216	1.28	11.039	1.78	8.173	2.28	6.541	2.78	5.470	3.28
17.949	1.29	10.960	1.79	8.138	2.29	6.516	2.79	5.452	3.29
17.690	1.30	10.881	1.80	8.091	2.30	6.490	2.80	5.435	3.30
17.445	1.31	10.804	1.81	8.051	2.31	6.465	2.81	5.417	3.31
17.207	1.32	10.729	1.82	8.011	2.32	6.440	2.82	5.400	3.32
16.977	1.33	10.654	1.83	7.972	2.33	6.415	2.83	5.383	3.33
16.755	1.34	10.581	1.84	7.933	2.34	6.390	2.84	5.365	3.34
16.540	1.35	10.509	1.85	7.894	2.35	6.366	2.85	5.348	3.35
16.332	1.36	10.437	1.86	7.856	2.36	6.341	2.86	5.331	3.36
16.131	1.37	10.367	1.87	7.818	2.37	6.317	2.87	5.315	3.37
15.936	1.38	10.298	1.88	7.781	2.38	6.293	2.88	5.298	3.38
15.747	1.39	10.230	1.89	7.744	2.39	6.270	2.89	5.281	3.39
15.563	1.40	10.163	1.90	7.707	2.40	6.246	2.90	5.265	3.40
15.385	1.41	10.097	1.91	7.671	2.41	6.223	2.91	5.248	3.41
15.211	1.42	10.032	1.92	7.635	2.42	6.200	2.92	5.232	3.42
15.043	1.43	9.968	1.93	7.599	2.43	6.177	2.93	5.216	3.43
14.879	1.44	9.904	1.94	7.564	2.44	6.154	2.94	5.200	3.44
14.719	1.45	9.842	1.95	7.529	2.45	6.131	2.95	5.184	3.45
14.564	1.46	9.780	1.96	7.494	2.46	6.109	2.96	5.168	3.46
14.412	1.47	9.720	1.97	7.460	2.47	6.086	2.97	5.152	3.47
14.264	1.48	9.660	1.98	7.426	2.48	6.064	2.98	5.137	3.48
14.120	1.49	9.601	1.99	7.393	2.49	6.042	2.99	5.121	3.49
13.979	1.50	9.542	2.00	7.360	2.50	6.021	3.00	5.105	3.50

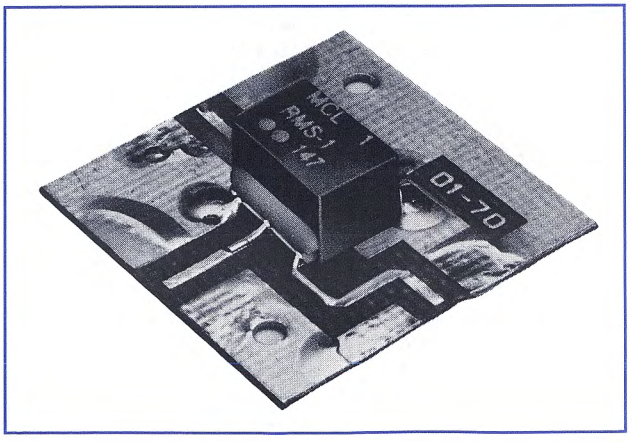
Practical Considerations for Attaching Surface-Mount Components

Mini-Circuits manufactures many RF/IF signal processing components in packages suitable for surface mounting:

SURFACE-MOUNT MODELS MODEL-NO. PREFIXES OF EACH PRODUCT TYPE, AVAILABLE IN THE SURFACE-MOUNT CASE STYLES SHOWN CASE STYLE AND DESCRIPTION		MIXERS	POWER SPLITTER / COMBINERS	AMPLIFIERS, MONOLITHIC	DIRECTIONAL COUPLERS	FILTERS	PHASE DETECTORS	SWITCHES	TRANSFORMERS	BI-PHASE MODULATORS/ ELECTRONIC ATTENUATOR/ SWITCHES
KK	SM, 6-LEAD, PLASTIC	ASK							T TT	
TT	SM, LEADLESS, 0.2" HT, SM, LEADLESS, 0.275" HT	RMS								RAS
WW	SM, 4-LEAD, PLASTIC, MAR			MAR-SM						
XX	SM, 8-LEAD, GLASS, HERMETIC							KSW KSWA KSWHA		
YY	SM, 8-SHORT-LEAD, 0.23" HT, SM, 8-SHORT-LEAD, 0.28" HT	SCM	SCP		SCDC	SCLF				
KKK	SM, 16-LEAD, PLASTIC							YSW YSWA		
MMM	SM, 4-LEAD, SOT143			VAM						
NNN	SM, 4-PIN, 0.23" HT, METAL	TUF								TFAS
QQQ	SM, 6-SHORT-LEAD, 0.2" HT	LRMS	LRPS LRPQ		LRDC					LRPS
RRR	SM, 4-LEAD, PLASTIC, MAV			MAV-SM						
TTT	SM, LEADLESS, 0.15" HT, SM, LEADLESS, 0.23" HT	SYM					SYPD			SYAS
AF	SM, 4-LEAD, CERAMIC, HERMETIC			RAM						
AG	SM, 16-LEAD, CERAMIC, HERMETIC							VSW VSWA		
AH	SM, LEADLESS, 0.25" HT		SYPQ							
AK	SM, LEADLESS, 0.16" HT								TC	

LEGEND: SM = Surface Mount; HT = Height of Case; MAR, MAV = Abbreviation of Model Prefix





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The photos included illustrate some of these components soldered to circuit boards.

What automated soldering methods can be considered for Mini-Circuits' surface-mount components? There are two basic methods: reflow and wave soldering. Generally, reflow soldering can be done when (1) there are only surface-mount components, or (2) these are present together with through-hole components and the latter will be soldered in a separate (wave-soldering) step. The surface-mount components can be located on both the upper and lower sides of the board, when reflow is used. Wave soldering is suitable for through-hole components mounted on top of the board as well as for surface-mount components on the bottom of the board. Both ceramic and polymer-based boards can be accommodated.

Reflow

Reflow requires applying a controlled amount of solder and flux to the areas where connections are to be made. A common technique is to print a pattern of solder paste on the board, and then put the components onto their places. They tend to stay in position because of the stickiness of the paste. Optionally, components can be held with chip-bonding epoxy. When heat is applied, it must produce a time-temperature profile suitable for accomplishing several process steps as illustrated in Figure 1.

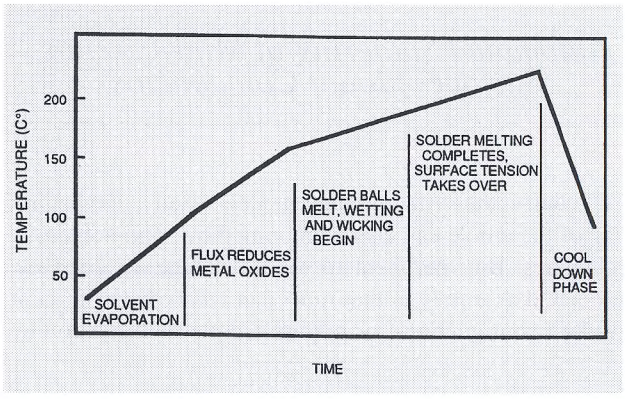

Fig. 1 Solder Reflow Phases

First, solvent evaporation is done at temperatures up to about 100°C. Second, flux reduces metal oxides as temperature rise to the solder melting point, typically 183°C. Third, as temperature continues to rise, the solder particles in the paste melt and wetting and wicking in the joint area begin. In the next step when temperature reaches a peak around 215°, surface tension shapes the fillet of fully molten solder. It takes only a few seconds for proper solder wetting at that temperature. The length of time that the work is actually above 200 is usually limited to one or two minutes to avoid damage. Many plastic-encapsulated components can withstand several minutes of solder-melt temperature when reflowed. Even at the higher temperature experienced in wave soldering (see below), such components tend to withstand several seconds immersion in molten solder.

There are several techniques for applying the heat needed for reflow. Two of the most common are infrared and vapor-phase. Infrared heat sources operate at very high temperature and are placed at the inner walls of the chamber, not in contact with the work. The actual temperature of the work is strongly affected by its mass, geometry and composition, as well as belt speed. Organic materials such as epoxy-based boards tend to absorb the IR radiation and conduct the heat to metal parts which, by themselves, would tend to reflect the IR away. On the other hand, in the vapor-phase soldering process the vapor surrounding the work is maintained at the optimum solder-wetting temperature. This is accomplished by boiling an inert liquid in a tank. The boiling point is approximately 215°C. When the work is held in the vapor just above the liquid, the heat at that temperature is transferred to all surfaces quite uniformly.

Figures 2 and 3 illustrate profiles obtained with both relow processes. Separately controlled heating zones in an IR oven provide an opportunity to shape the profile more optimally than is typical of the vapor phase process. However, the infrared method may require more careful setup to avoid undesired nonumiformity of heating.

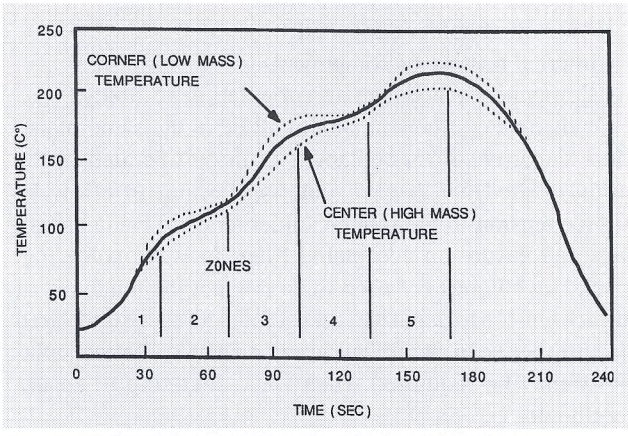

Fig. 2 Typical Five-Zone Infrared Profile.

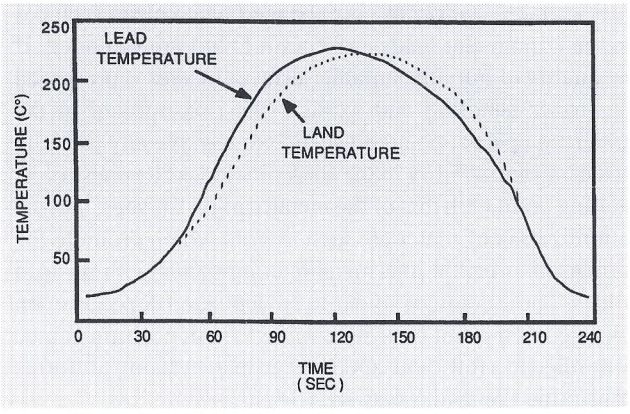

Fig. 3 Typical Vapor Phase Profile

Wave Soldering

This method applied molten solder to the bottom side of a circuit board after a preheating sequence, with cool-down following the soldering. There are variations to the method, mainly characterized by the shape of the solder wave; the choice among them is influenced by the type of assembly and the components being mounted. Solder temperature, typically 260°C, is higher than the peak temperatures used in the reflow method. The temperature profile experienced by the board and components increases during preheat to about 150° at at rate similar to reflow, but then rises rapidly when the solder wave impinges.

Components housed in molded plastic cases may be better suited to reflow soldering, because of the possibility of micro-cracks developing at the leads if they are wave soldered. Resistance to this defect is enhanced when moisture is baked out of the plastic material before soldering by either method; 24 hours at 125°C is usually effective.

Some Pointers

Among the considerations for successful attachment of surface-mount components are:

- Lead coplanarity, and wettability by the solder.
- Compatibility of solder composition with finish on components and circuit board.
- Amount of solder deposited.
- Internal heating of components.
- Component placement and orientation accuracy.

Leads on a component should all be in the same plane. More departure from coplanarity can be tolerated in the reflow method than in wave soldering, because in reflow the surface tension in the molten solder tends to bridge small gaps and ensure an acceptable fillet. In wave soldering, special techniques are used to counteract the tendency of surface tension to deposit excess solder and cause undesired bridging between metallization areas. Even so, better coplanarity may be requuired when wave soldering to ensure good joints.

Wetting, or the ability of solder to adhere to the entire joint surfaces uniformly, is enhanced when clean surfaces on the component leads and circuit board are provided. If the quality of initially suitable surface finishes is preserved by proper handling and storage, the flux applied in the soldering operation should suffice to remove any metallic oxides. Compatibility of the solder includes closeness of its melting point with that of the metallization finishes, and the minimization of materials such as gold which promote the formation of brittle intermetallic compounds with tin-lead solder. The amount of solder to be deposited depends upon joint geometry, but once determined the deposition can be controlled to a few thousandths of an inch by using preforms or printing the solder pattern.

Concern about internal heating of components during soldering becomes greater when the size or complexity of individual components increases, or where an assembly contains a mix of large and small components. In the latter case the heating rates can be disparate, or a large component may mask a small one from the source of heat. Careful study and experimentation may be needed to optimize the process. Measurement of air temperature in the processing chamber, even at several points, may not be sufficient with infrared heating. Monitoring with a surface temperature profiler can ensure that small components are not being overheated.

While high accuracy is needed for component placement on a circuit board, this requirement is eased somewhat in the case of reflow, because surface tension in the molten solder has a self-centering action. This assumes that a proper metallized footprint has been provided. Correct orientation of components requires assurance that when they are supplied in tape-and-reel, all have been inserted into the tape in a constant and known orientation. Also, the tape cavity dimensions must ensure that the orientation is maintained. Especially when component placement is done manually, a clear orientation index is necessary on each component. The following considerations tend to keep the components, once placed, from becoming dislodged before the solder solidifies: When all surface-mount components are on top of the board, the stickiness of solder paste and then the surface tension of molten solder usually suffice. Components on the bottom of the board may need pre-attachement with an adhesive such as epoxy. Caution is then necessary to prevent low-viscosity constituents of the adhesive from spreading onto the metallization areas ("creep"), which could inhibit solder wetting.

Automated Soldering of Mini-Circuits Surface -Mount Components

Of course, the surface-mount models listed at the beginning of the article can also be mounted by hand-soldering techniques. But, pertinent to the advantage afforded by automated assembly is that most can be soldered in their standard configuations, or require simple modification to

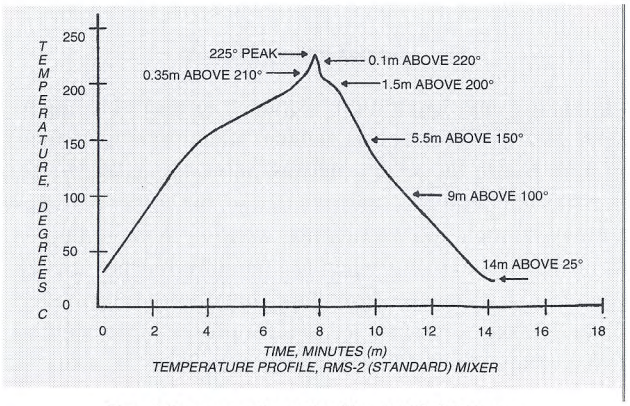

Fig. 4 Temperature Profile, RMS-2 Mixer

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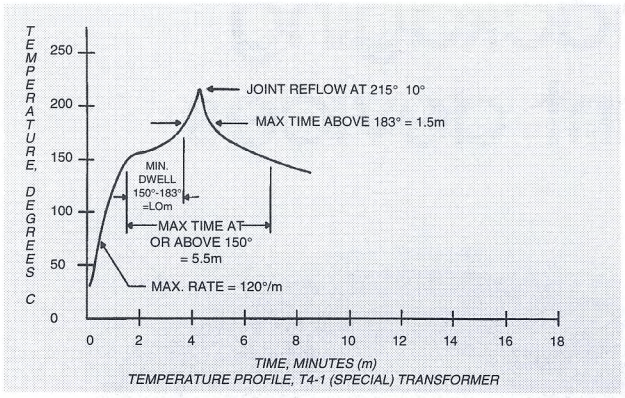


Fig. 5 Temperature Profile, T4-1 Transformer

their internal connection method or omission of a plastic enclosure, depending upon the particular temperature profile specified for a customer's application.

Examples of Soldering Temperature Profiles for Mini-Circuits Components

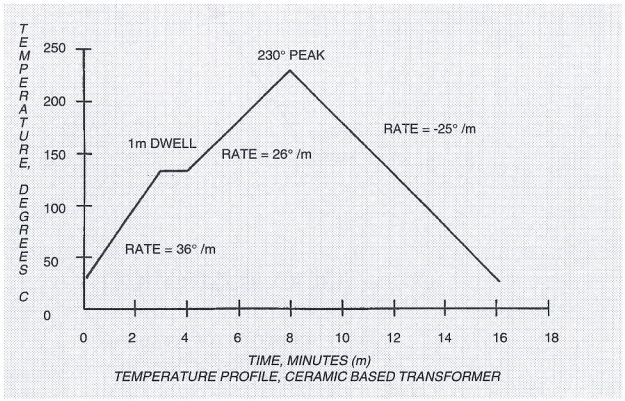


Fig. 6 Temperature Profile, Ceramic-Base Transformer

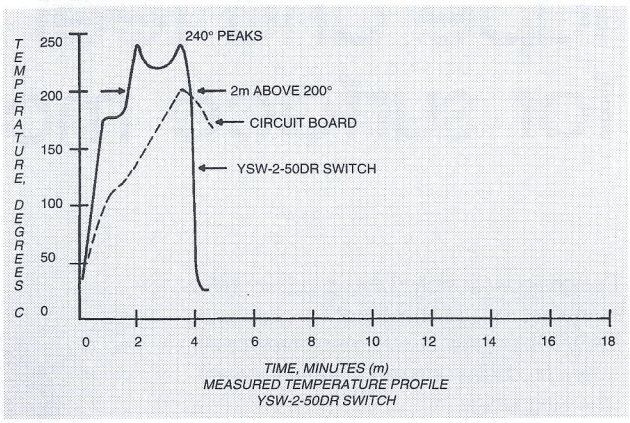


Fig. 7 Temperature Profile, YSW-2-50DR Switch

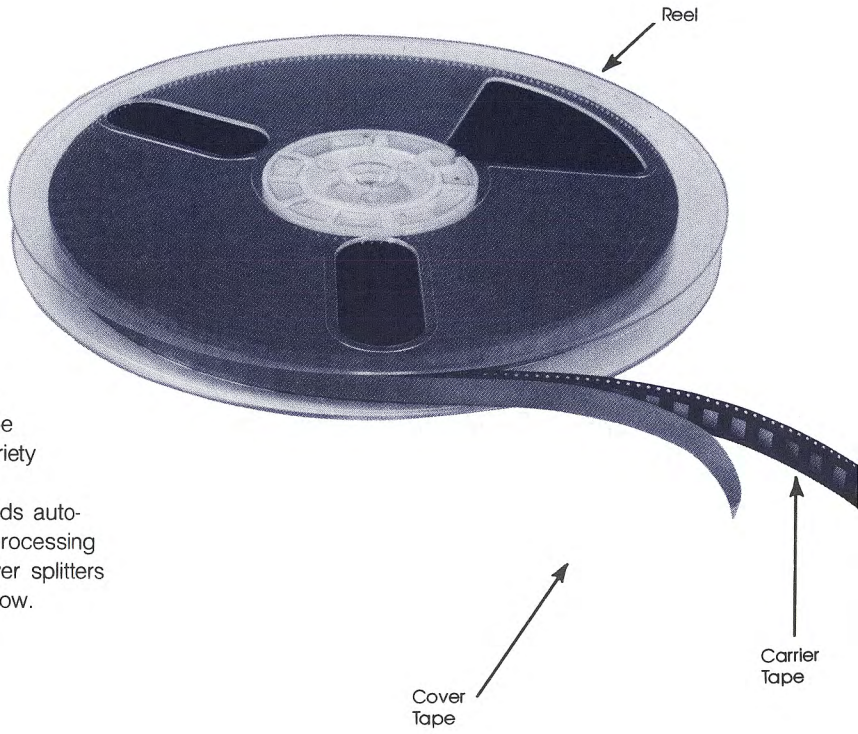
Mixer model RMS-2 meets the temperature profile shown in Figure 4 in its standard configuration. Transformer model T4-1 meets the profile in Figure 5 when a solder having 260°C solidus is used for its internal connections. A special transormer model designated TC, having a smaller version of case style TT100, has a ceramic base and no lid. It accepts the temperature profile shown in Figure 6. All three of these profiles were set by customer's specifications. As a final example, GaAs switches with drivers, in plastic case style KKK155 are designed to withstand a reflow heating and cooling cycle lasting 4 minutes, in which the component itself exceeds 200°C for 2 minutes. Figure 7 shows actual temperatures measured on a switch and on the circuit board to which it is being mounted, using an infrared reflow machine having four zones and seven source panels in a 72-inch overall length. The same GaAs switches in metal-ceramic case style AG191 will withstand a peak case temperature up to 275°C.

tape and reel packaging for surface mount devices

Design-For-Assembly (DFA) and Design-For-Manufacture (DFM) stand tall alongside CAD/CAM in the quest to optimize profitability, production efficiency and equipment operating usage.

Automation of surface-mount assembly by the use of pick-and-place equipment to handle tiny components has been enhanced by evolutionary improvements in tape-and-reel systems which can accommodate as many as 4000 parts on a 13-inch reel. This results in less frequent component reloading and less downtime of the assembly equipment. Other advantages of tape feeders include versatility or the ability to handle a variety of parts.

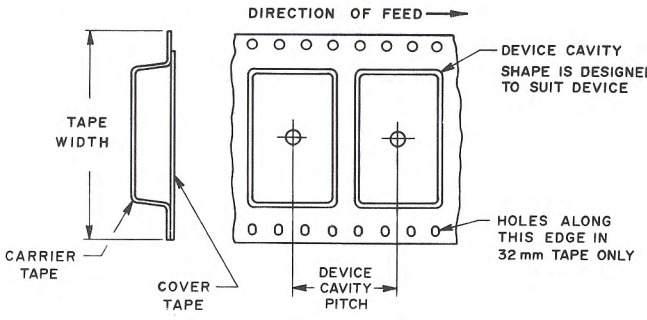
Mini-Circuits has kept pace with the trend towards automated assembly and offers RF/Microwave signal-processing components (mixers, amplifiers, transformers, power splitters and switches) in tape-and-reel format as shown below.

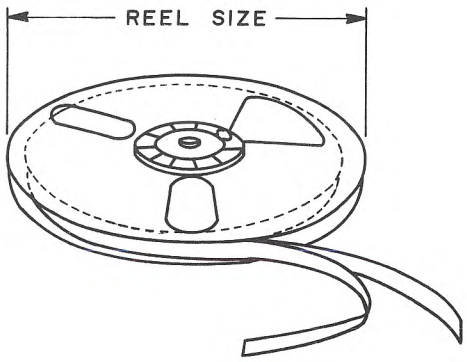


packaging information

Packaging Part No.	Case Style	Tape Width (mm)	Reel Size (inches)	Device Cavity Pitch (mm)	Devices per Reel	Orientation Figure No.
F1	KK81	24	13	12	500	T-001
F2	TT100	16	13	12	500	T-002
F3	TT146	16	13	12	500	T-002
F4	WW107	12	7	8	1000	T-003
F5	YY101	32	13	16	500	T-004
F6	YY161	32	13	16	500	T-004
F7	KKK155	24	13	16	500	T-005
F8	MMM168	8	7	4	3000	T-006
F9	NNN150	24	13	16	500	T-007
F10	QQQ130	24	13	16	500	T-008
F11	RRR137	12	7	12	500	T-009
F12	TTT166	24	13	12	500	T-010
F13	TTT167	24	13	12	500	T-010
F14	AF190	12	7	8	500, 1000, 1500	T-011
F15	AG191	16	13	12	500	T-005

tape illustration





Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

device orientation

Fig. T-001

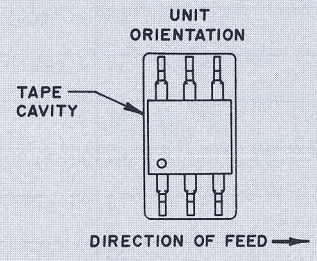


Fig. T-002

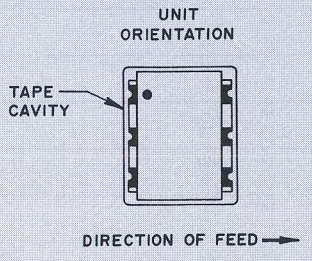
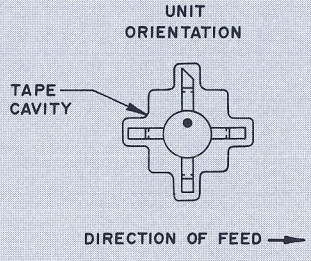


Fig. T-003



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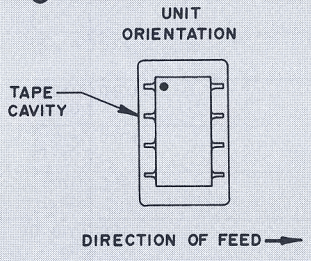


Fig. T-005

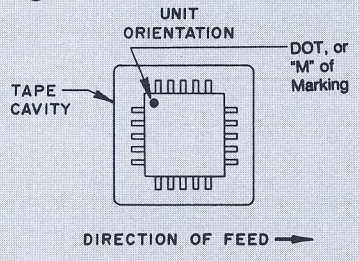


Fig. T-006

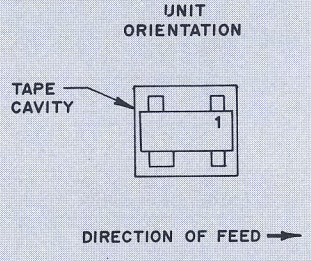


Fig. T-007

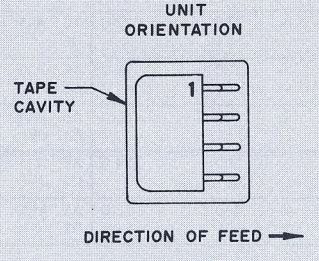
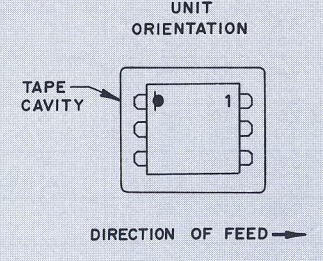


Fig. T-008



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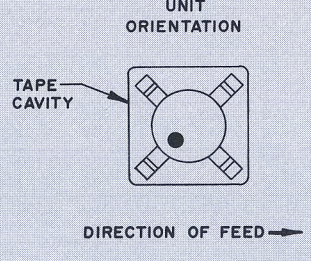


Fig. T-010

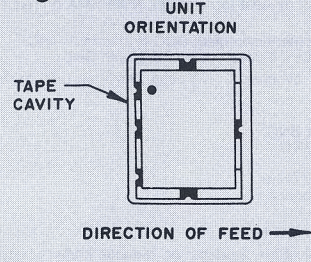
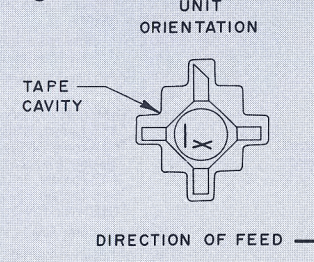


Fig. T-011



case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams.	NOTES*
A01	.770 19.56	.800 20.32	.385 9.78	.400 10.16	.370 9.40	.400 10.16	.200 5.08	.20 5.08	.14 3.56	.031 .79									5.2	A1, B3, E1
A03	.480 12.20	.500 12.70	.390 9.91	.405 10.29	.210 5.34	.230 5.85	.100 2.54	.20 5.08	.14 3.56	.020 .51									2.3	A1, B4, E1
A04	.770 19.56	.800 20.32	.200 5.08	.210 5.33	.370 9.40	.400 10.16	.200 5.08	.20 5.08	.14 3.56	.031 .79									3.7	A1, B3, E1
A05	.770 19.56	.800 20.32	.240 6.10	.250 6.35	.370 9.40	.400 10.16	.200 5.08	.20 5.08	.14 3.56	.031 .79									3.7	A1, B3, E1
A06	.770 19.56	.800 20.32	.285 7.24	.310 7.88	.370 9.40	.400 10.16	.200 5.08	.20 5.08	.14 3.56	.031 .79									5.2	A1, B3, E1
A11	480 12.20	.500 1.270	.240 6.10	.255 6.48	.210 5.34	.230 5.85	.100 2.54	.20 5.08	.14 3.56	.020 .51									1.9	A1, B4, E1
B02	.480 12.20	.500 12.70	.240 6.10	.255 6.48	.210 5.34	.230 5.85	.16 4.07	.100 2.54	.14 3.56	.20 5.08	.020 .51								1.9	A1, B4, E1
B13	.480 12.20	.500 12.70	.390 9.91	.405 10.29	.210 5.34	.230 5.85	.16 4.07	.100 2.54	.14 3.56	.20 5.08	.020 .51								2.3	A1, B4, E1
C07	.770 19.56	.810 20.58	.380 9.66	.410 10.42	.030 .77	.200 5.08	.20 5.08	.14 3.56											11.0	A1, E1
D08	1.000 25.40	1.025 26.04	.390 9.91	.430 10.93	.500 12.70	.525 13.34	.025 .64	.300 7.52	.200 5.08	.09 2.29	.13 3.31	.150 3.☆1	.20 5.08	.14 3.56					8.5	A1, E1
D09	1.000 25.40	1.025 26.04	.240 6.10	.280 7.12	.500 12.70	.525 13.34	.025 .64	.300 7.62	.200 5.08	.09 2.29	.13 3.31	.150 3.81	.20 5.08	.14 3.56					7.5	A1, E1
E10	1.580 40.13	1.620 41.15	.380 9.66	.410 10.42	.770 19.56	.810 20.58	.030 .77	.200 5.08	.10 2.54	.20 5.08	.14 3.56								23.0	A1, E1
F14	2.00 50.80	2.00 50.80	.75 19.05	1.00 25.40	.25 6.35	1.500 38.10	.125 3.18	.39 9.91	1.00 25.40	.50 12.70	1.00 25.40								170.0	A10 C1, D2
F53	2.00 50.80	2.00 50.80	.75 19.05	1.00 25.40	.13 3.31	1.750 44.45	.125 3.18	.39 9.91	1.00 25.40	.50 12.70	1.00 25.40								170.0	A10 C1, D2
G15	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	.61 15.50	— —	.80 20.32	.80 20.32	.76 19.31	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				85.0	A10 B1, D1
G144	1.25 31.75	1.25 31.75	— —	.63 16.01	.38 9.66	.61 15.50	— —	— —	— —	.76 19.31	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				85.0	A10, B6 D6
H16	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	1.000 25.40	.125 3.18	1.000 25.40	— —	— —	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				70.00	A10, B1, D2, D3, D4
J17	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	1.000 25.40	.125 3.18	1.000 25.40	— —	— —	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				75.0	A10, B1, D2, D3
K18	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	1.000 25.40	.125 3.18	1.000 25.40	— —	— —	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				70.0	A10, B1 C1, D2, D3
L19	1.50 38.10	1.13 28.70	1.00 25.40	.50 12.70	.155 3.94	2.345 59.57	.138 3.51	.987 25.07	2.50 63.50	.10 2.54	.31 7.88	1.19 30.23	— —	.66 16.77	— —	— —	.150 3.81		37.0	A6, A11, B2 D6
L20	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.10 2.54	.40 10.16	1.86 47.25	— —	.64 16.26	— —	— —	.150 3.81		74.0	A6, A11, B2 D5
M21	1.50 38.10	1.13 28.70	1.00 25.40	.50 12.70	.155 3.94	2.345 59.57	.138 3.51	.987 25.07	2.50 63.50	.10 2.54	.31 7.88	.75 19.05	1.19 30.23	.66 16.76	— —	— —	.150 3.81		40.0	A6, A11, B2 C1, D6
M22	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.10 2.54	.40 10.16	1.15 29.21	1.86 47.25	.64 16.26	— —	— —	.150 3.81		74.0	A6, A11, B2 C1, D5
M23	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.10 2.54	.63 16.00	1.06 26.93	1.63 41.40	.69 17.53	— —	— —	.150 3.81		70.0	A6, A11 B2, C1, D6

tolerance x ± .1 xx ± .03 xxx ± .015 inch

oz. = grams x.0353

*NOTES:

A. MATERIAL AND FINISH
A1. Header material C.R.S.; Pin material; #52 alloy. Finish; electro tin, hot-oil flowed. Cover material; cupro-nickel.
A6. Case material; aluminum alloy. Finish; blue paint over iridite.
A10. Case material; aluminum alloy. Finish, grey paint.
A11. Case material; aluminum alloy. Finish, blue anodized.

B. MOUNTING
B1. Mounting bracket available on request. Add suffix B to part number.
B2. Mounting bracket available on request. For bracket mounted on connector end add suffix B to part number and $5.00 to unit cost. For bracket mounted on the rear, add suffix BR to part number and add $1.50 to unit cost.
B3. Insulated spacer available. Request P/N B14-045-01.
B4. Insulated spacer available. Request P/N B-14-047-01.
B6. Bracket version only.

C. MARKING
C1. For port markings 1, 2, and 3 see specification data sheet.

D. CONNECTORS
D1. Connectors: SMA Standard. BNC on request (no charge). Male SMA on request, consult factory.
D2. Connectors: please specify, unless otherwise noted; BNC is standard, TNC, SMA and Type N, consult factory. (ZAPD −4 units not available with BNC).
D3. For Bracket Version, Option B, this dimension, "C*", changes from 0.75 to 0.94 inches.
D4. FTB Models available:
*A15 female BNC/isolated female BNC.
*C15 male BNC/isolated female BNC.
FT Models available:
*A16 female BNC/female BNC 75 ohms.
*B16 female BNC/male BNC 75 ohms.
*C16 male BNC/female BNC 75 ohms.
D5. Connectors: BNC standard, TNC consult factory.
D6. Connectors: Female SMA only. Male SMA available on request, consult factory.

E. SPECIAL TOLERANCES
E1. Pin diameter ±.005 inch.

Mini-Circuits™
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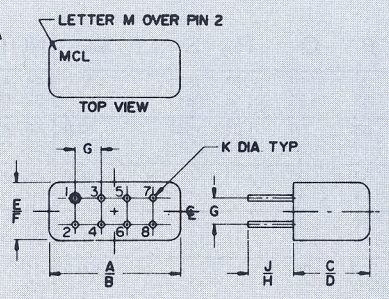
800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

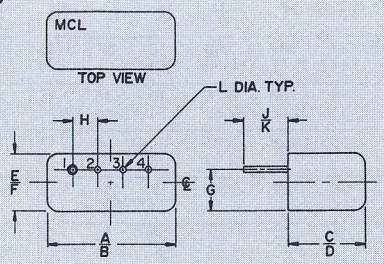
outline drawings

A



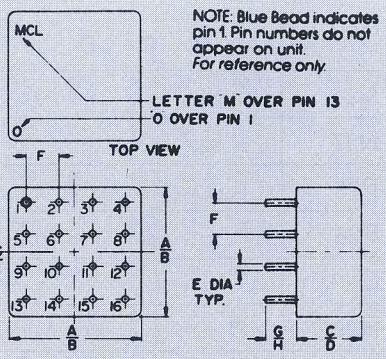
NOTE: Blue Bead indicates pin 1.
Pin numbers do not appear on unit.
For reference only.

B



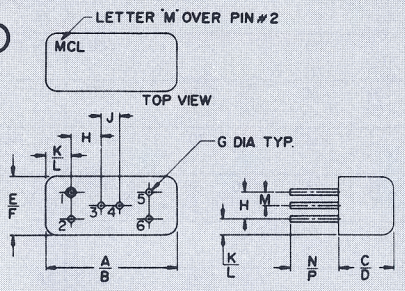
NOTE: Blue Bead indicates pin 1.
Pin numbers do not appear on unit.
For reference only.

C



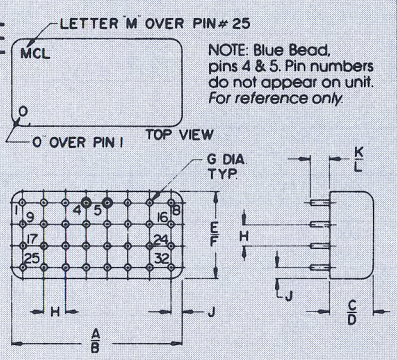
NOTE: Blue Bead indicates pin 1. Pin numbers do not appear on unit.
For reference only.

D



NOTE: Blue Bead indicates pin 1.
Pin numbers do not appear on unit.
For reference only.

E



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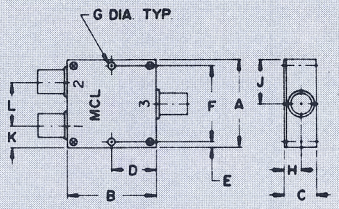

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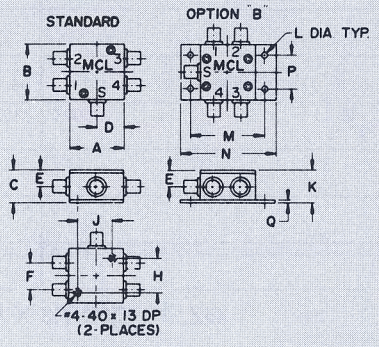

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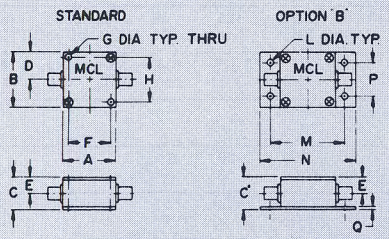

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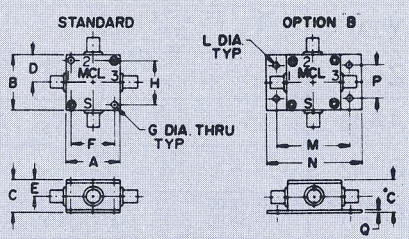

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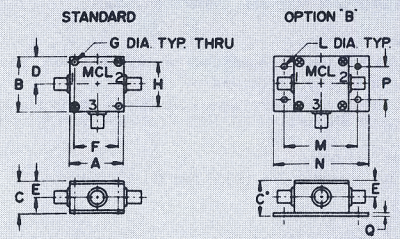

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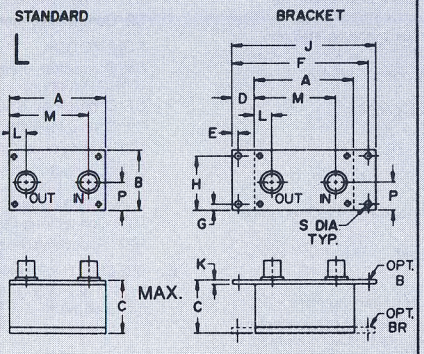
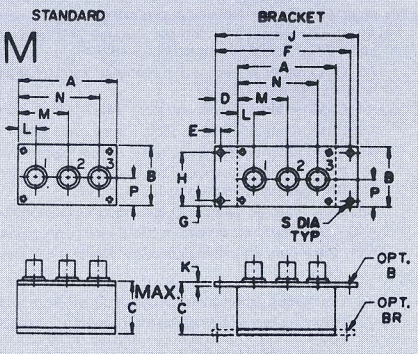


M



case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams.	NOTES*
N24	1.50 38.10	1.13 28.70	1.00 25.40	.50 12.70	.155 3.94	2.345 59.57	.138 3.51	.987 25.07	2.50 63.50	.10 2.54	.32 8.13	.75 19.05	1.18 29.97	.31 7.88	.56 14.23	.81 20.58	.150 3.81		45.0	A6, A11 B2, D6
N27	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.10 2.54	.48 12.19	1.13 28.70	1.78 45.21	.36 9.14	.69 17.53	1.01 25.65	.150 3.81		92.0	A6, A11 B2, D7
P25	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.10 2.54	.78 19.81	1.47 37.34	— —	.38 9.65	1.00 25.40	— —	.150 3.81		86.0	A6, A11 B2, D7
P26	1.50 38.10	1.13 28.70	1.00 25.40	.50 12.70	.155 3.94	2.345 59.57	.138 3.51	.987 25.07	2.50 63.50	.10 2.54	.50 12.70	1.00 25.40	— —	.31 7.88	.81 20.58	— —	.150 3.81		42.5	A6, A11 B2, D6
Q28	4.06 103.13	1.60 40.64	1.50 38.10	3.56 90.43	.24 6.10	.88 22.35	.36 9.15	.160 4.07	.4 10.16	.69 17.53	.58 14.73	.66 16.77	3.13 79.50	.8 20.32	.06 1.53				300.0	A10 D9
R29	4.06 103.13	1.60 40.64	1.50 38.10	3.56 90.43	.24 6.10	.88 22.35	.36 9.15	.160 4.07	.4 10.16	.69 17.53	.58 14.73	.66 16.77	3.13 79.50	.8 20.32	.06 1.53				300.0	A10, C2, D9
R30	6.69 169.93	1.60 40.64	1.50 38.10	6.22 157.99	.24 6.10	.88 22.35	.36 9.15	.160 4.07	.40 10.16	.69 17.53	.55 13.97	.66 16.77	5.72 145.29	.81 20.58	.06 1.53				500.0	A5, C2, D9
R31	9.31 236.98	1.60 40.64	1.50 38.10	8.84 224.54	.24 6.10	.88 22.35	.36 9.15	.160 4.07	.40 10.16	.69 17.53	.54 13.72	.66 16.77	8.34 211.84	.81 20.58	.06 1.53				700.0	A5, C2, D9
R67	6.69 169.93	1.60 40.64	1.50 38.10	6.22 157.99	.24 6.10	.88 22.35	.36 9.15	.160 4.07	.40 10.16	.69 17.53	1.22 30.99	.66 16.77	5.72 145.29	.81 20.58	.06 1.53				500.0	A5, D9
S32	3.75 95.25	2.00 50.80	1.8 45.7	.19 4.83	3.375 85.73	.19 4.83	1.625 41.38	.156 3.97	.6 15.24	.4 10.16	.5 12.7	1.30 33.02	.09 2.29	.38 9.65	3.00 76.20	.30 7.62	2.60 66.04		220.0	A7, D16
T34	4.75 120.65	2.00 50.80	2.21 56.14	.19 4.83	4.375 111.13	.23 5.84	1.540 39.12	.144 3.66	.58 14.73	.34 8.64	.50 12.70	1.50 38.10	1.00 25.40	.12 3.05	.38 9.65	4.00 101.60	.30 7.62	2.60 66.04	440.0	A7, A8, D16
T35	4.75 120.65	2.00 50.80	2.40 61.0	.19 4.83	4.375 111.13	.23 5.84	1.540 39.12	.144 3.66	.58 14.73	.34 8.64	.50 12.70	1.50 38.10	1.00 25.40	.12 3.05	.38 9.65	4.00 101.60	1.50 38.10	5.00 127.00	700.0	A7, A8, D16
U36	7.00 177.80	3.25 82.55	2.13 54.10	.25 6.35	6.500 165.10	.38 9.65	2.500 63.50	.156 3.97	.88 22.35	.73 18.54	.63 16.01	1.13 28.70	2.23 56.64	.125 3.18	.50 12.70	6.00 152.40			900.0	A7, A8, D6
U111	7.00 177.80	3.25 82.55	3.13 79.50	.25 6.35	6.500 165.10	.38 9.65	2.500 63.50	.156 3.97	.88 22.35	.43 10.92	.63 16.01	1.00 25.40	2.63 66.80	.125 3.18	.50 12.70	6.00 152.40	2.23 56.64		1100.0	A8 D6
U200	7.00 177.80	3.25 82.55	2.13 54.10	.25 6.35	6.500 165.10	.38 9.65	2.500 63.50	.156 3.97	.73 18.54	.53 13.46	.20 5.08	.70 17.78	1.25 31.75	.125 3.18	.50 12.70	6.00 152.40	2.15 54.61	.50 12.70	1000.0	A7, D6
V37	.83 21.08	.83 21.08	.75 19.05	.37 9.40	.42 10.67	1.25 31.75	.100 2.54	1.150 29.21	.095 2.41	.735 18.67	.21 5.33	.106 2.69	.06 1.52						34.0	A10, C1, D17
W38	.30 7.62	.27 6.86	.23 5.84	.010 .25	.042 1.07	.020 .51	.100 2.54	.05 1.27	.09 2.29	.37 9.40	.036 .91								.50	A3, E2
X65	.30 7.62	.27 6.86	.23 5.84	.010 .25	.042 1.07	.020 .51	.100 2.54	.05 1.27	.04 1.02	.12 3.05	.300 7.62	.35 8.89							.50	A3, E2
Y39	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.36 9.15	1.000 25.40	1.000 25.40	.125 3.18	.125 3.18	.46 11.69	2.18 55.38	1.688 42.88	.07 1.78	.750 19.05	.50 12.70	.80 20.32	.45 11.43	.29 7.37	50.0	A4, B1, D6, D22
Z40	7.06 179.32	3.13 79.50	.88 22.35	.250 6.35	1.750 44.45	5.310 134.87	6.810 172.97	.312 7.92	2.875 73.03	.144 3.66	3.53 89.66	.44 11.18	.415 10.54	.89 22.61					800.0	A10, D11
AA46	.830 21.08	.580 14.73	.265 6.73	.13 3.30	.415 10.54	.340 8.64	.025 .64	.50 12.70											6.4	A2, E1
BB48	.50 12.70	.39 9.91	.225 5.72	.025 .64	.07 1.79	.100 2.54	.250 6.35	.350 8.89	.06 1.53	.31 7.87									3.0	A1, E1
CC51	2.00 50.80	2.00 50.80	.75 19.05	.938 23.83	.13 3.30	1.750 44.45	.125 3.18	.38 9.65	1.00 25.40	1.25 31.75									120.0	A10, D11

tolerance x ± .1 xx ± .03 xxx ± .015 inch

oz. = grams x.0353

*NOTES:

A. MATERIAL AND FINISH

A1. Header material C. R. S. Pin material; #52 alloy. Finish; electro tin, hot oil flowed. Cover material; cupro-nickel.

A2. Case material; C. R. S. Pin material; #52 alloy. Cover material; stainless steel. Finish; gold flash per MIL-G-45204.

A3. Case material; epoxy. Pin material; iron-nickel alloy. Finish, bright tin-plate per MIL-T-10727

A4. Case material; aluminum alloy. Finish; iridite per MIL-C-5541.

A5. Case material; C. R. S. Finish; grey paint over hot-tin dip.

A6. Case material; aluminum alloy. Finish; blue paint over iridite.

A7. Case material; aluminum alloy. Finish; case black paint. Heat sink; black anodize. Baseplate iridite per MIL-C-5541.

A8. Case material; aluminum alloy. Finish; case iridite. Heat sink, black anodize

A10. Case material; aluminum alloy. Finish, grey paint.

A11. Case material; aluminum alloy. Finish, blue anodized.

B. MOUNTING

B1. Mounting bracket available on request. Add suffix B to part number.

B2. Mounting bracket available on request. For bracket mounted on connector end add suffix B to part number and $5.00 to unit cost. For bracket mounted on the rear, add suffix BR to part number and add $1.50 to unit cost.

C. MARKING

C1. For port markings 1, 2, and 3 see specification data sheet.

C2. Consecutive marking, n = no. of way power-splitter.

D. CONNECTORS

D6. Connectors; Female SMA only. Male SMA available on request, consult factory.

D7. Connectors: BNC only.

D9. Connectors; BNC standard, TNC or Female SMA on request, consult factory.

D11. Connectors; Please specify; Type N or SMA.

D16. Connectors please specify, unless otherwise noted SMA is standard for model ZHL-2-12 for all other models BNC is standard. TNC, N, or SMA available on request, consult factory.

D17. Connectors; Female SMA only.

D22. Gain Control Terminal on Models ZFL-1000G and ZFL-1000GH only.

E. SPECIAL TOLERANCES

E1. Pin diameter ± .005 inch.

E2. Lead width ± .010; lead thickness ± .005 inch.

Mini-Circuits™
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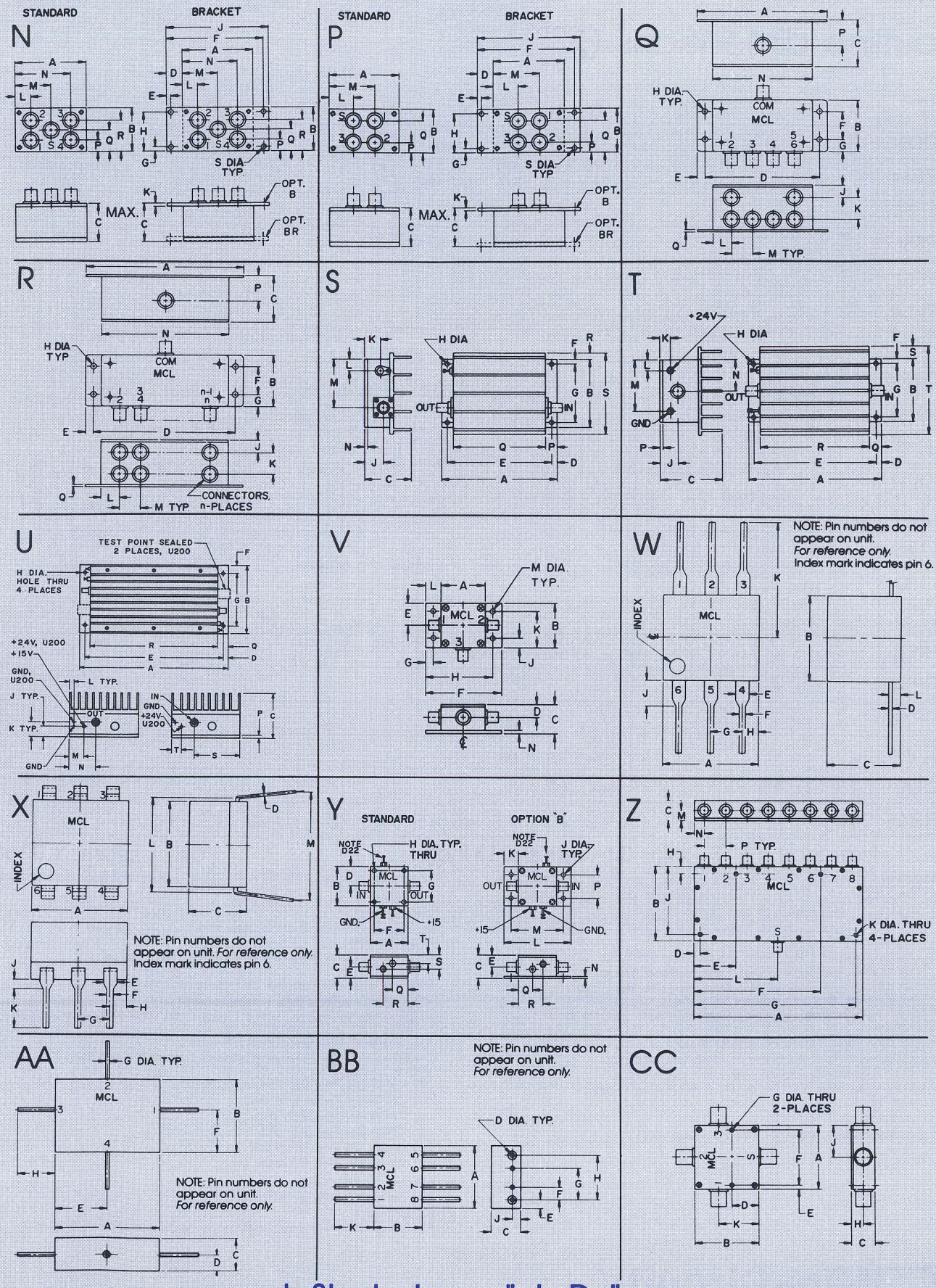
EUROPE 44-252-835094 Fax 44-252-837010

outline drawings

Mini-Circuits



In Stock...Immediate Delivery

case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams.	NOTES*
DD52	2.00 50.80	2.00 50.80	.75 19.05	.90 22.86	.156 3.96	1.688 42.88	.125 3.18	.392 9.96	1.00 25.40	.50 12.70	1.00 25.40	1.25 31.75							225.0	A10, D11
EE54	3.50 88.90	2.13 54.10	.88 22.35	.250 6.35	1.750 44.45	3.250 82.55	.250 6.35	1.813 46.05	.125 3.18	.44 11.18	.415 10.54	.89 22.61							250.00	A10, D11
FF55	1.40 35.56	.58 14.73	.73 18.54	2.59 65.79	— —														40.0	A9, D12
FF56	.98 24.89	.43 10.92	.47 11.94	1.70 43.18	— —														18.0	A9, D13
FF57	1.54 39.12	.72 18.29	.81 20.58	2.96 75.18	.82 20.83														90.0	A9, D14
FF58	1.40 35.56	.58 14.73	.61 15.50	2.59 65.79	.64 16.26														45.0	A9, D15
FF99	1.27 32.26	.72 18.29	.47 11.94	1.98 50.29															42.0	A9, D13
GG60	2.31 58.68	1.20 30.48	.60 15.24	.125 3.18	2.062 52.38	.30 7.62	.53 13.46	.63 16.00											75.0	A10, D10
HH68	9.31 236.47	1.60 40.64	3.57 90.68	8.84 224.54	.25 6.35	.88 22.35	.36 9.14	.160 4.06	.34 8.37	.69 17.53	.54 13.72	.66 16.76	8.34 211.84	.33 8.38	.06 1.52				1090.0	A5, D10
JJ77	1.50 38.10	1.13 28.70	.97 24.64	.50 12.70	.155 3.94	2.345 59.57	.14 3.55	.850 21.60	2.50 63.50	.10 2.54	.44 11.17	.75 19.05	.63 16.00	.54 13.71	.37 9.39	.43 10.92	.150 3.81	.73 18.54	50.0	A6, A11, D17
KK81	.30 7.62	.27 6.86	.23 5.84	.010 .25	.042 1.07	.020 .51	.100 2.54	.05 1.27	.05 1.27	.035 .88	.036 .91	.26 6.60	.575 14.60						.50	A3, E2, F1
LL85	1.43 36.32	.58 14.73	.75 19.05																21.5	A9, D18
LL86	1.19 30.23	.58 14.73	.51 12.95																14.0	A9, D19
LL87	1.43 36.32	.82 20.83	.68 17.27																48.5	A9, D20
LL88	1.43 36.32	.61 15.49	.75 19.05																24.0	A9, D21
NN92	3.66 92.96	3.25 82.55	2.13 54.10	.25 6.35	3.16 80.26	.38 9.65	2.50 63.50	.156 3.96	.72 18.29	.64 16.26	.74 18.80	1.78 45.21	2.30 58.42	.125 3.18	.50 12.70	2.66 67.56			440.0	A7, A8, D6
PP94	.360 9.14	.250 6.35	.25 6.35	.016 .41	.020 .51	.04 1.02	.200 5.08												1.5	A12, C3
PP120	.50 12.70	.21 5.33	.150 3.81	.016 .41	.020 .51	.04 1.02	.300 7.62												1.5	A12, C3
QQ95	.500 12.70	.250 6.60	.26 6.60	.016 .41	.020 .51	.04 1.02	.300 7.62	.150 3.81	.150 3.81	.075 1.91									3.5	A12, C3
QQ96	.600 15.24	.250 6.35	.26 6.60	.016 .41	.020 .51	.04 1.02	.400 10.16	.200 5.08	.200 5.08	.100 2.54									4.0	A12, C3
RR93	4.06 103.13	1.60 40.64	2.125 53.98	3.56 90.43	.25 6.35	.88 22.35	.36 9.15	.160 4.07	.4 10.16	.69 17.53	.58 14.73	.66 16.77	3.13 79.50	.8 20.32	.06 1.53	.33 8.38			350.0	A5, A10, D9

tolerance x ± .1 xx ± .03 xxx ± .015 inch

oz. = grams x .0353

*NOTES

A. MATERIAL AND FINISH

A3. Case material, epoxy. Pin material; iron-nickel alloy. Finish; bright tin-plate per MIL-T-10727.

A5. Case material; C.R.S. Finish; grey paint over hot-tin dip.

A6. Case material; aluminum alloy. Finish; blue paint over iridite.

A7. Case material, aluminum alloy. Finish, case black paint. Heat sink, black anodize. Baseplate iridite per MIL-C-5541.

A8. Case material; aluminum alloy. Finish; case iridite. Heat sink, black anodize.

A9. Case material, brass. Finish; nickel plate.

A10. Case material; aluminum alloy. Finish, grey paint.

A11. Case material; aluminum alloy. Finish, blue anodized.

A12. Header finish; gold plate per MIL-G-45204. Case material; cupro-nickel.

C. MARKING

C3. For Pin designations see specification data sheet.

D. CONNECTORS

D6. Connectors. Female SMA only. Male SMA available on request, consult factory.

D9. Connectors BNC standard. TNC or Female SMA on request, consult factory.

D10. Connectors. BNC standard. SMA on request, consult factory.

D11. Connectors; Please specify; Type N or SMA.

D12. Connectors; Male BNC, Female BNC standard. Other combinations with SMA available on request, consult factory.

D13. Connectors; Male SMA, Female SMA only.

D14.Connectors; Male N, Female N standard. Combinations with BNC, SMA, TNC available on request, consult factory.

D15. Connectors; Male TNC, Female TNC only.

D17. Connectors. Female SMA only.

D18. Connectors. Male BNC only.

D19. Connectors. Male SMA only.

D20. Connectors. Male Type N only.

D21. Connectors. Male TNC only.

E. SPECIAL TOLERANCES

E2. Lead width ±.010; lead thickness ±.005 inch.

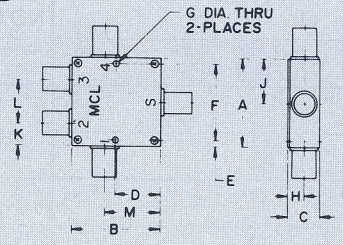
F. PACKAGING

F1-15. Tape and reel packaging available. See pages 0-38 and 0-39 for details.

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

outline drawings

DD



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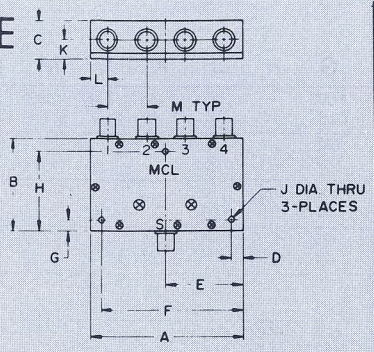

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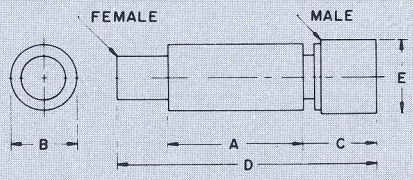

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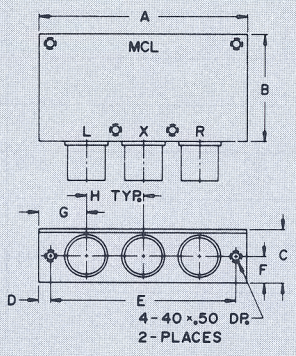

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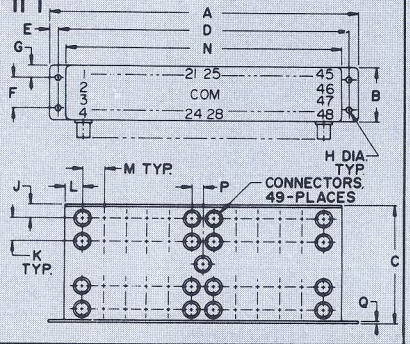

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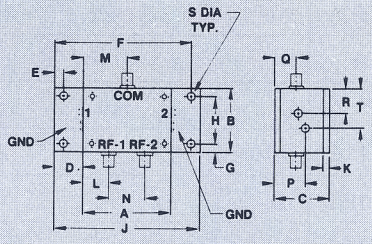
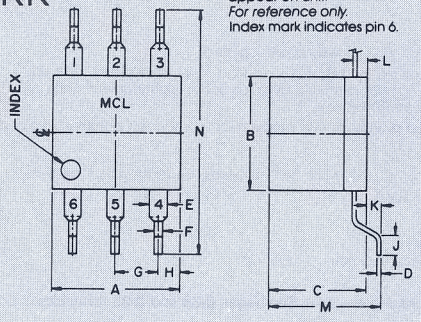


KK

NOTE: Pin numbers do not appear on unit.
For reference only.
Index mark indicates pin 6.



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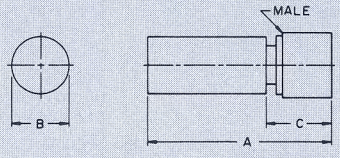

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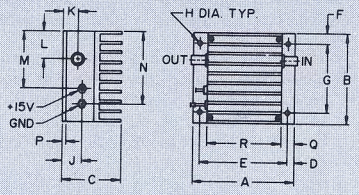
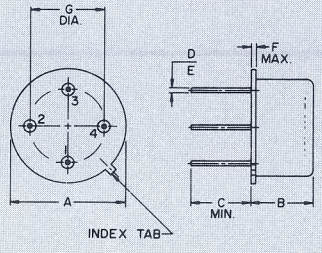


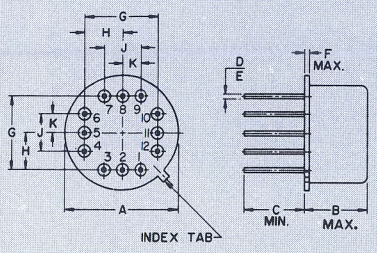
PP

NOTE: Pin numbers do not appear on unit.
For reference only.



QQ

NOTE: Pin numbers do not appear on unit.
For reference only.



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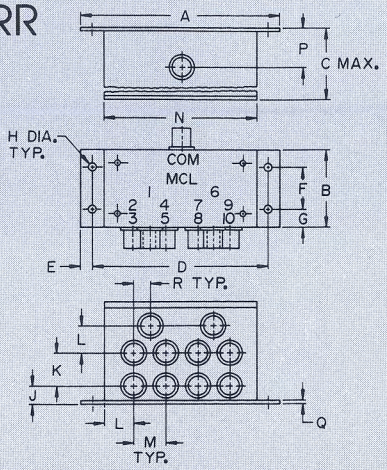

case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams	NOTES*
SS98	1.25 31.75	1.56 39.62	.75 19.05	.63 16.00	.39 9.91	1.56 39.62	1.000 25.40	— —	.125 3.18	.46 11.69	2.18 55.38	1.688 42.88	.07 1.78	.750 19.05	.50 12.70	.80 20.32	.45 11.43	.29 7.37	85.0	A8, B1, D6
TT100	.250 6.35	.310 7.87	.20 5.08	.100 2.54	.050 1.27	.035 .89	.040 1.02	.070 1.78	.270 6.86										.50	A14, F2
TT146	.250 6.35	.310 7.87	275 6.98	.100 2.54	.050 1.27	.055 1.40	.040 1.02	.070 1.78	.270 6.86										.50	A14, F3
UU102	3.50 88.90	2.00 50.80	.50 12.70	.150 3.81	3.350 85.09	1.00 25.4	.125 3.18	1.75 44.45	.20 5.08	.55 13.97									120.0	A10, C2 D17
VV105	.085 2.16	.060 1.52	.020 .51	.006 .15	.020 .51	.46 11.68													.015	A13, C4, E2
WW107	.018 .46	.10 2.54	.020 .51	.092 2.34	.085 2.16	.060 1.52	.006 .152	.020 .51	.025 .64										.015	A13, C4, E2, F4
XX112	.18 4.57	.06 1.52	.07 1.78	.40 10.16	.36 9.14	.050 1.27	.015 .38	.005 .13	.005 .13										.15	A15, E2
YY101	.75 19.05	.38 9.66	.20 5.08	.010 1.91	.020 .05	.050 1.27	.200 5.08	.075 1.91	.600 15.24	.47 11.94	.035 .89	.450 11.43	.100 2.54	.150 3.81					1.6	A13, E2, F5
YY109	.75 19.05	.38 9.66	.20 5.08	.010 1.91	.020 .05	.050 1.27	.200 5.08	.075 1.91	.600 15.24	.72 18.29	.16 4.05	— —	— —	— —					1.6	A13, E2
YY161	.75 19.05	.38 9.66	.28 7.11	.010 1.91	.020 .05	.050 1.27	.200 5.08	.075 1.91	.600 15.24	.47 11.94	.035 .89	.450 11.43	.100 2.54	.150 3.81					1.6	A13, E2, F6
ZZ121	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	.61 15.50	— —	.800 20.32	.800 20.32	.76 19.31	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				85.0	A10, B1, D6
AAA118	1.50 38.10	.50 12.70	.935 23.75	.040 1.02	1.100 27.94	.19 4.83	.400 10.16	.15 3.81	.600 15.24	.300 7.62	.20 5.08	.14 3.56							.034	A1, E1
BBB123	.145 3.69	.100 2.54	.04 1.02	.006 .152	.030 .762	.488 12.4													.015	A13, C5, E2
CCC127	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.74	.138 3.51	1.238 31.45	3.25 82.55	.12 3.05	.80 20.32	.69 17.53	1.60 40.64	.60 15.24	1.200 30.48	.52 13.21	.82 20.83	.150 3.81	80.0	A6, A11, D17

tolerance x ± .1 xx ± .03 xxx ± .015 inch

oz. = grams x.0353

*NOTES

A. MATERIAL AND FINISH

A1. Header material C. R. S. Pin material: #52 alloy Finish: electro tin, hot oil flowed. Cover material: cupro-nickel.

A6. Case material; aluminum alloy. Finish; blue paint over iridite.

A8. Case material; aluminum alloy. Finish; case iridite. Heat sink, black anodize.

A10. Case material; aluminum alloy Finish, grey paint.

A11. Case material; aluminum alloy. Finish, blue anodized.

A13. Case material; plastic. Lead finish, Tin plate.

A14. Case material; plastic. Leads: palladium platinum silver.

A15. Case material: kovar. Lead material: kovar. Finish: gold plate per MIL-G-45204.

B. MOUNTING

B1. Mounting bracket available on request. Add suffix B to part number.

C. MARKING

C2. Consecutive marking n = no. of way power splitter.

C4. RF Input lead (1) identified by diagonally cut lead; may additionally have orientation mark. Model dash number identified by color dot or alphanumeric code on case. See Specification Data Sheet.

C5. RF output is identified by index mark, model dash number by alphanumeric code.

D. CONNECTORS

D6. Connectors. Female SMA only. Male SMA available on request, consult factory.

D17. Connectors. Female SMA only.

E. SPECIAL TOLERANCES

E1. Pin diameter ± .005 inch.
E2. Lead width ± .010; lead thickness ± .005 inch.

F. PACKAGING

F1-15. Tape and reel packaging available. See pages 0-38 and 0-39 for details.

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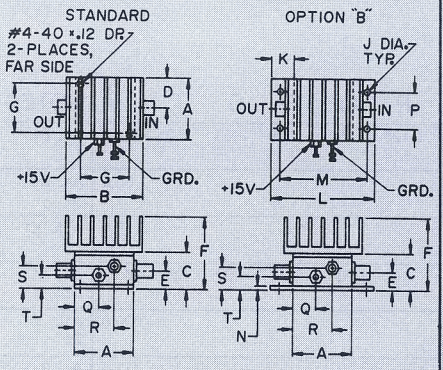
Mini-Circuits

SS



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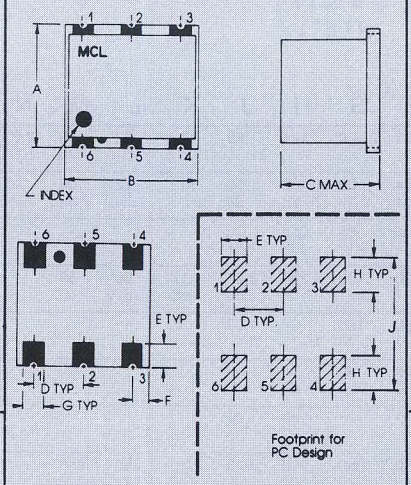

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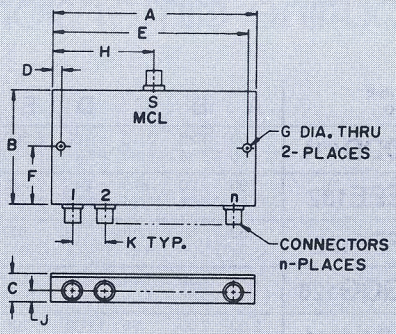

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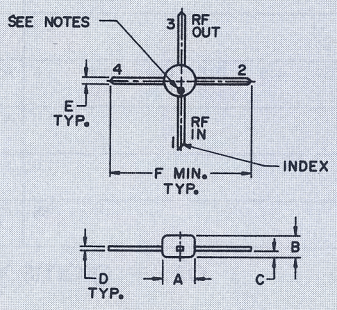

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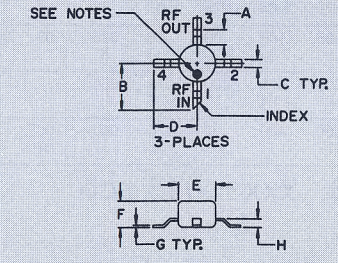

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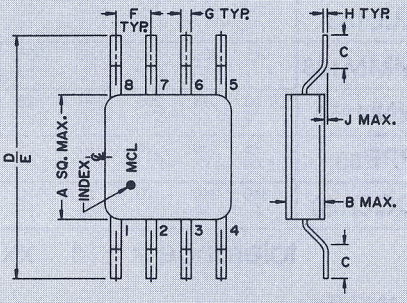

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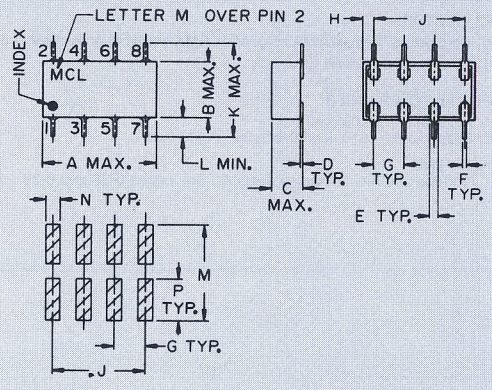

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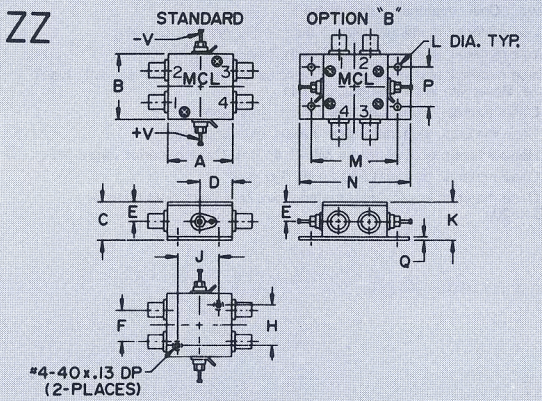

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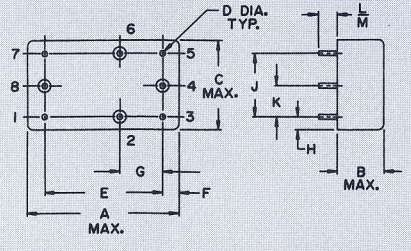

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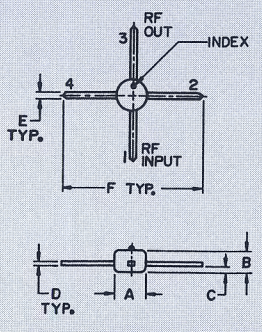

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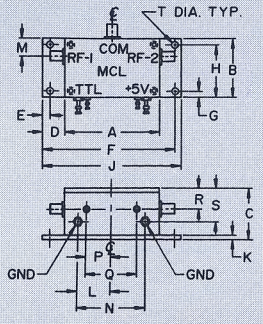

case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams.	NOTES*
DDD131	7.00 177.80	3.25 82.55	3.13 79.50	.25 6.35	6.500 165.10	.38 9.65	2.500 63.50	.144 3.66	.88 22.35	.73 18.54	.63 16.01	1.13 28.70	2.23 56.64	.125 3.18	.50 12.70	6.00 152.40	2.23 56.64	8.35 212.09	1884.0	A7, D6
EEE132	.90 22.86	.90 22.86	.675 17.15	.245 6.22	.45 11.43	1.34 34.04	.09 2.29	1.152 29.26	.09 2.29	.712 18.08	.22 5.59	.106 2.69	.05 1.27						50.0	A4, D6
FFF122	.83 21.08	.83 21.08	.18 4.57	.10 2.54	.100 2.540	.600 15.24	.95 24.13	.017 .432	.15 3.81										5.0	A15, E1
GGG126	2.25 57.15	1.38 35.05	1.24 31.50	.50 12.70	.150 3.81	3.100 78.7	.138 3.51	1.238 31.45	3.25 82.55	.12 3.05	.80 20.32	.69 17.53	— —	.60 15.24	1.200 30.48	.52 13.21	.82 20.83	.150 3.81	80.0	A6, A11 D17
HHH141	2.00 50.80	2.00 50.80	.95 24.13	1.000 25.40	.100 2.54	1.800 45.72	.125 3.18	.62 15.75	1.00 25.4	1.35 34.29									200.0	A10, C1 D6
III145	.770 19.56	.810 20.58	.380 9.66	.410 10.42	.030 .77	.200 5.08	.20 5.08	.14 3.56											11.0	A1, E1
JJJ142	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	.32 8.13	— —	.80 20.32	.80 20.32										70.0	A10, D17
KKK155	.32 8.13	.445 11.30	.090 2.29	.006 .152	.012 .31	.070 1.78	.050 1.270	.010 .254	.015 .380	.030 .762	.050 1.270	.050 1.270							.40	A13, F7
LLL163	.360 9.14	.400 10.16	.350 8.89	.020 .51	.016 .41	.040 1.02	.020 5.08												2.9	A12. C3
MMM168	.045 1.14	.053 1.35	.110 2.79	.120 3.05	.035 .89	.005 .13	.089 2.26	.104 2.64	.070 1.78	.080 2.03	.018 .46	.022 .56	.030 .76	.033 .84	.015 .38	.018 .46	.024 .61	.006 .15	1.0	A13, F8
NNN150	.50 12.70	.48 12.20	.255 6.48	.240 6.10	.23 5.85	.21 5.34	.06 1.53	.100 2.54	.09 2.29	.16 4.06	.020 .51	.09 2.29	.005 .13						1.9	A1, E1, F9
PPP83	.75 19.05	.38 9.65	.20 5.08	.010 .25	.05 1.27	.020 .51	.200 5.08	.075 1.91	.200 5.08	.14 3.56	.060 1.532								1.6	A13, E2
QQQ130	.310 7.87	.310 7.87	.20 5.08	.10 2.54	.010 .25	.100 2.54	.050 1.27	.400 10.16	.42 10.67	.120 3.05	.060 1.52	.100 2.54							.55	A13, E2, F10

tolerance x ± .1 xx ± .03 xxx ± .015 inch

oz. = grams x.0353

*NOTES

A. MATERIAL AND FINISH

A1. Header material C. R. S. Pin material: #52 alloy. Finish: electro tin, hot oil flowed. Cover material: cupro-nickel.

A4. Case material; aluminum alloy. Finish; iridite per MIL-C-5541.

A6. Case material; aluminum alloy. Finish; blue paint over iridite.

A7. Case material; aluminum alloy. Finish; case black paint. Heat sink; black anodize. Baseplate iridite per MIL-C-5541.

A10. Case material; aluminum alloy Finish, grey paint.

A11. Case material; aluminum alloy. Finish, blue anodized.

A12. Header finish; gold plate per MIL-G-45204. Case material; cupro-nickel.

A13. Case material; plastic. Lead finish, Tin plate.

A15. Case material: kovar. Lead material: kovar. Finish: gold plate per MIL-G-45204.

C. MARKING

C1. For port markings 1, 2, and 3 see specification data sheet.

C3. For Pin designations see specification data sheet.

D. CONNECTORS

D6. Connectors. Female SMA only. Male SMA available on request, consult factory.

D17. Connectors. Female SMA only.

E. SPECIAL TOLERANCES

E1. Pin diameter ±.005 inch.
E2. Lead width ±.010; lead thickness ±.005 inch.

F. PACKAGING

F1-15. Tape and reel packaging available. See pages 0-38 and 0-39 for details.

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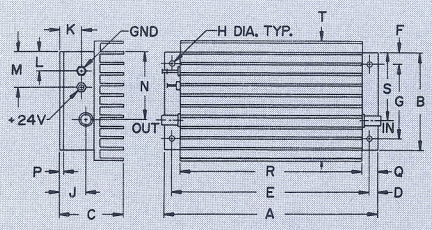
DDD



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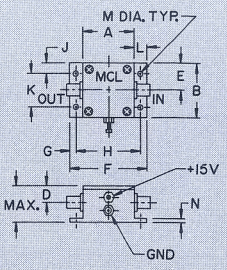

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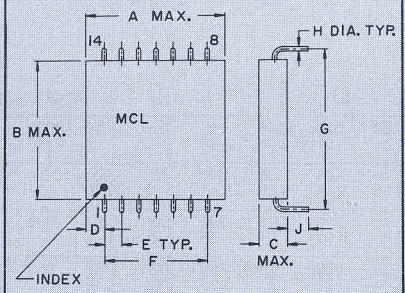

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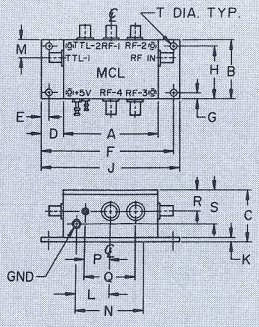

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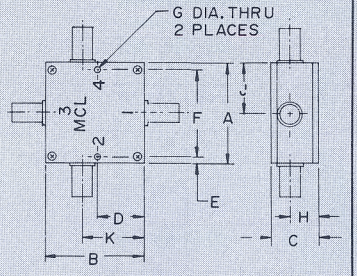

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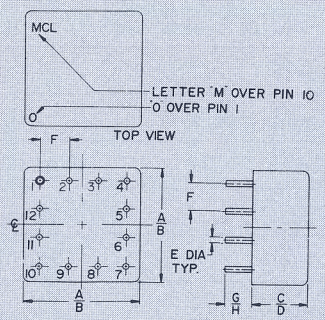

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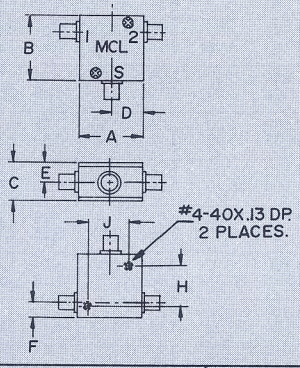

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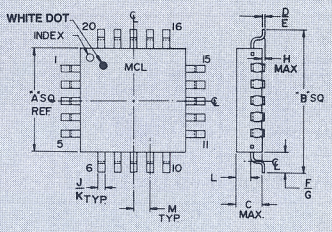

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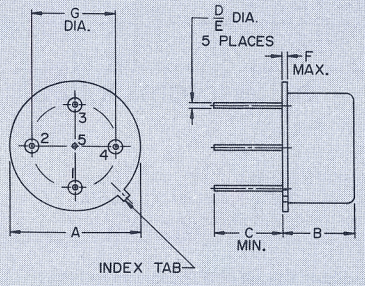

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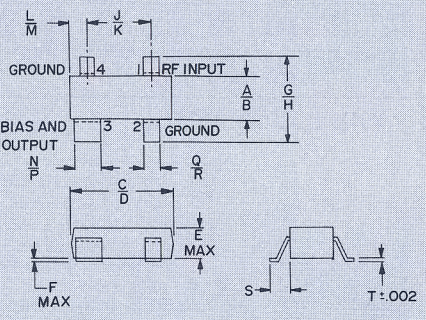
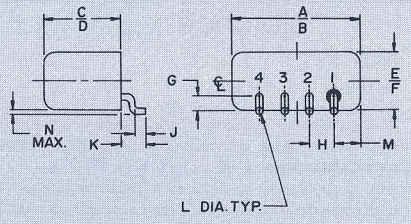


NNN

NOTE:
BLUE BEAD INDICATES PIN "1".
PIN NUMBERS DO NOT APPEAR
ON UNIT. FOR REFERENCE ONLY.



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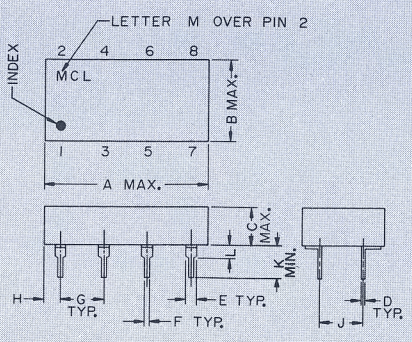

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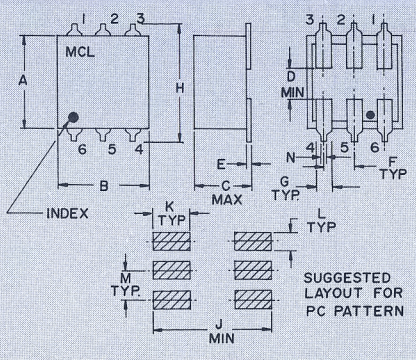
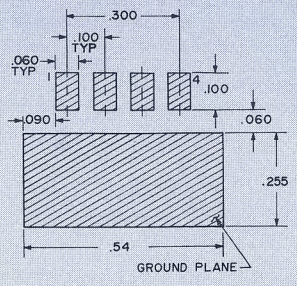




In Stock...Immediate Delivery

case styles

outline dimensions (inch / mm)

case no.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	wt. grams.	NOTES*
RRR137	.28 7.11	.14 3.56	.030 .76	.020 .51	.145 3.68	.110 2.80	.006 .15	.010 .25	.030 .76										.015	A13, C5 E2, F11
SSS173	1.25 31.75	1.25 31.75	.75 19.05	.63 16.01	.38 9.66	1.000 25.40	.125 3.18	1.000 25.40	— —	— —	.125 3.18	1.688 42.88	2.18 55.38	.75 19.05	.07 1.78				75	A10, D17
TTT166	.375 9.53	.500 12.7	.15 3.81	.020 0.51	.075 1.91	.250 6.35	.325 8.26	.187 4.76	.050 1.27	.050 1.27	.070 1.78	.270 6.86	.540 13.72	.060 1.52	.095 2.41	.445 11.30	.208 5.28	.415 10.54	.8	A14, F12
TTT167	.375 9.53	.500 12.7	.23 5.84	.020 0.51	.075 1.91	.250 6.35	.325 8.26	.187 4.76	.050 1.27	.050 1.27	.070 1.78	.270 6.86	.540 13.72	.060 1.52	.095 2.41	.445 11.30	.208 5.28	.415 10.54	.8	A14, F13
UUU179	8.50 215.90	3.95 100.33	.75 19.05	.250 6.35	8.250 209.55	.475 12.06	.187 4.76	3.475 88.27	.38 9.65	.500 12.70	4.250 107.95	.500 12.70							282	A4, D17
VVV180	1.80 45.72	1.75 44.45	.66 16.77	.125 3.18	1.675 42.55	.125 3.18	.125 3.18	1.675 41.28	.31 7.88	.63 16.00	1.13 28.70	.88 22.35							34	A4, D17
WWW181	2.30 58.42	2.25 57.15	.66 16.77	.125 3.18	2.175 55.25	.125 3.18	.125 3.18	2.125 53.98	.31 7.88	1.13 28.70	.63 16.00	1.13 28.70	1.63 41.66						51	A4, D17
XXX182	2.80 71.12	2.25 69.85	.66 16.77	.125 3.18	2.675 67.95	.125 3.18	.125 3.18	2.625 66.68	.31 7.88	1.38 35.05	.63 16.00	1.13 28.70	1.63 41.66	2.13 54.10					67	A4, D17
YYY183	1.26 32.00	1.00 25.40	.75 19.05	1.060 26.92	.200 5.08	.200 5.08	.125 3.18	.38 9.65	.35 8.89	.88 22.35	.63 16.00								24	A4, D17, B1
ZZZ184	2.26 57.40	2.00 50.8	.75 19.05	.200 5.08	2.060 53.32	.200 5.08	.125 3.18	.38 9.65	.35 8.89	.88 22.35	1.38 35.05	1.88 47.75	1.13 28.70						59	A4, D17
AB185	4.76 120.90	3.00 76.20	.53 13.46	.150 3.81	4.610 117.09	1.500 38.10	.125 3.18	.50 12.70	.25 6.35	1.13 28.70	.500 12.70								183	A4, D17
AC186	4.76 120.90	3.00 76.20	.63 13.46	.150 3.81	4.610 117.09	1.500 38.10	.125 3.18	.38 9.65	.25 6.35	.500 12.70									153	A4, D17
AD187	6.00 152.40	1.62 41.15	.88 22.35	.250 6.35	5.750 146.05	.810 20.54	.144 3.66	.50 12.70	.44 11.18	3.00 76.20	1.00 25.40								274	A4, D23
AE188	3.50 88.90	2.13 54.10	.88 22.35	.150 3.81	3.350 8.04	1.06 26.92	.125 3.18	.41 10.41	.44 11.18	.89 22.61	1.75 44.45								184	A4, D23
AF190	.180 4.57	.090 2.89	.020 0.51	.100 2.54	.083 2.11	.076 1.93	.005 0.13	.022 0.56											.04	A16, C6 E3, F14
AG191	.310 7.87	.400 10.16	.095 2.41	.003 0.08	.007 0.18	.035 0.89	.055 1.40	.020 0.51	.050 1.27										.40	A17, C7 E4, F15
AH202	.375 9.53	.500 12.70	.25 6.35	.020 0.51	.035 0.89	.050 1.27	.140 3.56	.180 4.58	.320 8.13	.360 9.15	.450 11.43	.465 11.81	.095 2.42	.135 3.43	.240 6.10	.280 7.12			.80	A13
AJ204	6.13 155.70	3.00 76.20	.53 13.46	.162 4.12	5.962 151.44	1.500 38.10	.180 4.57	.50 12.70	.25 6.35	1.13 28.70	.50 12.70								153	A4, C2, D17

tolerance x ± .1 xx ± .03 xxx ± .015 inch **oz. = grams x .0353**

*NOTES:

A. MATERIAL AND FINISH
- A4. Case material: aluminum alloy. Finish: iridite per MIL-C-5541.
- A10. Case material: aluminum alloy. Finish: grey paint.
- A11. Case material: aluminum alloy. Finish: blue anodized.
- A13. Case material: plastic. Lead finish. Tin plate.
- A14. Case material: plastic. Leads: palladium platinum sliver.
- A16. Case material: ceramic. Lead material: #42 alloy; Finish: tin plate.
- A17. Case material: CRS. Lead material: kovar. Finish: gold plate 50 micro inches

B. MOUNTING
- B1. Mounting bracket available on request. Add suffix B to part number.

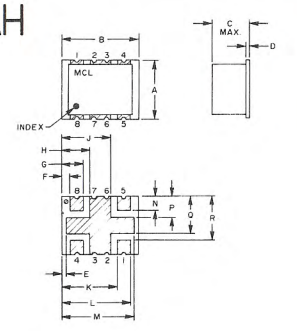
C. MARKING
- C5. RF output is identified by index mark.
- C6. RF input lead (1) identified by diagonally cut lead. Orientation is also indicated by underline in marking.
- C7. lead #1 is identified by diagonally cut lead, located near letter M in marking.

D. CONNECTORS
- D17. Connectors; Female SMA only.
- D23. Connectors. Please specify female type N or SMA.

E. SPECIAL TOLERANCES
- E2. Lead width ±.010; lead thickness ±.005 inch.
- E3. Lead width ±.005; lead thickness ±.002; cap diameter ±.005 inch.
- E4. All tolerances are ±.005 except where minimum or maximum limits are shown.

F. PACKAGING
- F1-15. Tape and reel packaging available. See pages 0-38 and 0-39 for details.

AH



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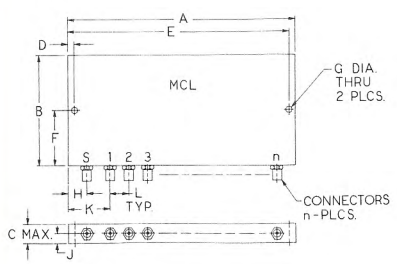

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outline drawings

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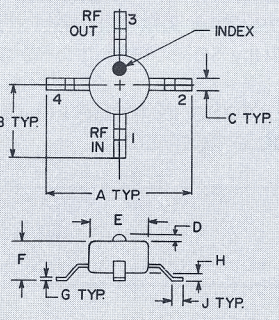
RRR



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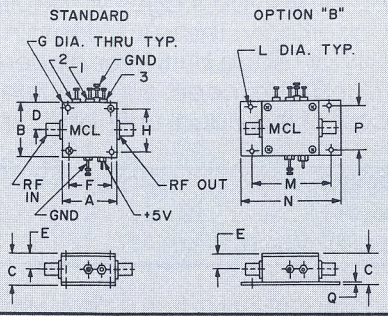

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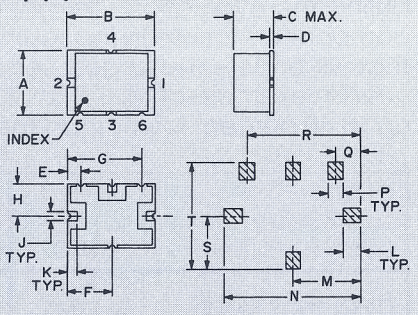

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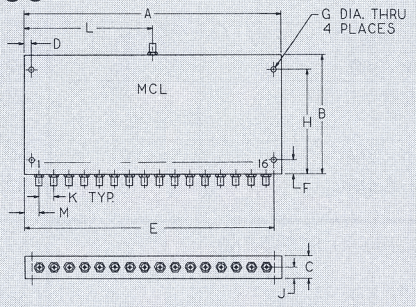

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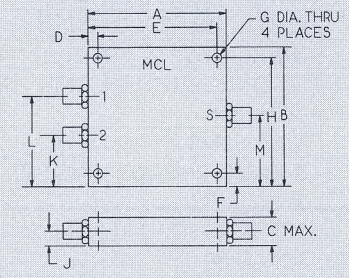

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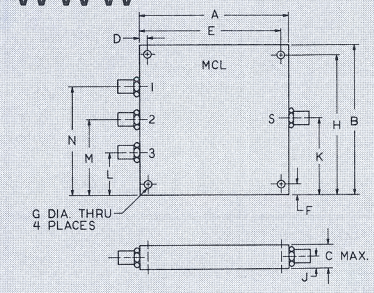

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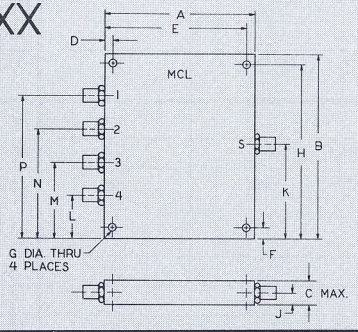

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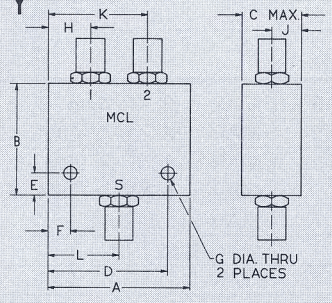

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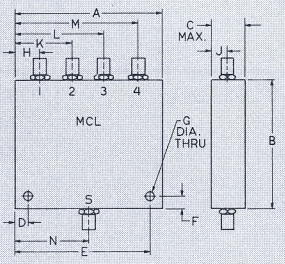

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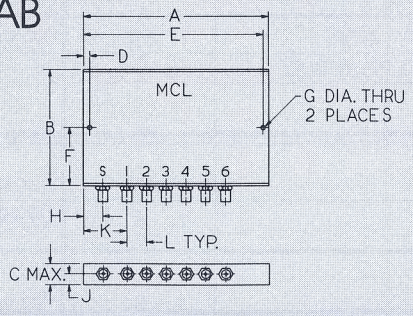

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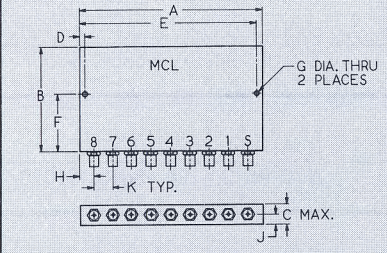

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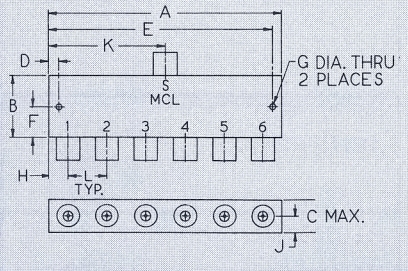

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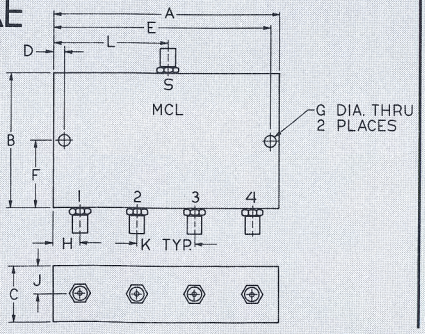

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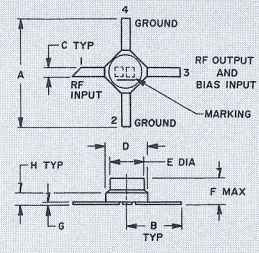

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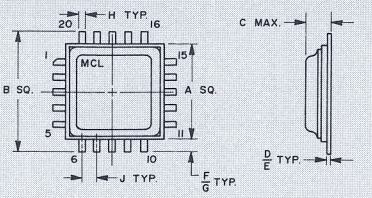

In Stock...Immediate Delivery

designers kits

Mini-Circuits offers a wide range of plug-in and surface-mount component kits to aid the engineer during the evaluation, design, and prototype stages. In addition, there are kits offered to provide components for use in the testing laboratory. These kits contain a carefully-selected group of models that will enable the largest versatility of usage by the engineer.

As an example of Mini-Circuit's quest to exceed our customer's expectations, these kits are priced up to 40 percent lower than the cost of individual units and are available from stock.

TYPE	KIT NO.	QTY. EACH MODEL	MODEL NUMBERS	TOTAL QUANTITY UNITS	PRICE
FREQUENCY MIXERS	K-SYM*	1	SYM-2, -11, -860, -11LH, 11MH, 11H	6	59.95
	K-TUF*	1	TUF-1, 1SM, -2, -2SM, -3, -3SM, -5, -5SM, -11A, -11ASM, -860, -860SM	12	79.95
	K1-RMS*	1	RMS-1, -1W, -2, -2D, -2U, -5, -11A, -860	8	59.95
	K1-LRMS*	1	LRMS-1, -1W, -2, -2D, -2U, -5, -11A, -860	8	59.95
	K2-LRMS*	1	LRMS-1LH, -2LH, 5LH, -1MH, -2MH, 5MH, -1H, -2UH, -5H	9	89.95
	K-SM*	2	SYM-2, RMS-2, LRMS-2, SCM-2, TUF-2SM	10	59.95
	K-860*	2	SYM-860, RMS-860, LRMS-860, TUF-860SM	8	82.60
POWER SPLITTERS	K1-PS*	1	SCP-2-1A, SCP-3-1, SCPQ-21.4, SCPQ-90, SCPQ-180, SCPQ-400	6	59.95
	K2-PS	1	PSCQ-2-21.4, -2-50, -2-90, -2-180, -2-250, -2-400	6	99.95
	K3-PS	2	PSC-2-1-75, -3-1-75, -4-1-75	6	99.95
	K4-PS	2	PSC-2-1, PSCJ-2-1, AND 1 EACH PSC-3-1A, PSC-4-3	6	99.95
AMPLIFIERS	DAK-2	5	MAR-1, -2, -3, -4, -6, -7, -8	35	59.95
	DAK-2SM*	5	MAR-1SM, -2SM, -3SM, -4SM, -6SM, -7SM, -8SM	35	61.95
	DAK-3*	3	MAR-1, -1SM, -2 -2SM, -3, -3SM, -4, -4SM MAR-6, -6SM, -7, -7SM, -8, -8SM, MAV-11, -11SM	48	59.95
	K1-MAN	1	MAN-1LN, 1HLN, -1, -2	4	59.95
	K2-MAN	1	MAN-1AD, 11AD, 2AD	3	59.95
	K-ZFL	1	ZHL-6A, ZFL-1000, ZFL-2000	3	395.00
CHIP CAPACITORS	KCAP-1	50	10PF, 22PF, 47PF, 68PF, 100PF, 220PF, 470PF,	850	99.95
			680PF, 1000PF, 2200PF, 4700PF, 6800PF, .010UF,		
			.022UF, .047UF, .068UF, .100UF		
DIGITAL STEP ATTENUATORS	K-TOAT	1	TOAT-124, -3610, -51020	3	149.95
	K-ZFAT	1	ZFAT-R512, -124, -3610, -51020	4	299.95
ELECTRONIC ATTENUATORS	K-PAS	1	PAS-1, -3, -2000	3	99.95

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TYPE	KIT NO.	QTY. EACH MODEL	MODEL NUMBERS	TOTAL QUANTITY UNITS	PRICE
FIXED ATTENUATORS/ TERMINATIONS	K1-AT	4	AT-3, -6, -10, -20	16	49.95
	K2-AT	1	AT-1, -2, -3, -4, -5, -6, -7, -8, -9, -10, AT-12, -15, -20, -30, -40, -3-75, -6-75, AT-10-75, -15-75, -20-75	20	49.95
	K1-MAT	2	MAT-3, 6, 9, 10, 12, 15, 20, 40	16	49.95
	K2-MAT	1	MAT-1, -2, -3, -4, -5, -6, -7, -8, -9 MAT-10, -12, -15, -20, -25, -30, -40	16	49.95
	K1-CAT	2	CAT-3, -6, -10, -20	8	89.95
	K2-CAT	1	CAT-1, -2, -3, -4, -5, -6, -7, -8, -9, CAT-10, -12, -15, -20, -30, -40	15	199.95
	K-CAT-75	1	CAT-3-75, -6-75, -10-75, -15-75, -20-75	5	74.95
	K1-SAT	2	SAT-3, -6, -10, -20	8	109.95
	K2-SAT	1	SAT-1, -2, -3, -4, -5, -6, -7, -8, -9, SAT-10, -12, -15, -20, -30, -40	15	219.95
	K-NAT	2	NAT-3, -6, -10, -20	8	149.95
	K-TRM	2	BTRM-50, STRM-50, NTRM-50	6	49.95
DIRECTIONAL COUPLERS	K1-DC	1	ZFDC-10-5, -15-5, -20-5 (BNC CONNECTORS)	3	199.95
	K2-DC	1	ZFDC-10-1, -20-4	2	89.95
	K3-DC	1	PDC-10-6, -15-21, -20A-5	3	79.95
	K4-DC	1	PDC-10-1-75, -15-6-75, 20-3-75, 20-6-75	4	59.95
	K5-DC	1	PDC-10-1, -10-54, -10-6	3	53.95
	K6-DC	1	ZFDC-10-21-75, -20-3-75, -3375 (BNC CONNECTORS)	3	119.95
	K7-DC	1	ZEDC-10-2B, -15-2B, ZFDC-20-4 (SMA CONNECTORS)	3	149.95
FILTERS	K-SCF*	1	SCLF-21.4, -30, -45, -135, -190, -380, -420	7	59.95
	K-PHP	1	PHP-50, -100, -150, -175, -200, -250, -300, PHP-400, -500, -600, -700, -800, -900, -1000	14	149.95
	K-LHP	1	SLP-50, -100, -300, -550, -1000, SHP-200, -400, -700	8	249.00
	K-PLP	1	PLP-5, -10.7, -21.4, -30, -50, -70, -90, PLP-100, -150, -200, -250, -300, -450, -550, PLP-600, -750, -800, -850, -1000, -1200	20	159.95
PHASE DETECTORS	K-PD*	1	MPD-1, MPD-2, MPD-21, SYPD-1, SYPD-2	5	79.95
SWITCHES	K1-KSW*	1	KSW-2-46, KSWA-2-46, KSWHA-1-20	3	99.95
	K-YSW*	2	YSW-2-50DR, YSWA-2-50DR	4	59.95
	K2-KSW*	1	KSW-2-46, KSWA-2-46, KSWHA-1-20, YSW-2-50DR, YSWA-2-50DR	5	124.95
	K-ZFSW	1	ZFSW-2-46, ZFSWA-2-46	2	139.95
RF TRANSFORMERS	TTK-1	2	TT1-6, 1.5-1, 2.5-6, 4-1, 4-1A, 16-1, 25-1	14	79.95
	TK-5	2	T1-1T, T1-6T, T2-1T, T2.5-6T, T3-1T, T4-1T,	22,	79.95
			T4-6T, T5-1T, T8-1T, T13-1T, T16-6T		
	TK-6	2	T1-1, 1.18-3, 1-6, 1.5-1, 1.5-6, 2.5-6, 4-6,	20	79.95
			9-1, 16-1, 36-1		
	THK-1	3	T1-1H, T4-1H AND 2 EACH T9-1H, T16-1H	10	59.95
	TMK-2	2	TMO-1-1, -2-1, -4-1, -9-1, -16-1	10	59.95

NOTES: * KITS CONTAINING SURFACE-MOUNT UNITS.
(1) AVAILABLE FROM MINI-CIRCUITS DISTRIBUTOR CENTERS.
(2) SORRY, NO SUBSTITUTIONS ALLOWED.
(3) PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

dBm - volts - watts conversion

(50-ohm system)

dBm	V	P_o	dBm	V	P_o	dBm	mV	P_o	dBm	µV	P_o
+53	100.0	200W	0	.225	1.0 mW	–49	0.80		–98	2.9	
+50	70.7	100W	–1	.200	.80 mW	–50	0.71	.01 µW	–99	2.51	
+49	64.0	80W	–2	.180	.64 mW	–51	0.64		–100	2.25	.1 pW
+48	58.0	64W	–3	.160	.50 mW	–52	0.57		–101	2.0	
+47	50.0	50W	–4	.141	.40 mW	–53	0.50		–102	1.8	
+46	44.5	40W	–5	.125	.32 mW	–54	0.45		–103	1.6	
+45	40.0	32W	–6	.115	.25 mW	–55	0.40		–104	1.41	
+44	32.5	25W	–7	.100	.20 mW	–56	0.351		–105	1.27	
+43	32.0	20W	–8	.090	.16 mW	–57	0.32		–106	1.18	
+42	28.0	16W	–9	.080	.125 mW	–58	0.286				
+41	26.2	12.5W	–10	.071	.10 mW	–59	0.251		**dBm**	**nV**	
+40	22.5	10W	–11	.064		–60	0.225	.001 µW	–107	1000	
+39	20.0	8W	–12	.058		–61	0.200		–108	900	
+38	18.0	6.4W	–13	.050		–62	0.180		–109	800	
+37	16.0	5W	–14	.045		–63	0.160		–110	710	.01 pW
+36	14.1	4W	–15	.040		–64	0.141		–111	640	
+35	12.5	3.2W	–16	.0355					–112	580	
+34	11.5	2.5W				**dBm**	**µV**		–113	500	
+33	10.0	2W	**dBm**	**mV**		–65	128		–114	450	
+32	9.0	1.6W	–17	31.5		–66	115		–115	400	
+31	8.0	1.25W	–18	28.5		–67	100		–116	355	
+30	7.10	1.0W	–19	25.1		–68	90		–117	825	
+29	6.40	800 mW	–20	22.5	.01 mW	–69	80		–118	285	
+28	5.80	640 mW	–21	20.0		–70	71	.1 nW	–119	251	
+27	5.00	500 mW	–22	17.9		–71	65		–120	225	.001 pW
+26	4.45	400 mW	–23	15.9		–72	58		–121	200	
+25	4.00	320 mW	–24	14.1		–73	50		–122	180	
+24	3.55	250 mW	–25	12.8		–74	45		–123	160	
+23	3.20	200 mW	–26	11.5		–75	40		–124	141	
+22	2.80	160 mW	–27	10.0		–76	35		–125	128	
+21	2.52	125 mW	–28	8.9		–77	32		–126	117	
+20	2.25	100 mW	–29	8.0		–78	29		–127	100	
+19	2.00	80 mW	–30	7.1	.001 mW	–79	25		–128	90	
+18	1.80	64 mW	–31	6.25		–80	22.5	.01 nW	–129	80	.1 *f*W
+17	1.60	50 mW	–32	5.8		–81	20.0		–130	71	
+16	1.41	40 mW	–33	5.0		–82	18.0		–131	61	
+15	1.25	32 mW	–34	4.5		–83	16.0		–132	58	
+14	1.15	25 mW	–35	4.0		–84	11.1		–133	50	
+13	1.00	20 mW	–36	3.5		–85	12.9		–134	45	
+12	.90	16 mW	–37	3.2		–86	11.5		–135	40	
+11	.80	12.5 mW	–38	2.85		–87	10.0		–136	35	
+10	.71	10 mW	–39	2.5		–88	9.0		–137	33	
+9	.64	8 mW	–40	2.25	.1 µW	–89	8.0		–138	29	
+8	.58	6.4 mW	–41	2.0		–90	7.1	.001 nW	–139	25	
+7	.500	5 mW	–42	1.8		–91	6.1		–140	23	.01 *f*W
+6	.445	4 mW	–43	1.6		–92	5.75				
+5	.400	3.2 mW	–44	1.4		–93	5.0				
+4	.355	2.5 mW	–45	1.25		–94	4.5				
+3	.320	2.0 mW	–46	1.18		–95	4.0				
+2	.280	1.6 mW	–47	1.00		–96	3.51				
+1	.252	1.25 mW	–48	0.90		–97	3.2				

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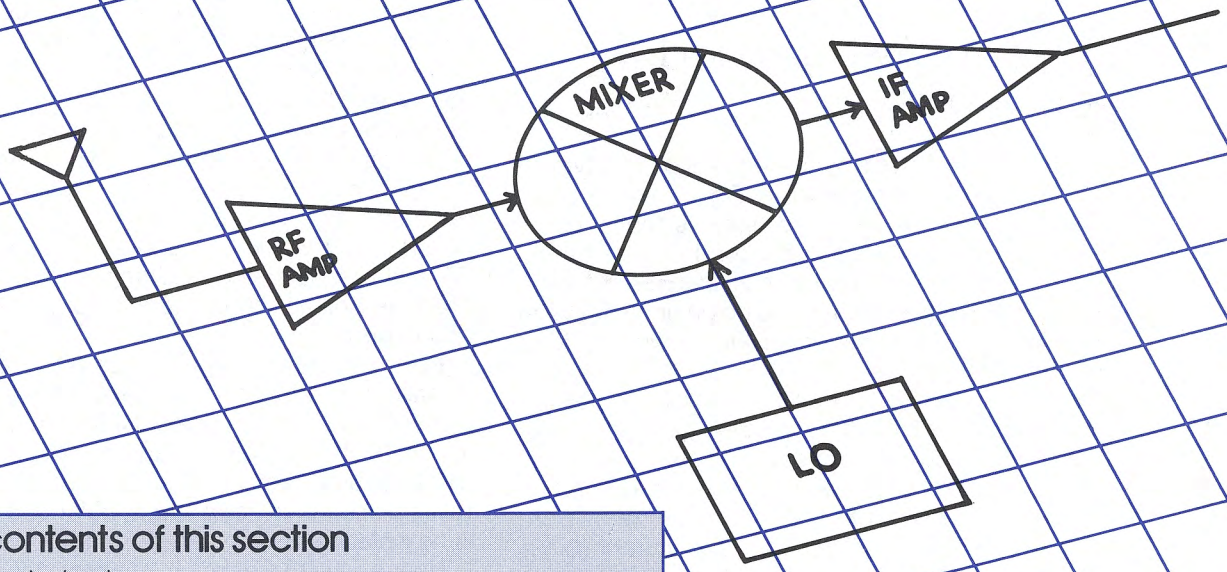
FREQUENCY MIXERS



contents of this section

technical

understanding mixers . . . . . 1-2 thru 1-7
definition of mixer terms 1-8, 1-9
select the proper mixer . . . . . 1-10 thru 1-17
improved two-tone, third order testing . . . . 1-18 thru 1-22
applications 1-23, 1-24
most often asked questions . . . . . 1-25 thru 1-29
specifications check list
a guide form for requirements 1-11

product specifications

active 1-30, 1-31
level 3 models 1-33
level 7 surface mount models 1-34, 1-35
level 7 pin models 1-36, 1-37
level 7 connector models 1-38, 1-39
level 10 & 13, broadband models 1-40, 1-41
level 17 very high dynamic range models 1-42
level 17S very low distortion models 1-43
level 23 ultra low distortion models 1-44
level 23S & 27, ultra low distortion models 1-45

computer data and curves

CAPD information . . . . . 1-46 thru 1-340

understanding mixers

double-balanced mixers

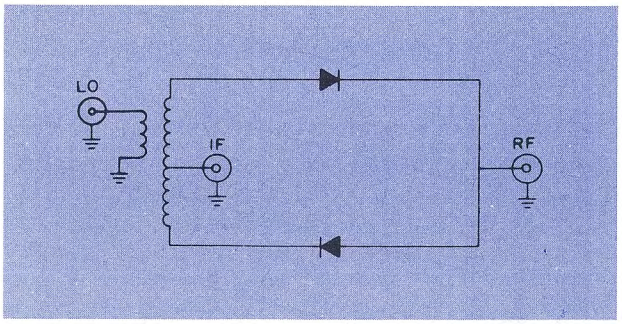
(DBMs) have become a standard component in communications systems, microwave links, spectrum analyzers and ECM equipment. Used properly, DBMs allow systems designers to achieve minimum levels of distortion with a high degree of isolation from interfering signals. However, used improperly, DBMs can degrade systems performance. Similarly, incorrect interpretation of mixer specifications can be costly. Underspecify and expect marginal performance; overspecify and pay for unnecessary device characteristics.

To properly apply and specify a double-balanced mixer, it is helpful to understand how it works, what factors influence distortion and how performance is measured. Also included are a number of practical application suggestions.

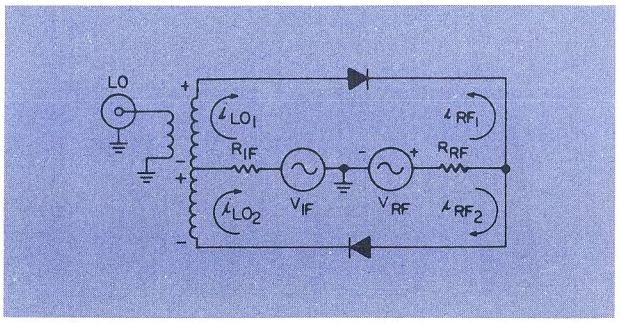
how a single-balanced mixer works

To begin, let's analyze a simplified version of a typical single-balanced mixer, shown in Fig. 1. The characteristic of the single-balanced mixer is that there is isolation between the local oscillator (LO) and the RF, attributable to the inherent circuit balance between the LO and RF. However, there is no balance between the RF and IF; examination of Fig. 2 with its loop currents explains why.

When the LO signal is applied, assume the polarity shown on the LO input-transformer; the direction of LO currents would then appear as shown for i_{LO1} and i_{LO2}. The total current through the IF and RF source resistances consists of the sum of the currents from the LO and RF inputs. First, consider what happens when the LO signal is applied. With the polarity shown



1. A single-balanced mixer offers good isolation between LO and RF but poor isolation between RF and IF.



2. Examination of loop currents in a single-balanced mixer explains poor RF to IF isolation.

at the LO transformer secondary, current flow is clockwise for i_{LO1} and i_{LO2}. These currents flow through the RF and IF source resistances. Looking at the current flow through the RF source resistance R_{RF}, there would be complete cancellation of the LO component (assuming the i_{LO} currents were exactly identical in amplitude and phase). Similarly, examining the local oscillator (LO) current flow through the IF source resistance, R_{IF}, again cancellation would occur. Thus no LO power would be developed at either the IF or RF outputs. The single-balanced mixer, therefore, provides isolation from the LO port, to both the RF and IF ports.

Now, let's analyze what takes place when the RF signal is applied. Assuming the polarity shown for the RF source, two mesh currents will flow, i_{RF1} and i_{RF2} as shown. Both i_{RF1} and i_{RF2} add as they pass through the IF source resistance, R_{IF}, and no cancellation takes place. Thus, for a single-balanced mixer, there is no isolation between the RF and IF ports.

How about the balance between the RF and LO ports? Since i_{RF1} flows through the upper winding of the LO transformer in the opposite direction as i_{RF2} in the lower winding, no voltage would be developed at the LO port, thus providing isolation.

All previous references to conditions of balance are based on currents being equal in amplitude. In actual practice, the following factors tend to upset the ideal conditions. Variations in transformer balance and unequal diode impedance will cause deviations in current balance. At high frequencies, above 100 MHz, wiring capacitance, transformer winding capacitance and physical location of components will also upset balance. As operating frequency increases, balance will fall off and a lower isolation specification will appear on the mixer data sheet.

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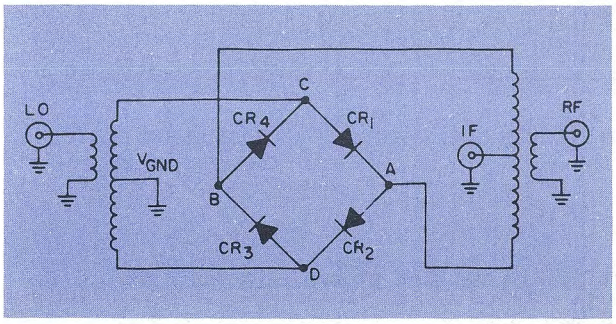
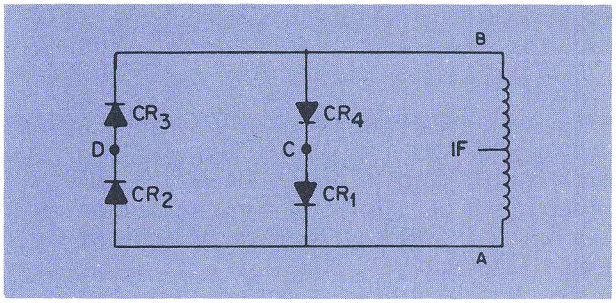


3. The symmetry of a double-balanced mixer's configuration is the key to the excellent isolation offered between LO, RF and IF ports.



4. IF leakage to RF and LO ports are minimized in a dbm by use of balanced transformers and matched diodes.

double-balanced mixers offer improved isolation

A typical schematic for a double-balanced mixer is shown in Fig. 3. Let's now examine how balance is achieved. If CR_1, and CR_2 and the LO transformer are symmetrical, then the voltage at point A is the same as the center-tap of the transformer, or ground. Similarly, if CR_3 is equal to CR_4, the voltage at B is the same as V_{GND}. Therefore, there is no voltage across A & B and no voltage across the RF or IF ports. This illustrates how isolation is obtained between LO and RF and IF ports.

Now let's look at the RF input. If CR_4 is equal to CR_1 and CR_2 equal to CR_3, the voltage at C will be equal to that at D. There will be no voltage difference between C-D and thus no RF will appear at the LO port. From symmetry, it can be seen that the voltage at the IF port is the same as the voltage at C, D or zero; thus there is no RF output at the IF port. The simplified sketch for the above is shown in Fig. 4.

Again assumptions for balance are based on transformer symmetry and diodes being equal.

get the most from mixers

As with single-balanced mixers, unbalance and a subsequent drop in isolation will result from diode junction capacity differences and transformer winding variations. Here's a rule-of-thumb approximation for isolation: as frequency of operation is increased, isolation tends to fall off at the rate of 5 dB per octave. Thus, for example, if you were to measure 40 dB isolation at 300 MHz, you could predict isolation of 45 dB at 150 MHz by using the 5 dB per octave estimate.

Whether the RF has a positive polarity or negative polarity, the inherent response of the DBM circuit is the same. For example, if a sine wave is applied, there would not be a lower conversion loss if the input was positive and a higher conversion loss for a negative-going input; the response is equal and independent of RF signal polarity. Again, it is assumed the diode characteristics are symmetrical for positive and negative input signal polarities.

Basically, the three major considerations of the double-balanced mixer are the inherent isolation between the various ports, as summarized in Table 1. The implications of these isolation properties appear in the variety of applications to which the double-balanced mixer can be used.

Another inherent characteristic of a DBM that suggests an area of application is the fact that the IF point is DC coupled to the diodes. This has two significant implications: (1) the frequency response is from DC to some very high frequency, which lends itself to use as a phase detector in phase-locked loop arrangements and (2) the high isolation between ports enables the DBM to be used as an electronic switch or attenuator. If the excellent balance between ports is deliberately upset so that isolation is degraded, some feedthrough would take place. The degree of feedthrough or isolation can be set by applying a DC current or voltage at the IF port. The resultant unbalance determines the level of attenuation. Typically, 10 to 20 mA current will change the insertion loss between LO and RF to as low as 3 dB or less. As the current through the IF port is varied, the balance between LO and RF will be altered; a predetermined amount of current will establish a preset degree of attenuation. Since the IF port response extends from DC to some very high frequency, very fast switching or change of attenuation characteristics is practical. Present-day switching techniques using PIN diodes as switches are not practical at lower frequencies because the PIN characterstics are lost below 1 MHz. With a DBM, satisfactory attenuator performance can be attained down to 500 Hz.

The disadvantage of the DBM in switching/attenuator application is the generation of harmonics of the

understanding mixers

Table 1. PROPERTIES OF DOUBLE-BALANCED MIXERS

PROPERTIES	IMPLICATIONS
■ Inherent isolation between LO & RF, IF ports	■ No filters necessary—thus broadband
■ Inherent isolation between RF & LO, IF ports	—can be used for suppressed-carrier modulation
■ Inherent isolation between IF & LO, RF ports	
■ IF DC coupled	**■ Can be used as phase detector**
■ Isolation depends on symmetry of transformers and diodes	■ High isolation—can be used as electronic switch/attenuator by injecting DC current to cause unbalance
■ Response to RF input same for either polarity of RF signal amplitude	**■ High rejection of even-order harmonics**

RF input, which may be undesirable in some designs.

Consider three different devices (not just mixers), as shown in Fig. 5, with a sine-wave input applied to each. In case (A)., the output of the linear device will be identical in waveform, although not necessarily in amplitude. In case (B)), unsymmetrical distortion due to unequal voltage sensitivity would develop an output that is flat-topped on one half cycle. And finally, non-voltage-polarity sensitive device could produce symmetrical flattening as shown in case (C). Mathematically, the output of case (A) is a constant K_1 times the input. In case (B), as a first approximation, the output is a constant K_2 times the input plus another constant K_2 times the input squared. In case (C), where distortion is symmetrical, the output is in the form of a constant K_1 times the input plus another constant K_3 times the cubic of the input. Case (C) applies for the double-balanced mixer where all circuit elements are balanced and distortion is uniform for both voltage polarities of the signal. The important point here is that the output of a DBM can be described, on first approximation, as a cubic. In practice, of course, no device is perfect and unbalances will occur. This means that, along with the cubic term, there will also appear second, fourth, etc. terms with the third-order the predominant term. In the double-balanced mixer, a third-order term will always exist because of some limiting factors that determine the saturation of the mixer, namely the diodes and transformer.

Even when only one input signal at the RF port combines with the LO signal, harmonic intermodulation and distortion will occur. The interaction of the LO and its harmonics with the RF input signal and its harmonics produce higher-order distortion products as shown in Table 2, for models SRA-1, SRA-2, ZAD-1 and ZAD-2. The distortion levels are indicated by the number of dB below the IF output level, the RF input frequency ± LO frequency; LO frequency = 52 MHz and RF frequency = 50 MHz. The upper chart (a) applies for an LO level of +7 dBm and RF input level of −10dBm; the lower chart (b) refers to a similar +7 dBm LO level with a higher RF input level of 0 dBm.

Table 2. Typical harmonic intermodulation signals on Models SRA-1, SRA-2, ZAD-1 and ZAD-2

LO frequency = 52 MHz, signal frequency = 50 MHz

Harmonics of the input signal	0	1	2	3	4	5	6	7	8	
7	>70	>70	>70	>70	>70	>70	>70	>70	>70	
6	>70	>70	>70	>70	>70	>70	>70	>70	>70	(a)
5	>70	>70	>70	>70	>70	>70	>70	>70	>70	−10 dBm
4	>70	62	>70	>70	>70	>70	>70	>70	>70	Signal
3	68	58	>70	58	>70	55	>70	52	68	level
2	66	55	>70	66	68	67	68	66	>70	+7 dBm
1	30	0	40	15	46	27	52	37	52	LO level
0		25	42	35	46	42	49	52	54	
7	>70	>70	>70	68	>70	68	>70	60	>70	
6	>70	>70	>70	>70	>70	>70	>70	>70	>70	(b)
5	>70	62	>70	52	>70	48	>70	48	69	0 dBm
4	>70	64	>70	>70	>70	68	>70	68	>70	Signal
3	53	42	55	42	58	52	66	47	68	level
2	64	59	67	66	66	66	67	61	68	+7 dBm
1	31	0	43	15	50	27	68	48	62	LO level
0		34	52	46	64	59	68	64	>70	

Harmonics of the LO

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two-tone, third-order distortion effects

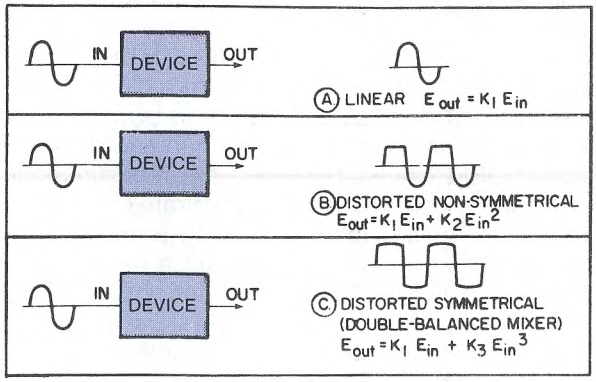
Let's analyze the distortion product of a double-balanced mixer (DBM). The output is proportional to the cube of the input voltage. If two input signals were applied equal in amplitude ($E_A = E_B$), the output would be proportional to $(E_A)^3$. This means if the input E_A changes 10 dB, the output changes by 30 dB. This explains a confusion often arising when two-tone, third-order distortion is discussed. A guideline for calculating such distortion is there is a two-to-one improvement in third-order response as the inputs are lowered. This merely means that for each 10 dB change in input there is a 30 dB change in third-order output for a net improvement of 20 dB, or 2 to 1.

More important, how can various mixers be compared on the basis of two-tone, third-order mixer distortion? Is a −100 dBm two-tone, third-order response for a −30 dBm input better than a spec of −70 dBm for an input of −20 dBm? The answer is no, mixer distortion performance is exactly the same. So here's some advice for the design engineer selecting a mixer. First, know the input level the mixer is expected to handle in order for the intermod spec to be meaningful. As just shown, a −100 dBm intermod spec may not satisfy a −80 dBm requirement at the desired input level. The two-tone, third-order distortion is closely related to the distortion characteristics of the mixer. To improve a mixer's two-tone performance, the mixer must be able to handle a larger input signal for the same amount of distortion.

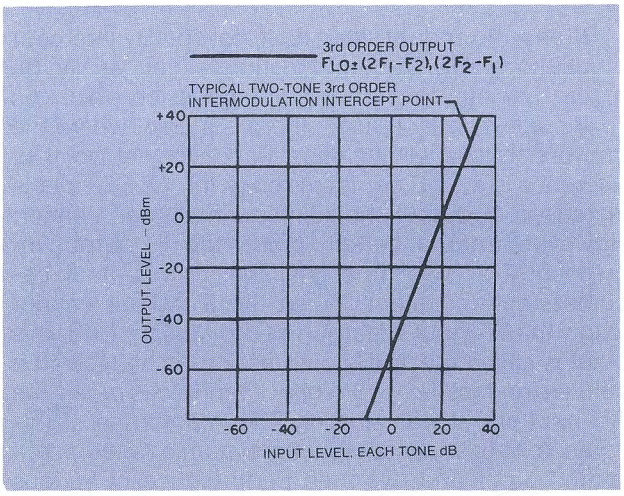
Let's take an example, Mini-Circuit's SRA-IH. If the input of each tone is at 0 dBm, typically, the third-order output is −60 dBm. This means the two-tone, third-order response is 54 dB below the desired IF output (assuming a 6 dB conversion loss). Now if the level of each tone drops to −10 dBm, the two-tone, third-order product would be at −90 dBm since a change of 10 dB at the input produces a 30 dB change in the output. Now assume the SRA-IH is a super-mixer and the two-tone input is raised to +10 dBm. The third-order output now changes from −60 dBm to −30 dBm, or 30 dB worse. Extend the assumption and apply a +20 dBm two-tone input; the third-order output would again change 30 dB to +0 dBm. Now let's further extend the assumption and apply +30 dBm two-tone input (of course, the SRA-IH couldn't handle this level) and now the two-tone, third-order product increases to +30 dBm. Now, the two-tone, third-order response is exactly equal to the two-tone input. This point is termed the "intercept" point where the third-order level is equal to the two-tone input level, see Fig. 6. In practice, mixers are not operated at this level but the intercept point offers a figure of merit for comparison of devices. In addition, it allows comparison of mixers where specs for intermod are given at different two-tone levels. Once the intercept point is known, you can calculate the two-tone, third-order response at any input level, remembering that every 1 dB change at the two-tone input produces a 3 dB change at the third-order output.

Thus it is possible to predict the RF input level allowable to keep two-tone, third-order response to a given level in a systems design. To use a mixer properly and to avoid generating excess distortion and compromising the final design it is necessary to relate the two-tone input and third-order output levels.

Not as obvious, but important, is the effect of increasing operating frequency on the mixer two-tone, third-order distortion characteristics. Generally, performance is better at low frequencies and drops off as frequency is increased. For high-frequency mixers (500 MHz), fall-off starts to occur somewhere between 50 to 100 MHz.



5. Feed the same sine wave input into three different devices, and three different outputs will result.

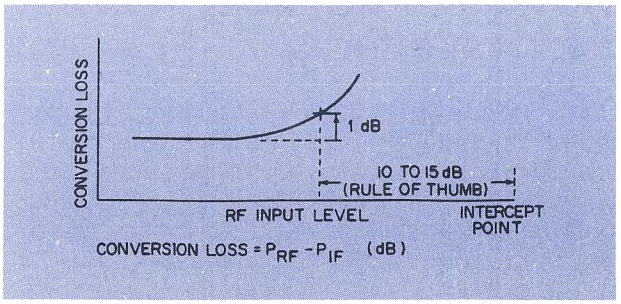


6. Although the intecept point is fictitious since mixers are not operated at this level, it is a convenient figure of merit for dBm evaluation.

understanding mixers

Often a mixer data sheet does not specify intercept point, so a rule-of-thumb estimate can easily be made by examining the IdB compression point. As RF input level is increased, there is a point where the conversion loss will increase. A convenient point of reference is a 1 dB compression point. As RF input is increased, IF output should follow in a linear manner. However, after a certain point, the IF output increases at a lower rate until the mixer output becomes fairly constant. When the IF output cannot follow the RF input linearly, and deviates by 1 dB, this point is called the 1 dB compression point. Now, the conversion loss is 1 dB higher than it was when the RF input signal was smaller. The importance of this figure is its utility in comparing dynamic range, maximum output and two-tone performance of various mixers.

As a rule-of-thumb, the intercept point is approximately 10 to 15 dB higher than the 1 dB compression point; at low frequencies about 15 dB, and at higher frequencies about 10 dB. See Fig. 7.



7. The 1 dB compression point is an indication of a dbm's dynamic range and maximum power capabilities.

how to measure mixer performance

A manufacturer with integrity does not play the "numbers game" when preparing specification data on his product line. Mini-Circuits' policy for product measurement and specification is straightforward—present the honest facts so the design engineer can evaluate product data for his circuit and system requirements and arrive at a proper design decision.

A 50-ohm broadband system is used for all factory measurements. It offers the customer a convenient and consistent means to obtain correlation with data prepared by Mini-Circuits.

conversion loss measurements

For conversion loss measurements, Fig. 8a, fixed attenuator pads are connected to all three ports so the mixer sees 50 ohms at the frequency of interest and all harmonics. An RF input level of −11 dBm is deliberately selected. Here's why: assuming a typical 6 dB conversion loss, the IF output would be −17 dBm. Mini Circuit's mixers provide LO-IF isolation typically in the order of 50 to 60 dB. Normally, the LO input is +7 dBm and thus with 50 dB isolation, the LO leakage level of −43 dBm would be much lower than IF output. Therefore the RF input level is high enough to operate the mixer in its linear range and not low enough to allow LO leakage to destroy the integrity of the measurement.

For the IF power level measurement, a filter is included before the broadband RF voltmeter, to reject all responses other than the desired IF. When a crystal filter is used, LO leakage would have no effect on the conversion loss measurement since it would not reach the RF voltmeter.

two general techniques for measuring isolation

There are two general techniques for measuring isolation, both requiring 50 ohm terminations at the unused ports. When measuring LO-RF isolation, see Fig. 8 (b), a pad is placed between the generator and DBM to ensure a 50-ohm-impedance. Also, a 50-ohm termination is connected to the IF port and the power at the RF port is measured to obtain the isolation performance.

When measuring isolation from RF-IF or RF-LO, the power applied at the RF port is set at a high level to make sure the diodes have sufficient drive power. This RF power level will be higher than encountered in actual DBM usage. However, the measurement results can be considered quite accurate.

The RF voltmeter technique actually produces isolation specs that are conservative since many applications normally involve narrowband circuits and filters that would eliminate harmonics. By assuming everything measured on the RF voltmeter is due to the fundamental and that harmonics are not present, mixers supplied by Mini-Circuits perform better than expected from the data sheet specs.

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Replacing the RF voltmeter by a spectrum analyzer enables the following improvement in measurement integrity. First, the power at the fundamental frequency of measurement can be observed. Now, for broadband applications, the effects of harmonics can be judged. For narrow-band applications, only the fundamental need be considered. By using the spectrum analyzer technique, the design engineer can avoid overspecifying his DBM isolation requirement with subsequent cost savings.

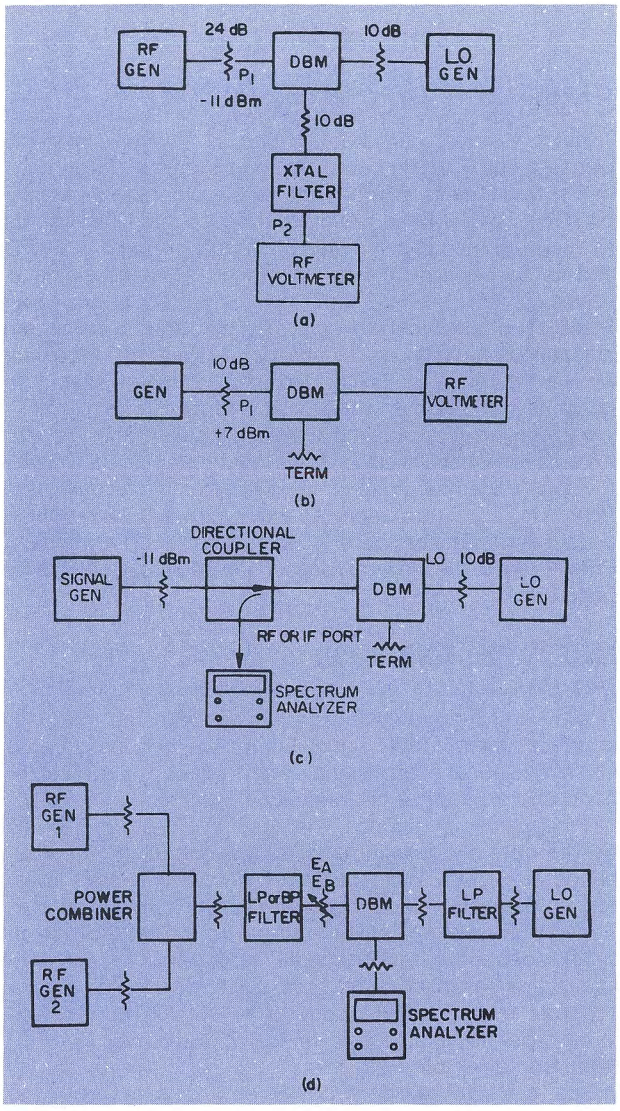
Here's another important advantage of the spectrum analyzer technique. When RF-IF or RF-LO measurements are made, the RF and LO levels can now be set at the normal operating level under which the DBM will be used.

VSWR measurements

VSWR measurements are made under the same dynamic conditions that the mixer would encounter in practice, see Fig. 8 (c). First, let's consider VSWR measurement at the RF port. An LO signal is applied to its port and the unused IF port is terminated in 50 ohms. The RF generator supplies an input level corresponding to linear mixer operation. With the double-balanced mixer disconnected from the directional coupler, a reference level is obtained (all the RF power is reflected back). The amount of reflected signal depends on the directional coupler used; a 20 dB coupler would establish a reference level 20 dB below the RF input. Next, the mixer is connected to the output of the directional coupler. The spectrum analyzer acts as a narrow-band filter and allows observation at the RF input frequency. The RF power reflected back from the mixer is displayed and can be measured by the calibrated scale on the spectrum analyzer.

The VSWR at the IF port is measured in a similar fashion. In this case, the RF port is terminated in 50 ohms.

Broadband mixers, it should be noted, exhibit a different VSWR characteristic at different frequencies. Factors causing this include circuit resonances and changes in diode impedances as the LO power level changes. Also of importance is the fact that the input impedances of the various ports are load dependent, even though they are isolated from each other. At high frequencies, this effect is more noticeable since isolation tends to drop as frequency increases.



8. Test measurement setups for (a) conversion loss, (b) isolation, (c) VSWR and (d) two-tone, third-order distortion.

two-tone, third-order intermodulation distortion

Two-tone, third-order intermodulation distortion takes place when two incoming signals arrive at the mixer RF port and interreact. The signals resulting from the interreaction may be objectionable within the IF response.

For specific details on checking two-tone, third-order response, see "Improve two-tone, third-order testing", on the following pages.

modern mixer terms defined

Statistical Processing

Today's stringent demands for precise electronic systems places a heavy burden on circuit and systems design engineers. Mini-Circuits provides the most comprehensive database for its RF/MW signal-processing components with its exclusive computer-automated performance data or CAPD and its specification charts which include $\bar{X}$ and sigma σ values.

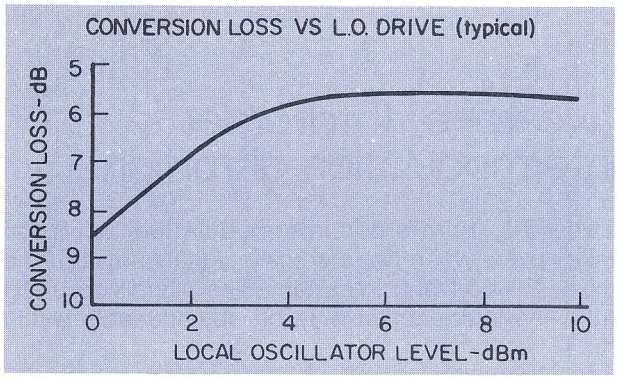
Statistical process control combined with the most modern automated production and test equipment are responsible for Mini-Circuits exclusive 5-year guarantee on mixers along with guaranteed 4.5 sigma, which basically means only four units in a million-lot production run approach the spec limit. For a full explanation of statistical process control terms such as $\bar{X}$, (average value of a group of samples), sigma (standard deviation unit), Cp (process capability), and Cpk (modified process capability factor), please refer to "Statistical Processing" in the General section, see Table of Contents for page number.

conversion loss

Conversion loss is a measure of the efficiency of the mixer in providing frequency translation between the input RF signal and the output IF signal. For a given frequency translation, two equal output signals are produced, a lower sideband and an upper sideband signal. Since only one sideband is generally of value, the specifications given in this handbook are for a single sideband output. If two sidebands are useful, then the conversion loss is 3 dB lower than in the single sideband case.

Conversion loss of a mixer is equal to the ratio of the IF single sideband output to the RF input level. All measurements are based on a 50 ohm system and with a local oscillator level specified in accordance with the appropriate mixer type. For example, level 7, +7 dBm; level 17, +17 dBm; and level 23, +23 dBm.

When the local oscillator power level deviates from the recommended level, the conversion loss will change slightly. The data sheets provide a curve of conversion loss vs. LO power level.



conversion compression

Conversion compression is a measure of the maximum RF input signal for which the mixer will provide linear operation. Normally, the IF output signal level is equal to a constant ratio of RF input signal level. However, when the RF signal level is within 10 dB of the LO drive level, the constant ratio between IF and RF levels will exhibit a change of about 0.1 dB. As the RF level increases further, there will be a greater change in the constant ratio. The conversion loss will increase as the RF input level increases. The IF output level does not exactly follow the increase in RF input level.

The criteria used to describe the deviation from linearity between the RF input level and the IF output level is a fixed amount of compression. Mini-Circuits specifies the 1 dB compression point. Naturally, if a higher compression point were selected, the corresponding RF input level would be higher.

Conversion compression provides an indication of the mixer two-tone performance. The compression point is useful when selecting a mixer for maximum linear operation. The compression point will change as a function of LO drive level. Therefore it is meaningful to specify the actual LO drive level when discussing the compression point.

Conversion loss desensitization is a measure of the nonlinearity caused by an unwanted RF signal at the mixer input. When the undesired RF input level causes the mixer conversion loss to increase by 1dB, for the desired low-level RF input signal, then the 1dB desensitization level is reached and the maximum undesired RF input level is defined.

isolation

Isolation is a measure of the circuit balance within the mixer. When the isolation is high, the amount of "leakage"or "feed thru" between the mixer ports will be very small. Typically, Mini-Circuit's mixer isolation falls off with frequency due to the unbalance in the transformer, lead inductance, and capacitive unbalance between diodes. Generally, at the highest frequency of operation, Mini-Circuits' mixers provide isolation of 30 dB.

The L to R isolation is the amount the LO drive level is attenuated when it is measured at the RF port; the IF port is terminated with 50 ohms. The L to I isolation is the amount the LO drive level is attenuated when it is measured at the IF port; the RF port is terminated with 50 ohms. Normally, only the LO isolation is specified since for RF isolation the RF signal power is much lower than the LO drive level; therefore, RF leakage is usually not a problem.

dynamic range

Dynamic range is the power range over which a mixer provides useful operation. The upper limit of the dynamic range is limited by the conversion compression point. The lower limit of the dynamic range is limited by the noise figure of the mixer. Since the mixer noise figure is only about 0.5 dB higher than its conversion loss, the lowest conversion loss is desirable to obtain the largest dynamic range.

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DC polarity

DC polarity defines the polarity of the IF voltage output when the mixer is used as a phase detector. Normally, the RF and LO signals are in phase, 0°, and are of equal amplitude. Mini-Circuits' mixers provide a negative polarity except where noted.

DC offset

DC offset is a measure of the unbalance of the mixer. For an ideal mixer, the DC offset is zero. DC offset defines the IF voltage output when the mixer is used as a phase detector and only the LO signal is applied, the RF-port is terminated in 50 ohms.

two-tone third order intermodulation distortion

This distortion term describes the degree by which the mixer conversion loss is non-linear. The two-tone third order distortion term is the amount of signal level at the IF output generated as a result of a third order frequency term. One frequency term corresponding to third order is (2 f R2 − f R1) ± fL, where f R represents the RF input signal and fL represents the LO drive.

Normally, this parameter is not specified on the data sheet because it is dependent upon frequencies, terminating impedances, and levels.

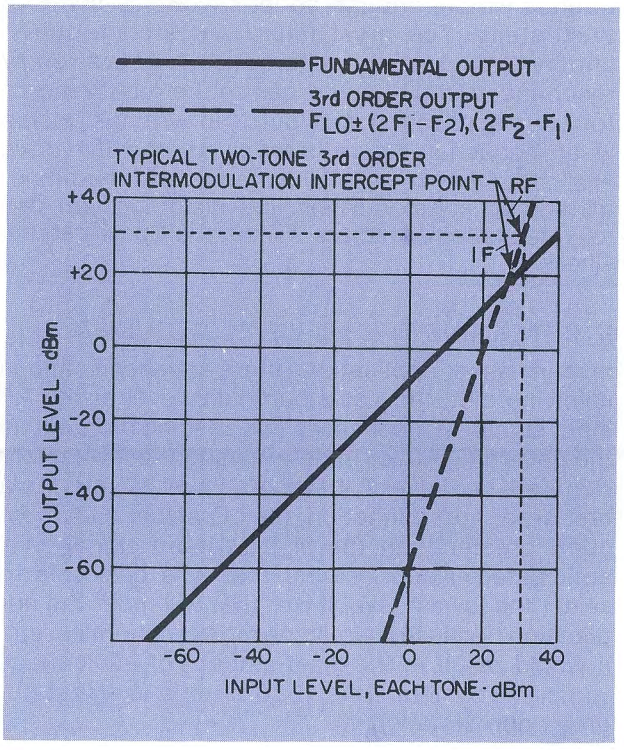
intercept point

Two-tone third-order intermodulation distortion is a measure of the third-order products generated by a second input signal arriving at the R port of a mixer along with the desired signal. A popular method of determining the suppression capability of a mixer is the "third-order intercept" approach. The third-order intercept point is a theoretical point on the RF input versus IF output curve where the desired input signal and third-order products become equal in amplitude as RF input is raised.

A convenient way to describe intermodulation products relative to input signal level is to state the relative difference between the two in dB; for example, a mixer may be specified as 60 dB down for two-20 dBm input signals. This means the mixer, with two-20 dBm signals as its input, will suppress third-order products by 60 dB. Now if the input level is reduced an additional 10 dB, the third-order product level would decrease by a factor of three, or 30 dB. The difference between the two would be 20 dB and thus, the mixer would offer 80 dB suppression with two −30 dBm signals at its input. With another 10 dB drop in signal level, third-order products would drop another 30 dB with a difference of 20 dB between the two. Thus, two −40 dBm signals would produce third order products suppressed by 100 dB. When will the two types of signal (input and third-order) theoretically become equal? The original input levels were −20 dBm and thus, the third-order products were 60 dB lower, or −80 dBm. Now if the input is raised 30 dB to +10 dBm, the third-order products would be increased by a factor of three or 90 dB; a 90 dB increase added to the original −80 dBm or +10 dBm, thus establishing equal amplitude for the desired and distorted signals.

Graphically, the intercept point is obtained by linearly extending the desired signal curve past the compression point until it intersects the third order curve.

A rule-of-a-thumb method for determining the intermod level is as follows: (1) find the 1 dB compression level (this is the RF input power level that caused the conversion loss to increase by 1 dB). (2) determine the intercept point. At the low end of the frequency range, this point is about 15 dB above the 1 dB compression point. As the mid to upper frequency range is approached, the intercept point drops to about 10 dB above the 1 dB compression point. (3) Multiply the difference between the intercept point and RF input level (equal RF levels) by the order of harmonic. (4) Subtract this number from the intercept point. This is the intermod level. For example: given a) 1 dB compression point at RF input of +1 dBm. b) RF input level −10 dBm, RF at low end of range. c) what is third-order intermod level? Solution: (1) Compression point is +1 dBm. (2) Intercept point equals 1 dBm +15 dBm = +16 dBm. (3) +16 dBm—(−10 dBm) equals +26 dBm. 26 dBm times third-order= +78 dBm (4) Intermod level equals +16 dBm −78 dBm = −62 dBm.



how to select a mixer

Select the proper mixer for your needs. There are hundreds of models available. Underspecify and face marginal performance, overspecify and pay for more than you need. Here's the proper approach.

Mixers are abundant in electronic systems ranging from inexpensive consumer products to sophisticated military hardware. You'll find them in video games, TV sets and video cassette recorders as well as communications gear, test instruments, radar units and countermeasure systems. Mini-Circuits offers well over a hundred different off-the-shelf models with thousands of variations. Different connector configurations, tighter specs, Hi-Rel, MIL, TX options are available on request. Improper mixer selection bears a penalty—underspecify and face marginal performance; overspecify and pay extra for unnecessary performance characteristics.

making the right choice

Simply stated, there are three basic steps—(1) Selecting the mixer level required in the applications, (2) deciding on a printed-circuit [PC] or connector version, and (3) picking a model that extends over the frequency range involved. Sounds simple enough so let's examine some of the details. The most important step requires understanding your specific needs; so it is strongly recommended that you organize the requirements for your applicaiton and put it in writing. Decide what frequency range is involved, the LO drive available, the level of harmonic and two-tone, third-order intermodulation (IM) distortion you can tolerate and other factors. Fill-out the Specifications Checklist.

I. DETERMINE THE LO LEVEL REQUIRED.

In many mixer applications there are specifications involving distortion at a particular level of the RF input signal. In most cases this specification will be the governing factor in determining the level mixer required; i.e. Level 7, Level 10, Level 17, etc. As a first order approximation, the LO power should be 10dB greater than the highest input signal level anticipated. Keep in mind that it is desirable to select the lowest level mixer that will meet the application because it would be more economical and it would result in the least amount of LO leakage within the system. This 10dB criteria is a first degree approximation.

In many cases this number may be modified. The trade-off is generally between performance versus cost. Mini-Circuits offers a wide range of different level mixers, from 7 to 27. Referring to Fig. 2, and the discussion on 1dB compression point to follow, select the level mixer for your requirement.

II. DETERMINE THE TYPE OF CONNECTIONS: PC BOARD MOUNTING OR COAXIAL CONNECTORS

Generally, the designer has evaluated his system requirements and will know beforehand whether the mixer is to be mounted on a pc board or is to have coaxial connectors.

Mini-Circuits has both types available. All pc board mounting units have at least 4 pins to ensure a mechanically rugged connection to the pc board. Many of these units easily comply with standard miliary requirements. The connector version mixers are available in five standard types: BNC, TNC, SMB, SMA and N. These units are available with or without a mounting bracket (please specify connector and bracket requirement).

III. DETERMINE THE FREQUENCY RANGE REQUIRED AND SELECT A MODEL.

Mini-Circuits offers extremely wideband mixers with a considerable amount of frequency overlap between models. Determine the required frequency range of operation. Then select the mixer whose frequency range specifications best "straddles" the range of frequency operation. It is good practice to try to select a mixer whose midband frequency range covers the frequency range of intended operation. Mini-Circuits has taken this design philosophy in specifying the frequency range of its models. All MCL mixers perform well at the edges of their frequency specification. In fact, many users operate outside of the band edge specified by MCL and expect and receive repeatable (unit to unit), high performing mixers.

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FIG. 1

Mini-Circuits

application

Space _____ Military _____ Industrial _____ Commercial _____

Description: _____

_____

Parameters important for application: _____

_____

electrical

FREQUENCY RANGE

LO _____ RF _____ IF _____

LEVEL MIXER: Dynamic range parameters (choose the most critical for your application)

1. Maximum RF input level anticipated _____
2. Percent distortion acceptable _____
3. Intercept point _____
4. Two-tone, 3rd order IM _____ dB at _____ dBm, RF input each tone
5. RF input at 1 dB compression level _____
6. LO power available _____
7. none of the above specified _____

CONVERSION LOSS, maximum

a) _____ dB over _____ MHz
b) Flatness over frequency _____ dB
c) Changes over temperature _____ dB over _____ °C
d) Unit-to-unit variation _____ dB

NOISE FIGURE, maximum _____ dB over _____ MHz

ISOLATION, minimum

LO-RF _____ dB over _____ MHz
LO-IF _____ dB over _____ MHz
RF-IF _____ dB over _____ MHz

VSWR OR RETURN LOSS

Impedance _____
LO port _____ RF port _____ IF port _____

HARMONIC INTERMODULATION REQUIREMENTS

_____ X LO by _____ X RF _____ dB below IF

REPLACEMENT FOR EXISTING MODEL

Manufacturer _____ Model _____

SPECIAL REQUIREMENTS: _____

_____

package

PINS

Hermetic seal required Yes ____ No ____
Small size important Yes ____ No ____
Max. size Requirement:
L ____" W ____" H ____"

Configuration

Plug-in _____ Flat pack _____
Surface Mount _____

CONNECTORS

BNC ____ SMA ____ N ____ TNC ____
Connector Orientation
all in one Face _____ T configuration _____
Other _____
Mounting requirements
thru hole ____ tapped hole ____ flange ____

environmental & reliability

TEMPERATURE RANGE

Operating _____ Storage _____

MIL SPEC _____ Group A _____, B _____, C _____

SCREENING REQUIRED

Test	Conditions	MIL-STD
Vibration		
Shock		
Temperature Shock		
Burn-in		
Other		

DATA REQUIREMENTS

Lot data _____
Unit data _____
Other _____

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how to select a mixer

1dB compression point key to choosing mixer level

What does the 1dB compression point signify? As RF input level is increased, IF output should follow in a linear manner. However, after a certain point, IF output increases at a lower rate until the mixer IF output becomes fairly constant.

The RF input level for which the IF output level deviates from linearity by 1dB is termed the 1dB compression point. Fig. 2 displays the RF input level at 1dB compression for various type mixer levels.

This 1dB compression point is useful in comparing dynamic range, maximum output and two-tone performance of various mixers. It is a basis on which mixer level is established.

The 1dB compression point, which defines the linearity of a mixer at high RF input levels, is relatively simple to test and thus this parameter is included on data sheets supplied by all mixer manufacturers. But, in real life, mixer linearity may be specified in accordance with the intended application. For example, in a receiver application, two-tone, third-order intermod may be the critical parameter; for TV applications, percent distortion or intercept point may be specified; and in an attenuator measurement system, compression may be important for a given RF input level. With this in mind, the engineer needs a convenient means to relate the particular parameter for his application with the published spec, the 1 dB compression point.

Fig. 3 lists ways mixer linearity might be specified.

1. MAXIMUM RF INPUT LEVEL ANTICIPATED. If you know this parameter, simply select the lowest level mixer whose maximum RF input level, at 1 dB compression, exceeds your requirement. For example, if the maximum encountered RF level is +5 dBm, select a Level 13 mixer, rated at +7 dBm maximum RF input for 1 dB compression point.

2. PERCENT DISTORTION. The percent distortion is usually specified in voltage. Thus, a 0.1% distortion figure means 0.999 of the desired voltage appears at the mixer output. Next, convert this voltage ratio to a power ratio in dB by squaring and taking ten times the log. The resultant figure is the amount of compression for the specified RF input level. Now this must be extrapolated to 1 dB compression for a corresponding RF input level. As a rule of thumb, extrapolation may be achieved by assuming a linear relationship in dB, between compression and RF input level. So a ten-times increase in compression corresponds to a ten-times increase in RF input level.

Let's illustrate with an example using a 0.1 percent distortion spec at −10 dBm RF input level. The 0.1 percent corresponds to a relative 0.999 voltage output; squaring this yields 0.988 power ratio or 0.009 dB. We, therefore, know that 0.1% distortion at −10 dBm input means the maximum allowable compression is 0.009 dB. Extrapolating, using the rule-of-thumb relationship, states that 0.09 dB compression corresponds to an allowable RF of 0 dBm, and 0.9 dB compression at a maximum allowable RF input level of 10 dBm. So which mixer is appropriate? A Level 17S, with +13 dBm RF input level at the 1 dB compression point, see Fig. 2

3. INTERCEPT POINT.

This parameter is a figure of merit corresponding to the amount of intermodulation products generated relative to the desired IF output. An intercept point can be defined for a second-order, third-order, fifth-order, product, etc. As a rule-of-thumb, two-tone third-order intercept point is approximately 15 dB above the 1 dB compression point. So, if the intercept point figure is given, merely subtract 15 dB from this figure and pick a mixer which meets the 1 dB compression point spec, see Fig. 2.

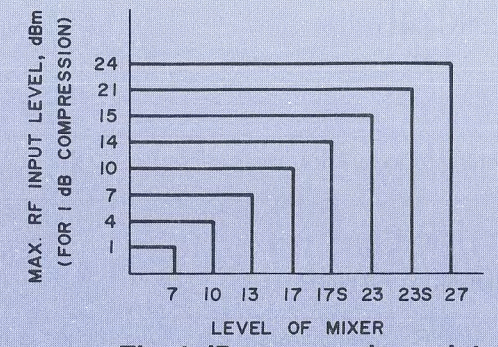

FIG. 2 **The 1 dB compression point as a function of the level of mixer**

FIG. 3 **Dynamic range parameters affecting mixer selection**

1. maximum RF input level anticipated
2. percent distortion acceptable
3. Intercept point
4. Two-tone, 3rd order IM _____ dB at _____ dBm, RF input each tone
5. RF input at 1 dB compression level
6. LO power available
7. none of the above specified

Let's correlate every parameter in Fig. 3 with the published 1dB compression point to show how simple it is to select the proper mixer level, Fig. 2.

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4. TWO-TONE, THIRD-ORDER INTERMODULATION (IM).
When a two-tone, third-order IM spec is given, the intercept point can be calculated. Remember that for each 10 dB increase in signal level, there is a 20 dB degradation in two-tone, third-order product. Once the intercept point is calculated, simply subtract 15 dB from the figure to find the 1 dB compression point and select the appropriate mixer.

5. 1dB RF INPUT COMPRESSION LEVEL.
This key paramter is listed on mixer spec sheets so merely choose the lowest level mixer that will meet the requirement.

6. LO DRIVE.
The LO drive is critical since the function of the LO drive is to switch the mixer diodes fully on and off for lowest distortion. So, for optimum performance, select the mixer level to match the LO drive. Mini-Circuits conveniently identifies its mixer levels by the LO drive requirement; thus a Level 7 mixer refers to a LO drive level of +7 dBm. If there are constraints on the LO power available, select the lowest level mixer closest to the available LO power. For example, if +12 dBm LO drive is available, select a Level 10 mixer.

7. NO PARTICULAR SPEC TO MEET.
Choose a Level 7 mixer. Why? Because it is the most popular and it offers the widest choice of models at lowest cost.

what about "Specials"?

When a particular model in a series has been selected the designer must determine if the model will meet the electrical performance criteria he has generated. All MCL mixers are characterized and a signfiicant number of performance curves and tabulated data describing the models are given on the data sheets. The performance curves on the data sheets describe typical performance. Sometimes the designer requires higher isolation, lower conversion loss, temperature tracking of converison loss, unit to unit tracking of conversion loss, selection of higher order harmonic products, less than 100 microvolts of phase detector DC offset, larger specified bandwidths etc. Mini-Circuits offers these special performance criteria and many more. Our high volume production enables us to select units to customer specifications at extremely low cost. Mini-Circuits maintains a highly documented system to handle specialized customer requirements.

In summary, contact us about "specials" and we'll do our best to satisfy your needs without excessive cost or delivery date extensions. Sometimes, "special" means shipping a quantity of mixers within a very short time span; since Mini-Circuits is the largest manufacturer of mixers in the world, this may hardly be considered "special" and you may be pleasantly surprised. Try us.

frequency range last deciding factor

Once the mixer level has been decided, you may find a wide variety of models to exercise your decision making. The specification pages are arranged by mixer level. For a particular level, photos and case styles describe various configurations available for your choosing. You may notice models within a series with overlapping frequency ranges. Why? So you can choose the optimum mixer for your requirement. Each model within a series has a different low-frequency limit. Select a mixer with the highest low-frequency limit and whose mid-band range best covers your application.

Specs on the data sheets are given in three ranges. The lower frequency range, L, covers the lowest specified frequency to one decade higher; the upper frequency range; U, covers the highest frequency to one octave lower and mid-range, M, covers the frequency between L and U. Thus a mixer specified from 0.5 to 500 MHz could offer a low-frequency range of 0.5 to 5 MHz, an upper frequency range of 250 to 500 MHz, and a mid-range of 5 MHz to 250 MHz.

practical questions

We get a lot of phone calls in which questions came up regarding mixer selection. Here are the most popular and their answers.

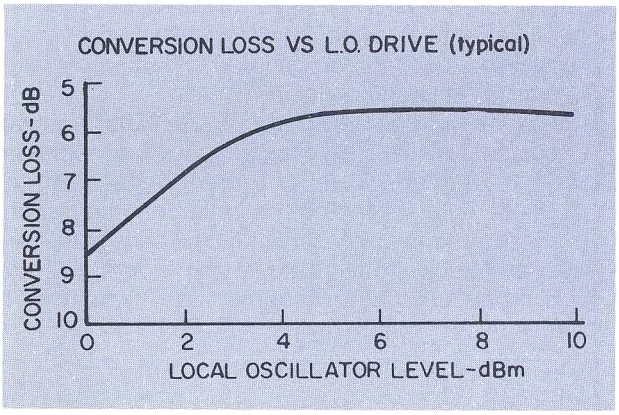
Q. *I'm ready to select a mixer. But there are so many models to choose from, where do I start?*

A. Start by defining your requirements as best you can, including electrical, mechanical, environmental, etc. Do you need printed circuit (PC) or connector version? What is the frequency range of interest? Use the MIXER SELECTION GUIDE to jot down key details. The objective of listing the requirements is to define what you *really* need, including the level of mixer required ... mixer level is the key for mixer selection. Once level has been determined, the specific mixer selection will be easy. Of course, there may be variables you may not know or that are not critical, so make the best estimate and proceed.

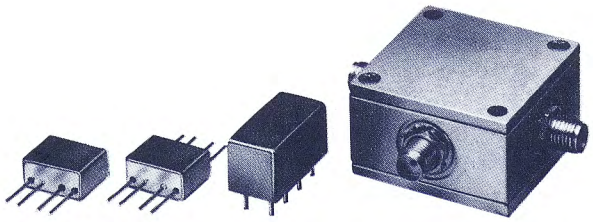
how to select a mixer

Q. *How critical is LO level in a mixer application?*

A. The purpose of the LO signal is to switch the mixer diodes on and off. Manufacturers select a fixed LO level so they can test and specify at a particular level. In practice, however, LO drive can vary with minimal effect on mixer performance. For example, a Mini-Circuits' SRA-1 unit is specified at +7 dBm LO level; if the LO drive was only 3 dBm perhaps a 0.5 dB increase in conversion loss might take place. Or a high-level SRA-1H might experience a 0.3 dB increase in conversion loss if LO level was +14 dBm instead of the specified +17 dBm LO.



Q. *I notice Mini-Circuits offers many series of mixers, such as the SRA, TAK, TFM, ASK, etc., including over 450 models. Why so many models?*



A. Mixers are used in systems covering communications, weapons, test instruments, radar, data transmission and countless other applications. A mixer manufacturer can opt to produce a dozen models and thus, in a sense, force the design engineer to compromise his specific needs by offering a rather narrow selection. Mini-Circuits approach is to offer a wide variety so the designer can buy what he needs, and thus neither compromise his design nor pay for more than he really needs. That's why Mini-Circuits offers more off-the-shelf models than all other manufacturers combined.

But that's not enough. As needs change, new models will be available. For example, the recent demand for higher density packaging has been filled by Mini-Circuits' ASK flatpack series, more than doubling packaging density on a PC board.

Finally, although we list over 450 off-the-shelf models, we can supply hundreds of variations (such as connector configurations, tighter specs, etc.) at our customer's request.

Q. *What's the difference between "Level 7", "Level 10", and "Level 27" mixers?*

A. The different levels of mixers are determined by the LO drive required for a particular application. Thus, each particular level mixer has been optimized for a given LO drive, and will offer low distortion even at the maximum input level specified for the mixer. The higher the level of mixer, the lower the distortion expected. It is obvious that the highest level mixer could satisfy most requirements. However, high LO drive would be necessary and the cost of a Level 27 mixer is higher than a lower level mixer, such as Level 10 or Level 7.

Thus, rather than overspecify, select the level of mixer that will optimize your system.

Q. *I don't have enough LO drive even for a Level 7 mixer. What can I do?*

A. Some Level 7 mixers (TFM/ZFM series), although specified for +7 dBm LO, will operate well with LO drive as low as 0 dBm.
However, there is some degradation; about 1 dB additional conversion loss, the upper frequency limit might be slightly reduced and there may be a slight increase in two-tone, third-order IM. Our exclusive CAPD data service can provide specific information on how LO drive variations affect mixer specs for your application.

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Q. *I am operating over a wide bandwidth and my LO drive level changes by about 3 dB. How should I take this into account when I select a mixer?*

A. The preferred approach would be to determine the lowest LO drive level over the band and then select a mixer for this drive level. Remember that as LO level increases over the nominal (to +10 dBm for a level 7 mixer), conversion loss is flat and thus optimum performance will be maintained and not degraded.

Don't guess; consult our CAPD data.

Q. *From my requirement for intercept point, I have selected a Level 13 mixer. Can I apply a +7 dBm LO drive and expect the high performance specified in the data sheets?*

A. No. Performance to the specifications take place when the mixer diodes are driven full "on" by the LO drive. Therefore, when LO drive is insufficient, the diodes operate on a different portion of their I-V characteristic curve. In addition to the LO drive, the RF input signal will influence the range in which the diodes operate on the I-V curve and thus increase nonlinearity and distortion.

That's why Mini-Circuits offers so many series of different mixer levels, (Level 7, 10, 13, 17, 17S, 23, 23S and 27).

Q. *I need a mixer with a flat conversion loss over my frequency range spec. How do I go about selecting a model?*

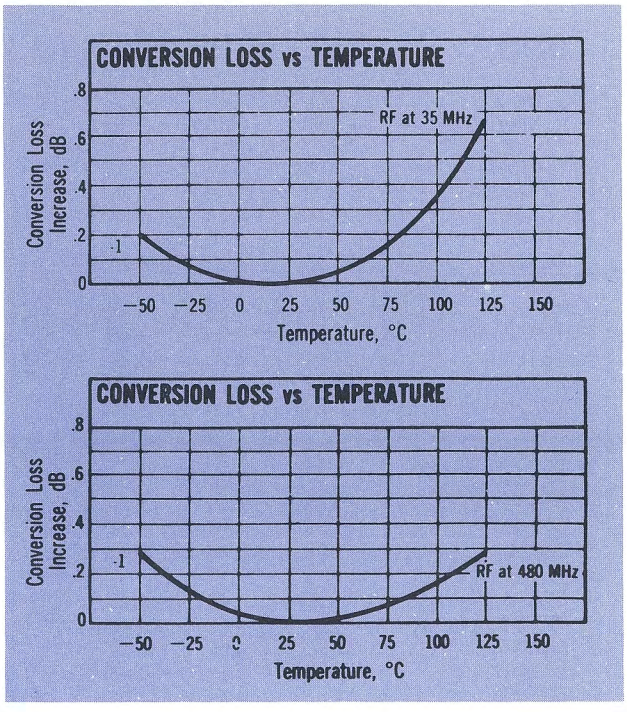
A. Conversion loss over the midrange response of a mixer is usually flat. So select a mixer that has a midrange response covering the frequency range you need.

Also, the VSWR of the mixer (especially the RF and IF ports) should be checked in order to minimize mismatch errors which could compromise the conversion loss flatness.

Q. *I expect wide temperature extremes for my latest RF design project and mixer conversion loss vs. temperature concerns me. What advice can you offer?*

A. For extreme cold environments (down to −55°C), to maintain flat conversion loss, pick a mixer that operates a minimum of two octaves below your lowest frequency of operation. For example, if your application involves operation at 30 MHz, select a mixer that extends to 7.5 MHz or lower. Why? The permeability of the ferrite core in the mixer transformer will drop at reduced temperature, resulting in higher losses or frequency fall off at the low end of the band.

In extreme heat or high-temperature environments, the mixer diodes will be the predominant factor affecting conversion loss. Diode impedance will change and cause mixer mismatch to upset flat conversion loss. So select a mixer whose upper frequency is an octave higher than that of your application. For example, if you are concerned with high temperature performance at 500 MHz, select a mixer good up to 1000 MHz (such as the SRA-2CM or TFM-2).



how to select a mixer

Q. *The RF-IF isolation spec is not shown on mixer data sheets. Is this spec important when I select a mixer?*

A. Generally, the RF-IF isolation spec is not important since the RF level is usually considerably lower than the LO level. As a rule of thumb, for Mini-Circuits mixers, the RF-IF isolation spec is about 10 dB less than the LO-RF isolation spec. If, for your particular application, the RF-IF isolation spec is important, specify your needs when you place the order and Mini-Circuits will screen and test to this spec at no additional charge.

However, in a phase detector application, the RF-IF spec may be critical, since the RF level is comparable to the LO level.

Q. *Do you supply a mixer with a specified maximum VSWR?*

A. Generally, a maximum VSWR spec is not given in the mixer data sheets. As a general rule, try to select a mixer whose midrange covers your frequency band of interest. In addition, if you state the maximum VSWR requirement, Mini-Circuits can screen and test to meet your needs. In addition, you can examine detailed CAPD data of VSWR at all three ports as well as VSWR sensitivity to LO power level changes.



computer-automated performance data

typical production unit / for data of other models consult factory

mixer VSWR v. LO power

model SBL-1

(LO frequency 150 MHz for R, and I port measurements)

freq.	VSWR, RF port			VSWR, LO port			VSWR, IF port		
freq. (MHz)	LO +5dBm	LO +7dBm	LO +9dBm	LO +5dBm	LO +7dBm	LO +9dBm	LO +5dBm	LO +7dBm	LO +9dBm
1.000	1.68	1.70	1.71	2.84	3.54	4.64	1.18	1.13	1.08
27.263	1.09	1.14	1.19	2.18	2.84	3.62	1.21	1.15	1.10
53.526	1.10	1.14	1.18	2.06	2.66	3.35	1.20	1.15	1.11
79.789	1.11	1.15	1.18	2.22	2.88	3.74	1.21	1.17	1.13
106.053	1.16	1.22	1.25	2.05	2.57	3.18	1.32	1.27	1.22
132.316	1.18	1.23	1.27	2.11	2.72	3.38	1.36	1.31	1.27
158.579	1.19	1.23	1.28	2.13	2.71	3.44	1.38	1.33	1.29
184.842	1.21	1.25	1.29	1.99	2.46	3.03	1.46	1.42	1.36
211.105	1.22	1.27	1.29	2.04	2.56	3.14	1.52	1.49	1.42
237.368	1.29	1.35	1.38	2.00	2.50	3.04	1.75	1.71	1.62
263.632	1.31	1.35	1.40	1.95	2.38	2.86	1.80	1.72	1.67
289.895	1.27	1.31	1.34	2.02	2.50	2.99	1.71	1.69	1.61
316.158	1.32	1.39	1.39	1.91	2.32	2.71	1.99	1.98	1.83
342.421	1.35	1.41	1.43	1.98	2.39	2.85	2.14	2.13	1.96
368.684	1.38	1.45	1.46	1.97	2.39	2.80	2.39	2.38	2.15
394.947	1.39	1.44	1.48	1.87	2.22	2.60	2.40	2.35	2.25
421.210	1.34	1.42	1.40	1.90	2.26	2.68	2.17	2.29	2.02
447.474	1.40	1.50	1.49	1.87	2.23	2.60	2.86	3.13	2.60
473.737	1.44	1.51	1.53	1.94	2.29	2.64	3.08	3.13	2.85
500.000	1.43	1.49	1.51	1.98	2.31	2.66	2.92	2.95	2.71

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Q. *My application involves maximum RF input signal levels of −20 dBm. I notice the 1 dBm compression point specification of many mixers is at +1 dBm and higher. Should this spec be of concern to me?*

A. Yes, if two-tone, third-order IM is critical or if receiver response to unwanted signals is important. The 1 dB compression point is related to the intercept point which is a "figure-of-merit" of the linearity or distortion characteristic of a mixer. It also indicates the susceptibility of the mixer to unwanted signals.

Q. *I've selected an SRA-1 mixer as the best model for my application. However, I need the typical isolation spec as a guaranteed minimum. What should I do?*

A. Mini-Circuit's specs are conservative and, thus, our typical specs will apply to just about every production unit. But ... that's not a good enough answer to your question. If you request a minimum isolation spec from us, we'll assign a special part number to our model. Then we'll screen and test on a 100% basis to your specification, at no extra charge. Mini-Circuit's commitment is to satisfy your requirement.

Q. *I need a mixer that nominally operates at +10 dBm LO drive but requires protection against sudden surges of RF input power as high as 250 mW. What mixer should I select?*

A. To avoid damage from a 250 mW input signal, choose a Level 17 mixer. Reason ... a Level 17 mixer containing eight diodes, each rated for 100 mW dissipation, easily copes with the 250 mW input. But, there is a penalty. For minimum distortion, you'll require +17 dBm LO drive, which may be higher than your original intent. Or, you can operate at a lower LO drive but suffer an additional conversion loss of 1.0 to 1.5 dB. The decision is up to you ... but the Level 17 mixer will be safe from the 250 mW surges.

Q. *I have an application requiring an RF frequency response from 100 Hz to 10 MHz. I don't see any mixers specified with an RF this low. What can I do?*

A. One of the characteristics of most double-balanced mixers (DBM) is that IF response usually extends from DC to the highest frequency specified for the mixer. Since all ports of the DBM are balanced and thus isolated from each other, simply connect the RF input signal to the IF port and take the IF output from the RF port. Make sure the RF frequency response of the mixer will handle the IF frequency requirements.

Disadvantages? Yes. Generally, the linearity characteristic will not be as good as with the signal connected in the conventional manner. Also, there is a danger that transients at the RF port (previously the IF port) can damage the diodes internal to the mixer.

Q. *How is DC offset voltage measured?*

A. It can be measured statically or dynamically. For a static measurement, terminate the RF port with 50 ohms and apply a signal only to the LO input. Measure the DC at the IF port through a low-pass filter; this is the DC offset voltage.

A disadvantage of the static approach is that any DC offset contributed by the RF input signal is not included.

In a dynamic test, an RF input signal and an LO signal of equal amplitude are applied to their respective ports, with the RF signal slightly offset (10 kHz) from the LO. Then a low pass filter is connected to the IF port to eliminate all frequency components including the 10 kHz difference frequency. Now, the DC offset voltage reading at the low-pass filter output is more accurate since it is measured under typical operating conditions.

improve two-tone, third order testing

First it's important to define the significance of input levels. Then full details on the measurement technique.

Two-tone, third-order intermodulation distortion (IM) expresses the degree of non-linearity of an amplifier or mixer. Normally, this parameter is not expressed on data sheets because it is dependent upon operating frequencies, terminating impedance and input levels. So two-tone, third-order distortion must be measured under specific performance conditions.

The two most common errors in these measurements are (1) failure to provide adequate isolation between the two input signal generators and proper impedance matching, and (2) insufficient filtering of the two input test signals. Without adequate isolation and matching, interaction between the test generators and the device-under-test may produce significant errors (as high as 20 dB). Without sufficient filtering, the generator harmonic will contribute to the distortion displayed on the spectrum analyzer and device performance thus will not be properly evaluated.

Before proceeding with the actual test, it is very important to note that two-tone, third-order IM distortion is only meaningful when the input levels to the device-under-test are defined. Without these stated input levels, the IM figures have no significance. To illustrate, suppose you wanted a device with a two-tone, third-order level of 60 dB. You could set up the test equipment as shown in the block diagram (Fig. 1) and vary the input levels of generators #1 and #2 until you eventually reached the 60 dB IM level.

However, unless your particular application dictates exactly the same RF input levels as your test setup inputs, the IM distortion figure is meaningless. For example, examine the spectrum analyzer display for a ZAY-1 double-balanced mixer, Fig. 2. Notice the significant difference in two-tone, third-order component with an input level of −10 dBm for each tone (a) compared with 0 dBm input level for each tone (b).

To repeat a key point, the input level of each signal must be specified before the IM test is begun.

The second key consideration is the need to specify the amount of two-tone, third-order relative to some reference level. The reference level can either be the amount of RF input or desired IF output; the desired IF output reference generally is much more meaningful.

A proper test setup and results are shown in the block diagram, Fig. 1 and Fig. 2.

The two RF input generators are isolated from each other by (1) two wideband (10-2000 MHz) amplifiers, MCL model ZFL-2000; (2) two 6 dB pads, MCL model CAT-6, and (3) a power combiner, MCL model ZFSC-2-2. This combination provides about 70 dB of isolation between the two RF input signals to the power combiner. Mismatch and generator interaction are considerably reduced by this arrangement.

Mini-Circuits offers a wide variety of low-cost fixed attenuators with various connectors (type N, TNC, BNC and SMA), 1 to 40 dB from DC to 1500 MHz.

A proper test setup for measuring two-tone, third-order IM distortion is shown. Note the use of two amplifiers and 6 dB pads for input generator isolation and proper 50 ohm matching. A practice of simply using a Tee-connector between generators develops mismatches and produces undesired harmonics which dramatically affect accuracy.

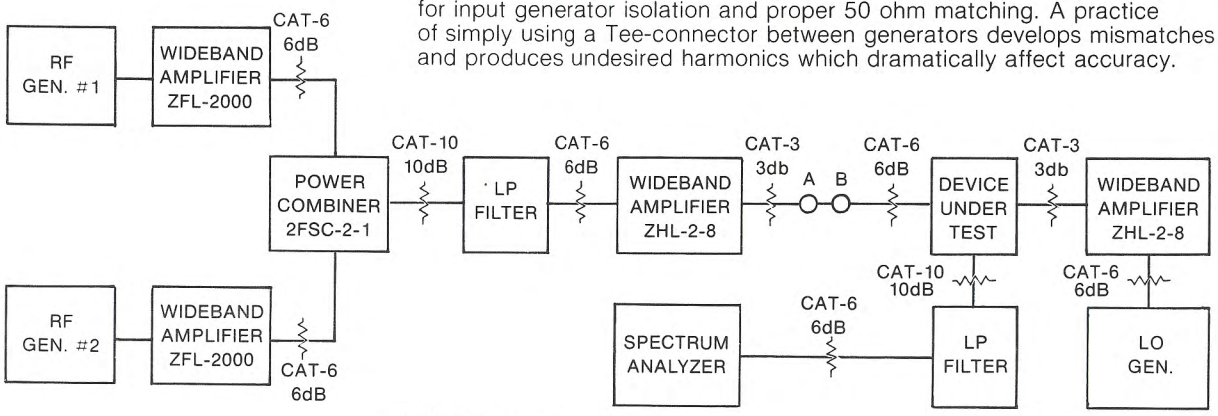

FIGURE 1

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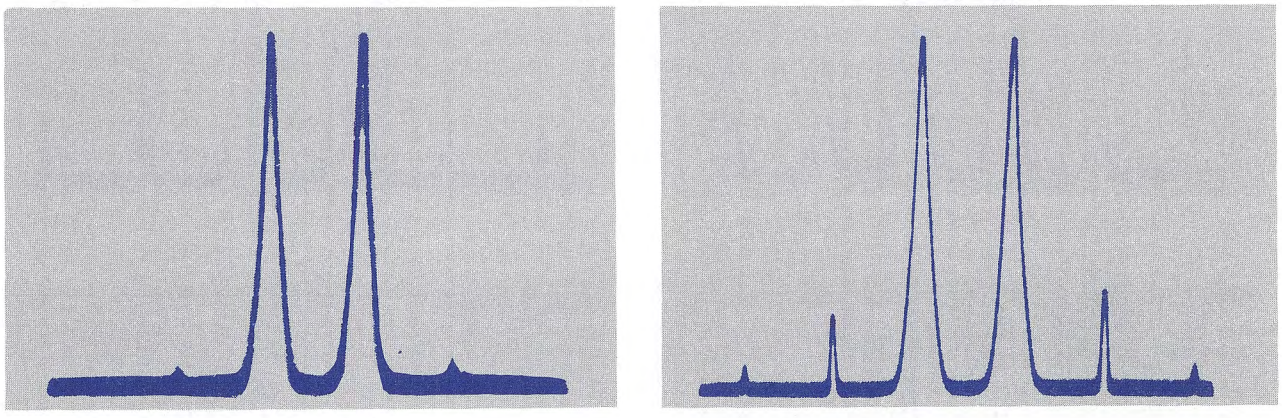
A low-pass filter follows the pads to remove generator second-order harmonics since levels as low as 60 dB can upset the two-tone, third-order measurement.

If the harmonics are not well-filtered, the true measurement figure may be degraded by as much as 20 dB. Here's why. Assume one of the generators has a second-harmonic content. When both RF generator inputs are applied to the mixer, the mixer will generate second-harmonic output. Now if the second-harmonic from the RF generators is 180 degrees out-of-phase with the mixer's second-harmonic, they may cancel causing the two-tone, third-order product to be drastically reduced. The numbers from such a measurement would look very good but could pose a serious error for engineers using the results as a basis for systems design. On the other hand, if both second harmonic signals are in phase, they would add and may increase the two-tone, third-order product by 3 dB. Therefore, without filtering the harmonics of the two-tone RF input, there is good likelihood of obtaining inaccurate results.

A wideband amplifier is now required to increase the level of the two-tone signal so that the two-tone, third-order components can be adequately observed and read on the spectrum analyzer display. Performance of this wideband amplifier is critical since it must not introduce its own third-order components. Pads are included at the input and output of the amplifier to maintain a well-matched 50-ohm system. The two pads following the amplifier allows the device-under-test to be checked at two input levels to verify that the spectrum analyzer is not contributing errors due to its harmonic content (more on this point later).

For high-level mixers, a second wideband amplifier is included between the local oscillator (LO) and the device-under-test. This additional gain permits an LO level as high as +17 dBm to be applied even with the 10 dB isolation pad.



a) RF-10dBm

b) RF 0dBM

For meaningful two-tone, third-order IM figures, use the same input RF levels in your test setup as your specific application will require. Notice the significant difference in two-tone, third-order component with an input level of −10dBm for each tone (a) compared with 0 dBm input level (b). Measurements made on Model ZAY-1, LO power at +21.5 dBm.

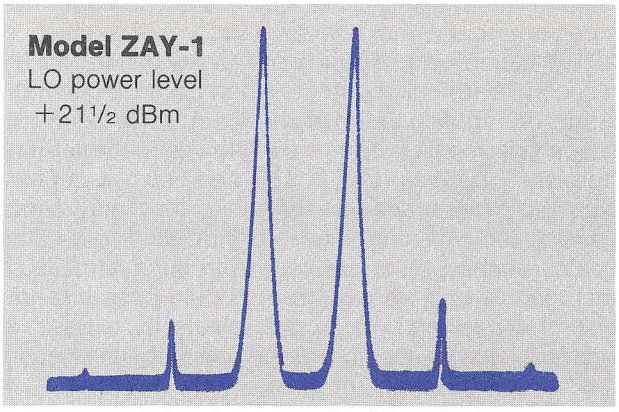
FIGURE 2

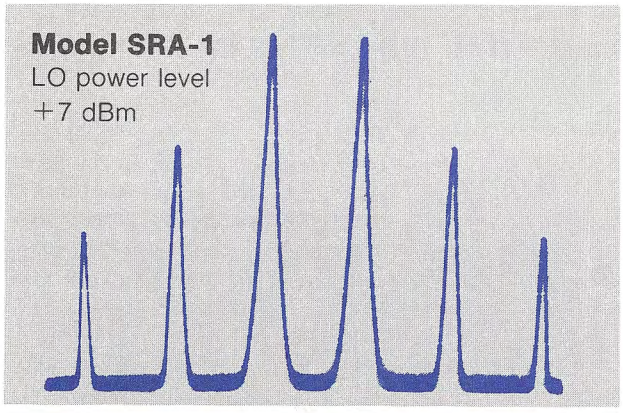
improve two-tone third order testing

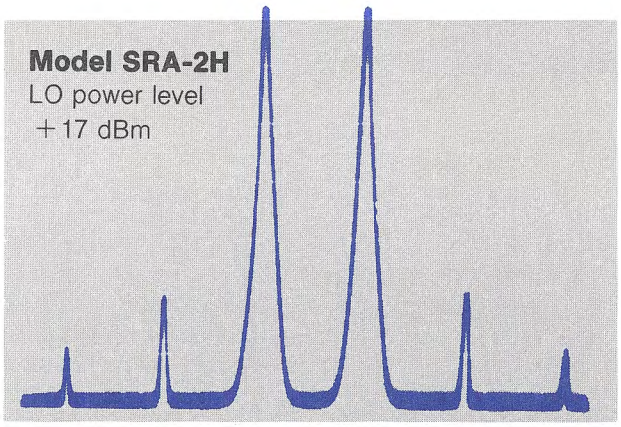
typical intermodulation performance comparing different level double-balanced mixers

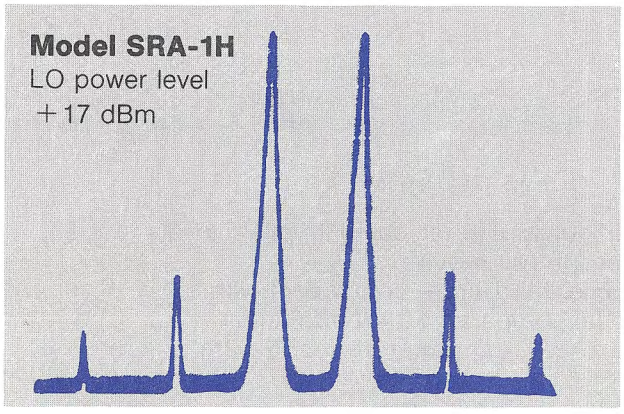
power level each tone = 0 dBm

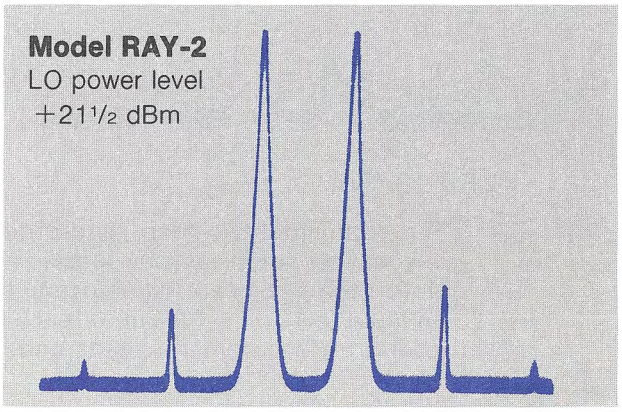
RF signal #1	Frequency	180 MHz
RF signal #2	Frequency	181 MHz
LO signal	Frequency	200 MHz
IF signal #1, #2	Frequency	20 MHz 19 MHz
Horizontal scale	500 kHz per cm.	
Vertical scale	10 dB per cm.	











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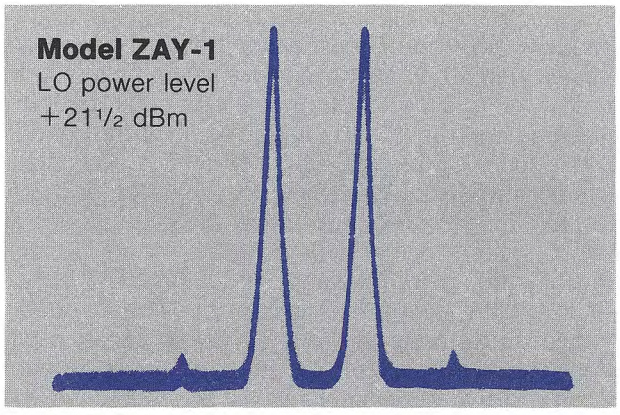
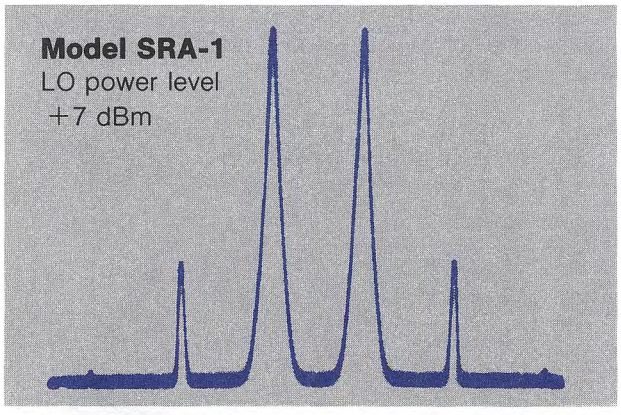
power level each tone = −10 dBm

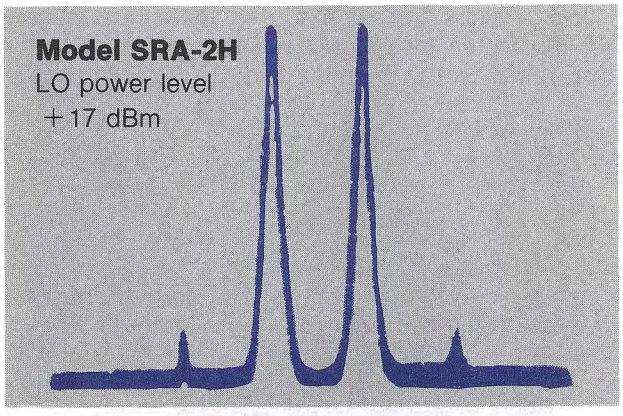
Model ZAY-1
LO power level
+21½ dBm



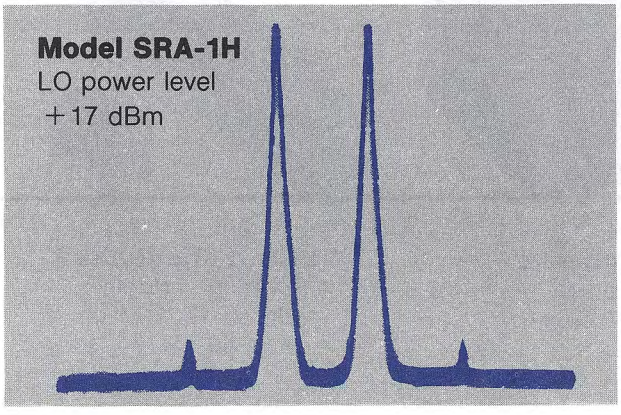
Model SRA-1
LO power level
+7 dBm



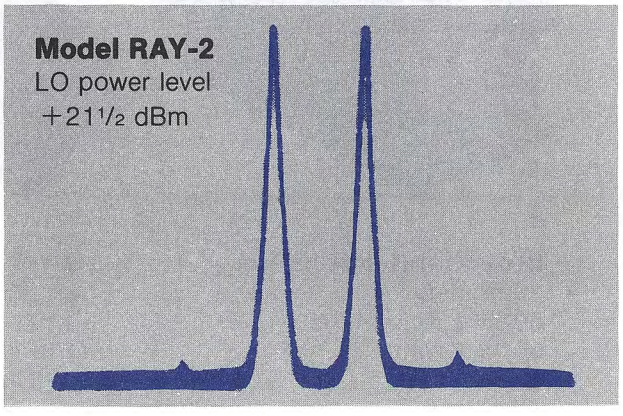
Model SRA-2H
LO power level
+17 dBm



Model SRA-1H
LO power level
+17 dBm



Model RAY-2
LO power level
+21½ dBm



improve two-tone third order testing

To proceed with the two-tone, third-order IM measurement, first set the power input from each RF generator. To set the desired power for each signal or tone at the input to the device under test, first measure the power from RF GEN #1. Thus, disconnect RF GEN #2, replace with a 50-ohm pad to maintain proper matching. Adjust the level of RF GEN #1 until the desired power at C (Fig. 1) is obtained. To set the power level of RF GEN #2 repeat the procedure.

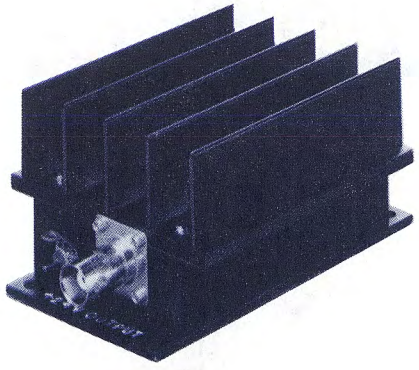
Next, place the spectrum analyzer after the filter and check the integrity of the setup; no second- or third-order components should be observed. If some level is observed, recheck to eliminate this component. Next, place the spectrum analyzer after the wideband amplifier. Again, no second- or third-order component should be seen on the spectrum analyzer display. If the input signal to the device-under-test has to be reduced, apply attenuation before, rather than after, the wideband amplifier in order to reduce its input level and thus the degree of amplifier distortion. The pads at all three input terminals to the mixer-under-test provide a constant 50-ohm impedance over a broad band to avoid reflections due to mismatch.

Now to check that the spectrum analyzer is not contributing to the distortion figures. If the input to the mixer-under-test is changed 3 dB, a 9 dB change in distortion product should be observed on the spectrum analyzer. The reason: The output of a double-balanced mixer is proportional to the cube of the input. If two equal-amplitude signals ($E_A = E_B$) are applied, the output would be $(E_A)^3$. Thus, if input E_A is changed by 3 dB, the output should change by 9 dB.

Suppose this 3:1 change is not observed? The problem could be with the test setup or the linearity of the spectrum analyzer. That's easily determined in this manner. Add 10 dB attenuation between the IF output of the mixer and the spectrum analyzer and repeat the measurement with a 3 dB change again. If the change in IM product is 9 dB, the spectrum analyzer is responsible for introducing distortion. If, on the other hand, less than a 9 dB change is noted, the test setup is at fault. Go back to the input generators and recheck that they are not interacting.

If it is difficult or impossible to observe the intermodulation distortion (IM) output, either obtain a different spectrum analyzer or use a higher level input signal and interpolate the results based on the 3:1 change on IM relationship. For ultra-low distortion mixers, this approach may be the most practical possible.

Upgrade your test setups and system's designs with Mini-Circuits' full line of low-cost, high-performance RF signal-processing components.



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up to 2 watts



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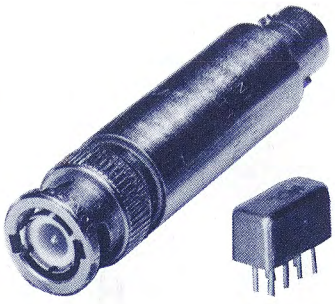
up to 48-way



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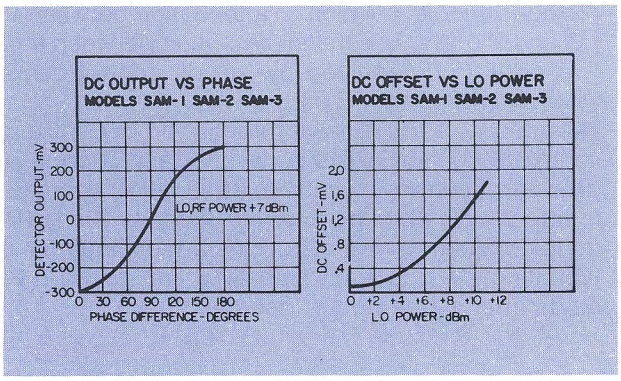
double balanced mixer



The most popular application of balanced mixer modules is to convert an incoming RF signal to a lower frequency IF output in equipment such as receivers, spectrum analyzers and radar front ends. In a double-balanced mixer, the incoming RF signal (R) is combined with a high-level oscillator signal (LO) and the desired IF sideband is selected at the output by appropriate filters. Four specially-selected Schottky-barrier diodes combined with two carefully balanced wideband transformers considerably reduce the amount of RF and LO signals appearing at the IF output; the more effective the balance, the less stringent the demand on the IF filter requirements.
In most models the R and LO signals are transformer-coupled while the IF output is dc coupled; all three ports are isolated from each other; to achieve optimum isolation between the R and LO signals, it is recommended that the oscillator be connected to the LO port and RF input be applied to the R port; for down-converter service, output is taken from the IF port. When the incoming RF signal is lower than the rated frequency response of the R-port transformer, the IF port may be used as the RF input and the R-port as the IF output.

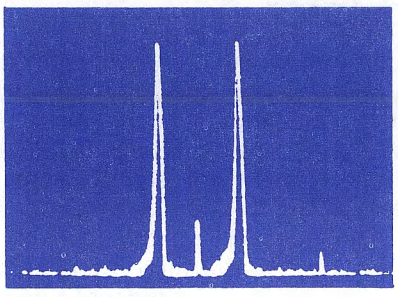
phase detector

When two signals of identical frequency but different phase are applied to the inputs of a balanced mixer, the output at the IF port will be dc voltage proportional to the phase difference. In this phase detector application, the balanced configuration reduces input signal interaction and eliminates the need for expensive, time consuming null adjustments. For optimum results, it is recommended that the two input signals be approximately the same amplitude level. For Level 7 mixers, input levels of 0 to +7 dBm are suggested since levels above this figure will tend to produce an unbalanced phase characteristic while lower input levels may deliver an insufficient dc output voltage.



balanced modulator

For double-sideband, suppressed-carrier applications, the balanced mixer is used with the carrier, signal f_c, applied to the R port and the modulating signal, f_m applied to the IF port. In this balanced modulator configuration, the output signal-composed of the f_m signal centered on the suppressed carrier f_c, is taken from the LO port.
The high isolation of Mini-Circuits mixers enable higher, 40 dB, suppression of the carrier while the undesired higher-order sidebands are almost totally removed.

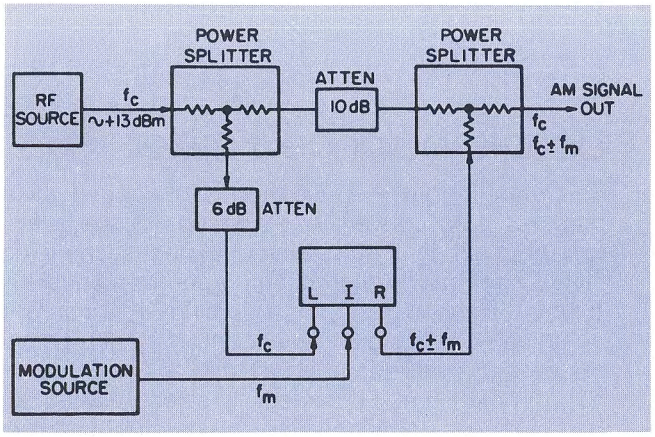


Vertical: 10 dB/Div.
Horizontal: 1 MHz/Div.

applications

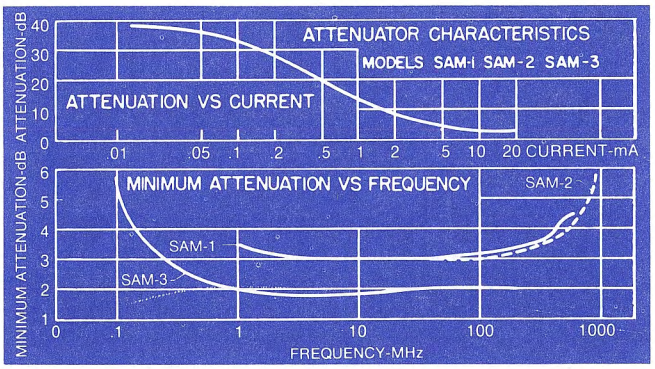
amplitude modulator

For amplitude modulator applications, the carrier, f_c, is applied to the R input while the modulating signal, f_m, is routed to the IF port. A dc current is also fed to IF port and its setting determines the quiescent point on the amplitude vs control current curve. The modulated output is taken from the LO port.
Another approach involves the use of a balanced modulator arrangement with the carrier reinserted at the mixer output, as shown. Improved control of modulation index as well as lower distortion is offered by this technique versus the variable bias approach.



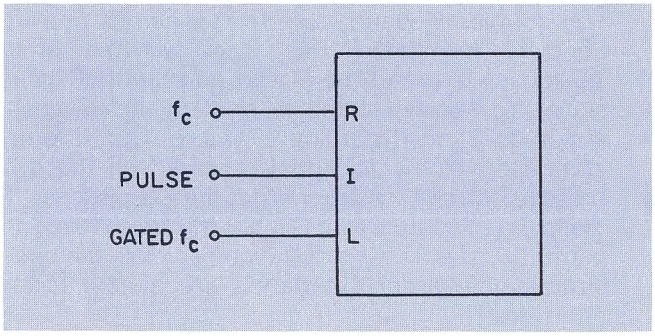
current-controlled attenuator

An interesting application of the balanced mixer is to provide variable isolation or attenuation between the LO and R ports. The transfer function between these two ports is determined by the dc control current flowing through the IF port.
When no dc current flows through the IF port, maximum attenuation exists between L and R ports. As dc control current is applied, attenuation decreases to about 2 dB when bias current exceeds 10 ma. The double balanced mixer provides a technique for attenuating low frequency signals where standard PIN diode attenuators do not operate.



pulse modulator

When service as a pulse modulator is required, the carrier is applied to the R port and the modulating pulse (either positive or negative) is connected to the IF port. The pulsed output is taken from the LO port. As with the controlled attenuator configuration, a sharp rise in current at the IF port due to a sudden pulse input drives the diodes fully on; the double balanced mixer offers the capability to provide extremely fast switching times, in the order of 1 nanosecond.



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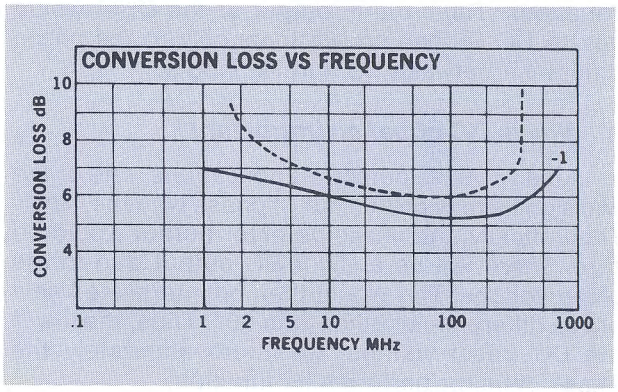
Mini-Circuits

most often asked questions about mixers

Q. ***I have several 50-ohm DBM samples in my desk drawer and need to put together a 75-ohm prototype subsystem. If I use them, what are the drawbacks?***

A. Here are some rule-of-thumb guides. The high-frequency end of the DBM range might be narrowed by approximately 20 percent (for example, a 10-500 MHz model would drop to 400 MHz). At the low end, the frequency range could be narrowed by 50 percent (for example, a 1 MHz spec would become 1.5 MHz). Thus, a 50-ohm DBM rated for a given conversion loss figure over a 1-500 MHz range would maintain the same conversion loss in a 75-ohm system over a 1.5-400 MHz range.



Q. ***Isolation specs for LO to RF and LO to IF are generally included in mixer specs, but RF to IF isolation is often not listed. What are the typical values?***

A. In a mixer application, the RF signal level is generally very low and thus the RF-IF isolation parameter is unimportant. However, in a phase detector application, the RF level is high and thus the RF-IF isolation becomes important. As a rule of thumb, LO-IF isolation is generally less than LO-RF isolation; −10dB less at low frequency, 15-20 dB less at mid- and high frequency.

Q. ***I see ads for mixers that are "termination insensitive". They are quite expensive and frankly, I can't afford them in my current design assignment. Do I have any alternatives?***

A. Yes, you do. It involves a trade-off . . . which, in fact, could lower your costs by as much as 10:1 over a "termination-insensitive" model and actually offer lower distortion provided your design can tolerate 1 dB or so additional conversion loss. Here's the alternative: select a Mini-Circuits mixer for the LO drive you have available (with Mini-Circuits Level 7, 10, 13, 17, 23 and 27 to choose from, you can optimize for lowest distortion) and your specific frequency range of operation. Then add a 3 dB attenuator (check our low-cost AT, MAT, CAT series) to the IF output. The combination will perform as well as the "termination-insensitive" model at a lower price and, in addition, is optimized by LO drive level for minimum distortion and fits your frequency range. What's the catch? The Mini-Circuits' mixer you selected probably has a conversion loss of 6 dB; plus the 3 dB attenuator results in an overall loss of 9 dB or about 1 dB higher than the "termination-insensitive" model. If your design can tolerate this slight degradation, you have a viable alternative.

Q. ***I have an application requiring mixers with coaxial connectors; a female BNC for the RF and LO input and a male BNC for the IF output. Is such a mixer available?***

A. Not as a standard model. However, you may specify a BNC male connector at the IF port, at an additional nominal charge of $1.00 per unit.
If your application requires other connector combinations, please contact us.

Q. ***My application requires a mixer with coaxial connectors and a mounting flange. What model is recommended?***

A. All Mini-Circuits' connector-style mixers are available with flange mounting. The suffix letter B should be added to the basic model.
For example, the ZAD-2 with mounting bracket would be ordered as a ZAD-2B.

most often asked questions about mixers

Q. *I recently purchased several Mini-Circuits mixers and noticed the marking "Hi-Rel". What does this mean?*

A. In addition to all of the quality control steps taken at Mini-Circuits to ensure high-reliability mixers, additional Hi-Rel steps are taken including: (1) burn-in for 96 hours at 100°C with 8 mA at 1 KHz; (2) thermal shock, and (3) gross and fine leak tests per MIL-STD-202.

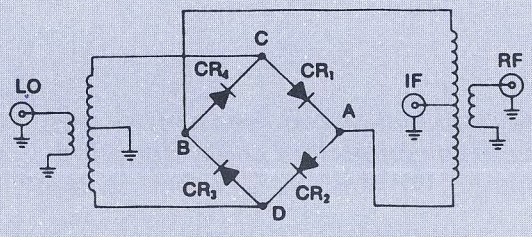
Any model may be ordered with Hi-Rel testing. Just add the suffix Hi-Rel to the model number and $1.00 per unit.

Q. *My application requires a rugged, low-cost mixer with high reliability. What model would you recommend?*

A. We recommend the SBL-1 for a rugged, industrial application. It is the lowest cost mixer in the world (only $3.95 in small quantity lots) with over millions of units operating reliably in the field today.

Q. *A couple of diodes can be hooked up as a phase detector. Why go to the trouble and expense of using a double-balanced mixer (DBM) for the same function?*

A. A DBM is an ideal device for phase detection since it offers high isolation between all three ports—the reference (LO), input signal (RF) and output (IF). Furthermore, the DBM provides very low DC offset or residual voltage at the IF output.



Double-Balanced Mixer Schematic

Q. *I've tried using a DBM as a phase detector and have experienced an odd result. What am I doing wrong?*

A. Perhaps you added an op amp without considering the op amp DC input voltage, impedance matching and/or proper filtering.

Another source of erratic results can be a defective diode in the DBM. To check, measure the LO to RF isolation at a fairly low frequency. If isolation does not meet or exceed published specs, a diode is probably defective.

Q. *Why must the DBM be operated in a saturated mode when used as a phase detector?*

A. When sufficiently high input level signals are applied to the LO and RF ports, the DBM operates in a saturated mode (as a limiter) and thus the IF output becomes independent of input signal level variations. Thus, the IF output of the DBM would have a DC voltage proportional only to the phase difference between LO and RF inputs.

Q. *Why is DC offset so important?*

A. In many phase detector applications, one of the two signals may be 90° out of phase with the other. Theoretically, the phase detector output would be zero. There will be a slight DC output due to the offset voltage. This would then be interpreted as a phase difference of other than 90°. Thus, the lower the DC offset voltage, the more accurately the phase detector performs its function.

Q. *Data sheets from most phase detector manufacturers indicate both input signals, RF and LO, should be equal in amplitude. Suppose they are not?*

A. If the signal inputs to the LO and RF ports are of sufficient magnitude, the phase detector will operate in a saturated mode and provide a DC output proportional to the phase difference between the two signals. However, if the LO signal is of sufficient amplitude but the RF signal is low in amplitude, the output of the phase detector will be proportional to the amplitude as well as the phase of the RF input.

To operate the DBM in the required saturated mode, the RF signal level should be at least:

+1 dBm for Standard Level (+7 dBm LO) mixers
+10 dBm for High Level (+17 dBm LO) mixers
+15 dBm for Very High Level (+23 dBm LO) mixers.

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Q. *I've selected a mixer that will provide the IM products to meet my design requirements. However, I'm concerned that LO power variations may get me into trouble. How can I be sure of my design?*

A. Mini-Circuits exclusive CAPD data is your salvation. Detailed point-by-point data are available for a given RF input level and frequency with LO drive a variable. For example, let's consider an SRA-1 mixer with RF input at −10 dBm and 400 MHz, and an LO at 370 MHz. Here's how LO drive variation affects the 3 × 1 product (third harmonic of RF mixing with LO): with LO at +4 dBm, the 3 × 1 product is 40 dB below IF; at +7 dBm LO, 56 dB down; and at +10 dBm LO, 63 dB below IF. This indicates a rather substantial change in IM level with LO drive variation. There's no need to gamble or guess . . . take advantage of Mini-Circuits exclusive CAPD service for these and similar unusual design situations.

mixer harmonic intermodulation

model SRA-1

(Relative to desired IF Output)

Harmonic RF Order	RF CAL	LO at +4dBm						
		0	1	2	3	4	5	6
0	0	—	36	17	24	24	29	33
1	0	18	—	33	18	35	31	45
2	74	42	49	41	63	45	57	57
3	78	66	40	51	35	54	38	57
4	79	68	72	66	69	63	69	63
5	78	72	71	72	65	68	59	60
6	77	70	71	71	72	73	72	73
7	78	71	69	71	71	71	72	71
8	78	72	71	71	70	71	71	70
9	80	72	72	68	70	71	71	72
10	80	71	72	71	70	72	71	71
11	79	71	72	72	72	71	70	70
12	79	71	71	72	71	72	71	71
13	78	71	71	71	70	72	71	71
14	80	72	71	72	71	71	71	71
15	73	66	73	71	71	71	71	72

Harmonic LO Order

Harmonic RF Order	RF CAL	LO at +7dBm						
		0	1	2	3	4	5	6
0	0	—	31	17	27	22	28	30
1	0	17	—	37	11	33	37	47
2	74	48	47	50	52	49	60	56
3	78	66	56	58	46	57	44	68
4	79	71	71	72	70	73	69	70
5	78	73	73	72	73	73	71	72
6	77	73	71	72	71	73	73	73
7	78	73	71	72	71	73	73	73
8	78	74	72	72	71	74	74	73
9	80	74	72	73	72	72	72	73
10	80	73	74	73	71	73	73	73
11	79	71	73	73	72	72	72	71
12	79	73	73	72	74	72	73	72
13	78	73	73	73	73	72	73	73
14	80	73	72	73	73	73	73	73
15	73	66	73	72	73	73	73	73

Harmonic LO Order

Harmonic RF Order	RF CAL	LO at +10dBm						
		0	1	2	3	4	5	6
0	0	—	26	13	25	16	21	21
1	0	19	—	42	10	30	30	39
2	74	63	53	71	59	58	62	58
3	78	69	63	70	69	73	64	72
4	79	72	73	74	72	73	73	74
5	78	72	72	74	74	74	72	73
6	77	71	72	73	72	73	73	72
7	78	72	72	71	73	72	73	73
8	78	72	71	72	72	72	74	73
9	80	74	71	71	71	72	73	73
10	80	73	73	72	72	74	72	73
11	79	73	73	72	73	73	73	71
12	79	73	73	73	73	73	73	72
13	78	73	73	74	72	73	72	73
14	80	72	73	72	74	74	74	73
15	73	66	73	73	73	72	73	73

Harmonic LO Order

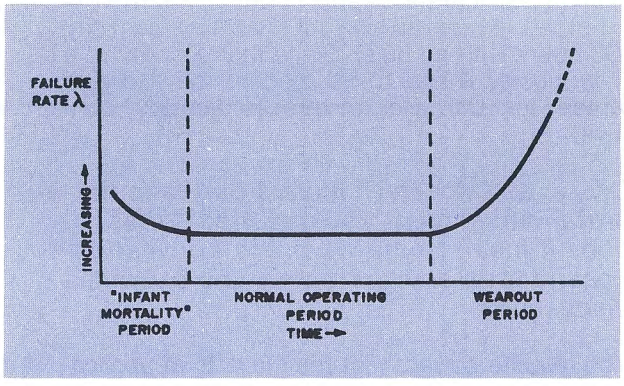
test conditions

RF = 400.1 MHz at −10dBm LO = 370.01 MHz

For other test frequencies, contact factory.

Q. *Mini-Circuits' ads refer to HTRB testing. What does this mean?*

A. The predominant factor in mixer failure is traced to diode breakdown and punch-through resulting in high leakage currents. Mini-Circuits HTRB (High-Temperature Reverse Bias) technique is an accelerated diode screening program. Each Schottky diode is operated at 150°C for 168 hours with one volt reverse bias applied. This process deliberately stresses the diodes to accelerate aging and force time-related failure modes to occur and thus screen out "infant mortality". This method locates potentially-unreliable diodes before they are assembled into the mixer package.



most asked questions about mixers

Q. *I need a mixer that can perform with an LO level of 0 dBm or even lower, What can you suggest?*

A. Mini-Circuits' model UNCL-L1 includes a built-in amplifier between the LO input and the mixer, so excellent performance over 0.5 to 500 MHz can be achieved with LO input as low as −4 dBm. Also consider the Level 3 RMS series of +3 dBm LO mixers that perform well even at 0 dBm.

Q. *My new design will require surface-mount mixers. What SMT models are available from Mini-Circuits?*

A. We offer a wide variety of off-the-shelf surface-mount packages in plastic or metal cases. All catalog models can be obtained in surface-mount configurations; contact our Applications Engineering department.

Q. *Input noise is a critical factor in my receiver design. Which mixer would you recommend?*

A. There are many factors to consider in addition to conversion loss and noise figure. The article "How to Select a Mixer" (See Table of Contents) will lead you to a model best suited for your application and you can then choose from the wide variety offered by Mini-Circuits.

Q. *What makes it possible for Mini-Circuits to offer a five-year guarantee on its Ultra-Rel™ mixers?*

A. The key factor is an improved monolithic processing technique, developed jointly by Mini-Circuits and H-P, for producing Ultra-Rel diodes that meet and exceed MIL-STD-883 tests with ease. When these devices were exposed to a brutal accelerated high-temperature test of 250°C for 981 hours, none failed; even at a sizzling 300°C, none failed. Conventional diodes could not endure such punishment.

Other tests applied to these Ultra-Rel diodes include grueling mechanical shock and vibration, thermal cycling, autoclave, and 85/85 (85°C at 85% humidity for 168 hours with no bias). Since the reliability of a mixer is closely linked to its diodes, the five-year guarantee for Ultra-Rel mixers is actually consevative.

Q. *OK . . . so Ultra-Rel™ mixers can take the brutal punishment you describe. What does it mean to me when my application doesn't face anywhere near the extremes discussed?*

A. You're quite correct that the majority of applications do not require the demanding levels of endurance offered by Ultra-Rel™ mixers. But recent studies among design engineers indicate quality is the number-one factor today in selecting a vendor and his product line, with price second, and prompt delivery third. With this in mind, consider how Ultra-Rel™ mixers in your product design and production will enhance your product's reliability and thus strongly influence your firm's reputation and your customer's satisfaction.

Q. *My application dictates a rugged surface-mount mixer but price is critical. What would you recommend?*

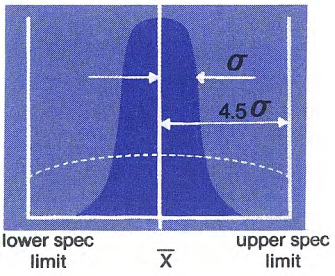
A. Consider Mini-Circuits' TUF-series, the most rugged surface-mount mixers in the world, with all-welded internal and external construction. The 0.5 by 0.2 by 0.25 in. metal case TUF- units employ only four gull wings to simplify lead placement on pc boards. And priced low . . . from $3.95 each in 10 quantity.

Q. *I need a "termination insensitive" mixer but most advertised models are too expensive for my current application. Any thoughts?*

A. For 1-500 MHz operation, consider Mini-Ciruits' UNCL-X1 or -X1MH which provides a built-in buffer amplifier between the mixer and the following IF amplifier stage. The excellent 50-ohm match of the internal amplifier is repsonsible for better than 20 dB IF and RF return loss. Excellent directivity of the amplifier is responsible for the termination insensitivity of the mixer. And prices start from only $23.95.

Q. *Your ads highlight "4.5 sigma guaranteed". Without overwhelming me with statistical processing equations, can you briefly describe what this means to me and my company's design and production efforts.*

A. By applying powerful statistical process-control techniques, Mini-Circuits can guarantee "skinny" sigma with spec limits 4.5 sigma from the mean value (process capability C_{PK} of 1.5). That's the brief mathematical description.



Sigma (σ) is a statistical measure of the Gaussian variability around a mean value $\bar{x}$. In a normal Gaussian distribution (dotted line), 68% of the units fall within one standard deviation or one sigma. With a 4.5 sigma criteria, only 4 units in a million-lot production run approach the spec limit.

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Here's what this means to you and your company in terms of design and production. We guarantee that production units sent to you today, tomorrow, and next year will very closely match the performance of units supplied for your initial evaluation and prototypes. Such product uniformity translates to substantial reductions in cost by trimming manufacturing throughput time, rework, specialized test equipment, troubleshooting, report paperwork, and inspection personnel. This all results in cost savings to you.

Q. *I am a digital designer, dealing with pulses rather than sine waves. Is it necessary to furnish only sine waves to a DBM?*

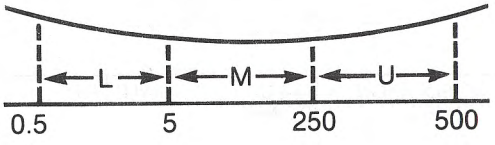
A. No. A DBM operates as a switching device . . . pulses are fine (and may even lower distortion).

Q. *I see specs given in normalized frequency ranges. Can you clarify such terms as: one octave from band-edge, lower band-edge to one decade higher, and upper band-edge to one octave lower?*

A. To normalize frequency on spec sheets, the mixer frequency range is divided into three parts, L, M and U.

The lower frequency range, L, covers the lowest specified frequency to one decade higher (or ten times the lowest frequency). The upper frequency range, U, covers the highest frequency to one octave lower (or one-half the highest frequency). The mid-range, M, covers the highest end of the low-frequency range to the low end of the high-frequency range.

For example, a mixer covering 0.5-500 MHz would have the following divisions:



Q. *DBMs don't seem to be cluttered with bulky and expensive filters. How come?*

A. The inherent isolation between LO, IF and RF ports make filters unnecessary. Thus, DBMs can be operated over a wide bandwidth with very high isolation; 50 dB is typical at lower frequencies.

Q. *I'm dealing with low-level 1000 MHz signals and low distortion is a must. I have a 70 MHz IF amplifier following the mixer. Should I be concerned with the amplifier input impedance?*

A. If the IF port does not appear as 50-ohms, there will be reflections causing distortion products.

Q. *I need to attenuate low frequencies, from 1 KHz to 2MHz, and PIN diode attenuators won't do the job. Can I use a DBM for this application?*

A. Yes. A DC current flowing through the IF port can provide isolation or attenuation between the LO and RF ports. With no current through the IF port, maximum attenuation (50 dB or more) exists between the LO and RF ports. As IF port current flow increases, attenuation decreases to about 2 dB.

Q. *A basic DBM uses four diodes in a symmetrical arrangement. How can I diagnose a defective mixer?*

A. Most mixer failures can be traced to defective diodes. Measure the LO-RF isolation at the low-frequency end of the DBM range (10 MHz or lower). If isolation is less than 45 or 50 dB, one of the diodes is probably shorted or leaky. Then check conversion loss. A leaky diode would increase the conversion loss by 0.5 dB; and an open diode by as much as 2 dB.



Q. *Your ads mention CAPD (Computer-Automated Performance Data). What's its significance to me, the design engineer?*

A. Most mixer manufacturers merely supply a spec sheet for each model. Mini-Circuits has developed and introduced its exclusive Computer-Automated Performance Data (CAPD) software, using computer-controlled test set-ups. Here's how you, the designer, benefits:

- no more guesswork on how the mixer interacts with filters
- clearly shows how critical parameters vary with frequency
- quickly indentifies in-band spurious responses
- indicates how LO drive variations affect VSWR, conversion loss, isolation and intermod. And offers perhaps the only published data on how LO drive affects VSWR and intermod.

Quite significant, CAPD allows you to obtain specific data at the frequencies you are concentrating on rather than arbitrary frequencies selected by a manufacturer. Need specific information? Just contact our Engineering Applications department, let us know what models you are interested in and your frequencies of interest—we'll fulfill your request and supply you with appropriate CAPD data.

Frequency Mixers

Load Insensitive

UNCL-X1 (+7 dBm LO, up to +1 dBm RF)
UNCL-X1MH (+13 dBm LO, up to +7 dBm RF)

case style selection

outline drawings see Table of Contents



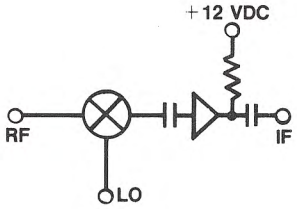
UNCL-X
UNCL-X1MH

	MODEL NO.	FREQUENCY MHz LO/RF f_L	FREQUENCY MHz IF f_U	CONVERSION GAIN, dB Mid Band $\bar{X}$	Mid Band σ	Mid Band Min.	Total Range Min.	LO-RF ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO-IF ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INPUT POWER (dBm) 1 dB Comp Typ.	DC POWER Volt	DC POWER Current (mA)	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
UNCL-X case A01	UNCL-X1	1-500	10-500	1.57	.05	-1.0	-1.0	60	40	30	25	25	20	50	30	30	20	26	18	1	12	36	23.95	●	●
	UNCL-X1MH	1-500	10-500	2.41	.015	0.5	0	60	40	35	25	30	20	50	30	25	18	18	14	7	12	60	27.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

features

2-tone 3rd-order IM
insensitive to IF load
VSWR 1.2:1, IF/RF ports

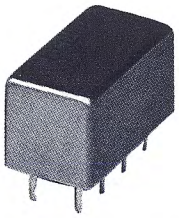


Low Noise (4.3 dB typ.)

UNCL-R1 (+7 dBm LO, up to -10 dBm RF)
UNCL-R1H (+17 dBm LO, up to +1 dBm RF)

case style selection

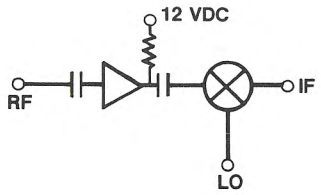
outline drawings see Table of Contents



UNCL-R1
UNCL-R1H

	MODEL NO.	FREQUENCY MHz LO/RF f_L	FREQUENCY MHz IF f_U	CONVERSION GAIN, dB Mid Band $\bar{X}$	Mid Band σ	Mid Band Min.	Total Range Typ.	Total Range Min.	LO-RF ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO-IF ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INPUT POWER (dBm) 1 dB Comp Typ.	DC POWER Volt	DC POWER Current (mA)	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
UNCL-R case A01	UNCL-R1	10-500	DC-500	5.53	.11	2	5	2	65	45	55	40	47	35	40	30	30	20	25	17	-10	12	35	23.95	●	●
	UNCL-R1H	10-500	DC-500	6.32	.23	3	6	2	65	45	55	40	47	35	40	30	35	25	28	19	1	12	60	27.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)



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Mini-Circuits

ULTRA•REL™ MIXERS

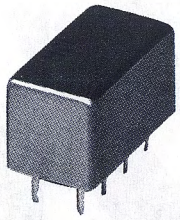
5-YR. GUARANTEE *

Low LO drive

UNCL-L1 (−4 dBm LO, up to 1 dBm RF)
UNCL-L1H (+6 dBm LO, up to 14 dBm RF)

case style selection

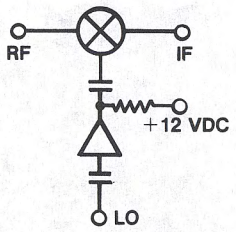
outline drawings see Table of Contents



UNCL-L1
UNCL-L1H

	MODEL NO.	FREQUENCY MHz LO/RF f_L f_U	IF	CONVERSION LOSS, dB Mid Band $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO-IF ISOLATION dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	INPUT POWER 1 dB Comp Typ.	DC POWER Volt	Current (mA)	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
UNCL-L	UNCL-L1	10-500	DC-500	5.73	.08	8.0	8.5	45	30	35	20	25	17	32	20	23	15	18	12	11	12	35	23.95	•	•
case A01	UNCL-L1H	10-500	DC-500	5.73	.07	8.0	8.5	45	25	36	20	24	17	32	18	25	15	18	10	14	12	60	27.95	•	•

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)



pin connections

	UNCL-X	UNCL-R	UNCL-L
LO	7	7	1
RF	8	1	7
IF	1	8	8
CASE GND	3, 5, 6	3, 5, 6	3, 5, 6
DC	4	4	4
NOT USED	2	2	2

NOTES:
1. For quality control procedures, environmental specifications, see Table of Contents.
2. Absolute Maximum Ratings, see Table of Contents.
3. Prices and specifications subject to change without notice.

$\bar{X}$ = Average of conversion loss at center of mid-band frequency (f_L + f_U/4).
σ = Standard deviation.

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

SURFACE MOUNT MIXERS

...with a difference



actual size

up to 1900MHz from $6.25

Now available, a large variety of tiny, ultra-rel high performance mixers to handle your applications from extra wideband, high isolation, low two-tone third-order IM, to very low +3dBm LO power. Mini-Circuits' new LRMS-series Ultra-Rel™ mixers are offered with a difference... unprecedented reliability. Units are manufactured with Ultra-Rel diodes, all-welded construction, metal stubs to all connections, and to 4.5 sigma performance repeatability. Each Ultra-Rel™ LRMS mixer can withstand strenuous shock and vibration, will perform over a -55° to +100°C range, and is guaranteed for five years. Aim for 4.5 sigma repeatability in your product designs by specifying Mini-Circuits' Ultra-Rel™ LRMS mixers, available for immediate delivery in tape-and-reel format (500 units, 16mm width) at prices from $6.25.

ULTRA-REL™ MIXERS
*5-YR. GUARANTEE **

with extra long life due to unique HP monolithic diode construction, 300°C high temp. storage, 1000 cycles thermal shock, vibration, acceleration, and mechanical shock exceeding MIL requirements.

SPECIFICATIONS: all spec limits are 4.5 σ from mean

Model	Freq. Range LO. RF	(MHz) IF	LO Level (dBm)	Conv. Loss Mean ($\bar{X}$) mid-band (dB)	L-R Isol. Mean ($\bar{X}$) mid-band (dB)	Price $ (1-9)
LRMS-2L	800-1000	DC-200	+3	6.6	24	6.95
LRMS-1	0.5-500	DC-500	+7	6.4	45	6.25
LRMS-1W	2.0-750	DC-750	+7	5.8	45	6.75
LRMS-2	5-1000	DC-1000	+7	6.8	38	6.95
LRMS-2D	5-1000	DC-1000	+7	6.8	40	7.25
LRMS-2U	10-1000	10-1000	+7	6.5	46	11.45
LRMS-5	5-1500	DC-1000	+7	6.0	41	13.95
LRMS-11A	1400-1900	40-500	+7	7.0	25	16.95
LRMS-1LH	2.0-500	DC-500	+10	5.8	47	7.95
LRMS-2LH	5-1000	DC-1000	+10	6.6	40	8.95
LRMS-5LH	10-1500	DC-900	+10	5.4	38	14.95
LRMS-1MH	2.0-500	DC-500	+13	5.7	44	8.95
LRMS-2MH	5-1000	DC-1000	+13	6.6	44	9.95
LRMS-5MH	10-1500	DC-900	+13	5.8	46	15.95
LRMS-1H	2.0-500	DC-500	+17	6.3	44	10.95
LRMS-2H	5-1000	DC-900	+17	7.2	36	11.95
LRMS-2UH	10-1000	10-750	+17	7.1	38	14.45
LRMS-5H	10-1500	DC-900	+17	7.2	45	17.95

finding new ways...
setting higher standards

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C146 REV.ORIG.

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

LEVEL 3 (+3 dBm LO, up to −3 dBm RF)
low LO power
400 MHz to 1400 MHz



RMS LRMS

MODEL NO.	FREQUENCY (MHz) LO/RF f_L-f_U	FREQUENCY (MHz) IF	CONVERSION LOSS (dB) $\bar{X}$	CONVERSION LOSS (dB) σ	CONVERSION LOSS (dB) max.	ISOLATION LO-RF (dB) typ.	ISOLATION LO-RF (dB) min.	ISOLATION LO-IF (dB) typ.	ISOLATION LO-IF (dB) min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
o□RMS-L RMS-2L	800-1000	DC-200	5.34	.077	8.4	24	16	20	12	6.95	•	•
case TT-146 RMS-5L	400-1400	DC-800	5.34	.077	9.8	22	14	18	6	13.95	•	•
o□LRMS-L LRMS-2L	800-1000	DC-200	5.34	.077	8.4	24	16	20	12	6.95	•	•
case QQQ-130 LRMS-5L	400-1400	DC-800	5.34	.077	9.8	22	14	18	6	13.95	•	•

typical performance

Model RMS-5L

LO Frequency (MHz)	Conversion Loss@ (dB)	LO-RF Isolation (dB)	LO-IF Isolation (dB)
400	6.12	37.67	32.17
480	5.89	38.84	30.34
560	5.34	43.01	30
600	5.32	48.76	28.84
680	5.33	40.17	26.67
760	5.5	31.33	24.16
840	6.08	27.17	21.5
920	6.74	24.5	19.17
1000	7.26	22.5	17.33
1080	7.73	21.52	15.67
1120	7.96	21.01	15.5
1200	8.05	20.33	13.83
1280	8.02	20	12.5
1360	8.24	19.66	11.16
1400	8.29	19.83	10.5

@ With IF frequency at 150 MHz

features

- low LO power: 3 dBm.
- RMS-2L is usable at 0 dBm LO.
- wide band coverage: 400-1400 MHz.
- 1 dB compression, −3 dBm typical.
- miniature surface mount (0.25″ x 0.31″ x 0.2″).
- conversion loss spec limit 4.5 σ typical from mean.
- ideal for cellular applications.

pin configuration

LO	1
RF	4
IF	5
GND	2,3,6

NOTES:
o Available on tape and reel. please consult factory.
□ **NON-HERMETIC**
1. Max. RF power: 50 mW
2. Max. IF current: 40 mA
3. Prices and specifications subject to change without notice

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

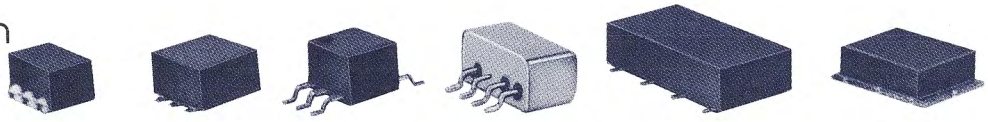
Frequency Mixers

40 KHz to 4.3 GHz

LEVEL 7 (+7 dBm LO, up to +1 dBm RF) surface-mount

case style selection

outline drawings Table of Contents



RMS LRMS ASK-KK81 TUF-SM SCM-NL SYM

	MODEL NO.	FREQUENCY MHz LO/RF f_L-f_U	IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO-IF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
o□†RMS	RMS-1	0.5-500	DC-500	5.94	.05	7.0	8.5	55	50	33	25	27	20	55	45	30	23	24	19	6.25	●	●
case TT-100	RMS-1W	2-750	DC-750	5.83	.21	7.5	8.5	70	45	45	28	38	22	60	45	40	25	30	20	6.75	●	●
	RMS-2	5-1000	DC-1000	6.67	.26	8.0	9.5	60	40	40	20	25	18	55	30	30	20	20	12	6.95	●	●
	RMS-2D	5-1000	DC-1000	6.81	.06	8.0	10.0	59	40	40	30	33	22	55	30	40	22	30	20	7.25	●	●
	RMS-2U	10-1000	10-750	6.79	.16	8.0	9.5	55	40	40	30	30	25	55	30	35	25	30	22	11.45	●	●
	RMS-5	5-1500	DC-1000	5.92	.34	7.5	9.5	60	40	40	20	30	18	55	30	30	18	15	8	13.95	●	●
	RMS-11A	1500-1900	40-400	—	.19	—	9.0			25 (typ.)		17 (min.)				23 (typ.)		15 (min.)		16.95	●	●
	RMS-860	800-1050	DC-250	5.5	.23	7.5	7.5			36 (typ.)		25 (min.)				24 (typ.)		18 (min.)		11.45	●	●
o□† LRMS	LRMS-1	0.5-500	DC-500	5.94	.05	7.0	8.5	55	50	33	25	27	20	55	45	30	23	24	19	6.25	●	●
case QQQ-130	LRMS-1W	2-750	DC-750	5.83	.21	7.5	8.5	70	45	45	28	38	22	60	45	40	25	30	20	6.75	●	●
	LRMS-2	5-1000	DC-1000	6.67	.26	8.0	9.5	60	40	40	20	25	18	55	30	30	20	20	12	6.95	●	●
	LRMS-2D	5-1000	DC-1000	6.81	.06	8.0	10.0	59	40	40	30	33	22	55	30	40	22	30	20	7.25	●	●
	LRMS-2U	10-1000	10-750	6.79	.16	8.0	9.5	55	40	40	30	30	25	55	30	35	25	30	22	11.45	●	●
	◇ LRMS-1R	0.5-500	DC-500	5.80	.16	7.0	8.5	55	50	33	25	27	20	55	45	30	23	24	19	14.45	●	●
	◇ LRMS-2R	5-1000	DC-1000	6.60	.14	8.0	10.0	55	40	39	20	22	17	46	35	30	20	18	11	14.95	●	●
	LRMS-5	5-1500	DC-1000	5.92	.34	7.5	9.5	60	40	40	20	30	18	55	30	30	18	15	8	13.95	●	●
	◇ LRMS-5R	10-1500	DC-1000	5.62	.12	8.0	9.9	50	40	34	20	22	18	50	27	30	15	14	7	16.95	●	●
	LRMS-11A	1500-1900	40-400	—	.19	—	9.0			25 (typ.)		17 (min.)				23 (typ.)		15 (min.)		16.95	●	●
	LRMS-860	800-1050	DC-250	5.5	.23	7.5	7.5			36 (typ.)		25 (min.)				24 (typ.)		18 (min.)		11.45	●	●
o□ASK	ASK-1	1-600	DC-600	5.58	.06	7.0	8.5	50	30	35	25	30	20	45	35	30	20	25	15	6.95	●	●
case KK-81	ASK-2	1-1000	DC-1000	6.79	.10	8.0	9.8	60	40	35	18	26	16	50	30	25	17	15	10	8.25	●	●
o□TUF-SM	TUF-1SM	2-600	DC-600	5.85	.04	7.0	8.0	60	50	42	30	37	25	60	45	47	30	36	22	4.25	●	●
case NNN-150	TUF-2SM	50-1000	DC-1000	5.85	.07	7.5	9.0	58	40	47	30	42	25	50	35	44	20	29	18	5.20	●	●
	†TUF-3SM	0.15-400	DC-400	4.7	.02	7.0	8.0	60	50	46	30	35	25	60	40	47	25	35	20	6.10	●	●
	TUF-5SM	20-1500	DC-1000	5.7	.04	9.0	9.0	54	40	42	30	39	25	40	25	32	18	23	8	9.45	●	●
	TUF-11ASM	1400-1900	40-500	6.8	.30	8.6	8.6			33 (typ.)		20 (min.)				29 (typ.)		15 (min.)		16.95	●	●
	TUF-860SM	800-1050	DC-250	5.6	.24	7.75	7.75			35 (typ.)		25 (min.)				27 (typ.)		20 (min.)		9.45	●	●
o□SCM	SCM-1	1-500	DC-500	5.72	.10	7.0	8.0	60	40	45	35	40	30	50	40	45	35	40	25	4.25	●	●
case YY-101	SCM-2	5-1000	DC-500	5.76	.03	7.5	9.8	50	40	40	25	35	20	55	30	40	25	30	18	5.45	●	●
	SCM-5	1250-1800	DC-500	5.82	.19	—	8.0			28 (typ.)		17 (min.)				18 (typ.)		8 (min.)		11.95	●	●
	SCM-2500	500-2500	DC-500	5.88	.08	6.9	10.0	35	22	35	22	35	22	18	12	18	12	18	12	11.95	●	●
o□SYM	SYM-2	2-1000	DC-1000	5.4	.10	7.2	9.5	70	45	50	30	40	25	63	40	48	24	37	20	11.95	●	●
case TTT-166	SYM-860	800-1050	DC-250	5.6	.10	7.0	7.0			39 (typ.)		25 (min.)				37 (typ.)		20 (min.)		8.95	●	●
case TTT-167	SYM-11	1-2500	10-600	7.0	.30	9.0	10.5	63	40	40	24	34	20	61	40	35	20	28	15	9.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

m=mid band ($2f_L$ to $f_U/2$)

NOTES:

o Available in tape and reel. Please consult factory.
◇ hermetically sealed diodes
PAM-42 protected under patent 4,430,758.
† Phase Detection, Polarity Positive
□ NON-HERMETIC
$\bar{X}$ = Average of conversion loss at center of mid-band frequency (f_L + $f_U/4$).
σ = Standard deviation.
1. For quality control procedures, environmental specifications, and Hi-Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings: RF power 50 mW, peak IF current 40 mA, see Table of Contents.
3. Prices and specifications subject to change without notice.

pin connections

see case style outline drawing

Series	RMS LRMS	SCM			SYM
models	all models	-1	-2	-2500 -5	all models
LO	1	8	8	1	2
RF	4	1	1	8	1
IF	5	3,4	3	3	3
GND◆	2,3,6	2,5,6,7	2,5,6,7	2,4,5,6,7	4,5,6
CASE GND	—	4: NOT USED			

◆ Ground externally. All measurements made with GND pin(s) grounded externally.

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

Plug-In/Flat-Pack



ASK-X65



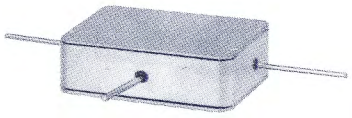
ASK



TUF
TFM



LMX



PAM

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{x}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO–IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
□* ASK	ASK-1	1–600	DC–600	5.58	.06	7.0	8.5	50	30	35	25	30	20	45	35	30	20	25	15	6.95	●	●
case W38	ASK-2	1–1000	DC–1000	6.79	.10	8.0	9.8	60	40	35	18	26	16	50	30	25	17	15	10	8.25	●	●
TFM	TFM-2	1–1000	DC–1000	5.74	.07	7.5	8.5	50	45	40	25	30	25	45	40	35	25	25	20	13.95	●	●
case B02	†TFM-2P	1–1000	DC–1000	5.74	.07	7.5	8.5	50	45	40	25	30	25	45	40	35	25	25	20	13.95	●	●
	TFM-3	0.04–400	DC–400	4.70	.06	7.0	8.0	60	50	50	35	35	25	55	40	45	30	35	25	21.45	●	●
	†TFM-4	5–1250	DC–1250	6.47	.05	7.5	8.5	50	45	40	30	30	25	45	40	35	25	25	20	23.45	●	●
	TFM-5	5–1500	DC–1000	6.33	.06	8.5	9.5	60	45	35	25	30	25	60	40	35	15	25	14	25.45	●	●
case B13	TFM-11	1–2000	5–600	7.16	.07	8.5	9.0	50	45	35	25	25	10	45	40	27	20	25	20	47.45	●	●
	TFM-12	800–1250	50–90	5.71	.14	—	7.5	35	25	35	25	35	25	30	20	30	20	30	20	47.45	●	●
	TFM-2400	750–2400	DC–400	6.65	.20	—	9.0	30	20	30	20	30	20	30	10	30	10	30	10	28.95	●	●
	TFM-4300	300–4300	DC–800	5.87	.13	—	10.5	30	20	—	—	30	17	15	7	—	—	10	7	38.95		
LMX	LMX-3	0.04–400	DC–400	4.84	.05	7.0	8.0	60	50	50	35	35	25	45	40	35	25	25	20	25.95	●	●
case BB48	LMX-113	5–1000	DC–1000	5.72	.05	7.0	8.0	50	40	40	25	35	25	45	35	35	30	30	20	16.95	●	●
	LMX-124	0.5–500	DC–500	5.18	.06	6.5	7.0	50	40	45	25	45	22	45	40	40	30	30	20	27.95	●	●
	LMX-149	10–1500	DC–1500	6.58	.09	7.5	9.0	55	40	45	35	30	20	50	40	40	25	20	12	29.95	●	●
	LMX-156	800–2500	DC–1500	7.09	.37	9.0	9.0	35	25	35	25	35	25	22	17	22	17	22	17	44.95	●	●
□ PAM	PAM-42	2000–4200	DC–1300	8.13	.14	—	8.5		25 (typ.)		17 (min.)				12 (typ.)		8 (min.)			27.95	●	●
case AA46																						
□TUF	TUF-1	2–600	DC–600	5.85	.04	7.0	8.0	60	50	42	30	37	25	60	45	47	30	36	22	4.25	●	●
case B02	TUF-2	50–1000	DC–1000	5.85	.07	7.5	9.0	58	40	47	30	42	25	50	35	44	20	29	18	5.20	●	●
	†TUF-3	0.15–400	DC–400	4.7	.02	7.0	8.0	60	50	46	30	35	25	60	40	47	25	35	20	6.10	●	●
	TUF-5	20–1500	DC–1000	5.7	.04	9.0	9.0	54	40	42	30	39	25	40	25	32	18	23	8	9.45	●	●
	TUF-11A	1400–1900	40–500	6.8	.30	8.6	8.6		33 (typ.)		20 (min.)				29 (typ.)		15 (min.)			16.95	●	●
	TUF-860	800–1050	DC–250	5.6	.24	7.75	7.75		35 (typ.)		25 (min.)				27 (typ.)		20 (min.)			9.45	●	●

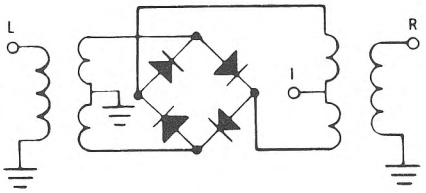
L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)
m=mid band (2 f_L to $f_U/2$)

*ASK–Plug-In mounting case X65.

ASK	TUF-SM TUF TFM	LMX	PAM	CBL
all models	all models ■	all models	all models	all models
1	4	8	3	8
4	1	5	1	3,4
5	2	4	4	1
2,3,6	3	2,3,6,7	2	2,5,6,7
—	3	2,3,6,7	2	

■ TFM-2400, TFM-5 and TFM-4300 LO = 1; RF = 4

schematic



NSN GUIDE

MCL NO.	NSN
ASK–1	5895–01–320–0366
TFM–2	5895–01–135–1852
TFM–3	5895–01–112–0031
TFM–12	5895–01–179–5686
TFM–4	5895–01–317–9388

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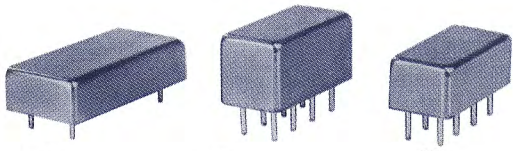
most widely–used

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

case style selection

outline drawings Table of Contents



GRA SRA SBL SIMA

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO–IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
GRA case D09	GRA-1	.5–500	DC–500	5.96	.09	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	14.95	●	●
	GRA-3	.025–200	DC–200	4.78	.07	7.5	8.5	60	50	45	35	35	25	45	35	40	30	30	20	18.45	●	●
	GRA-6	.003–100	DC–100	4.70	.14	7.5	8.5	60	50	45	30	35	25	60	45	40	25	30	20	28.95	●	●
	GRA-8	.0005–10	DC–10	6.03	.08	7.5	8.5	60	50	50	40	45	35	60	50	50	40	45	35	31.95	●	●
SRA case A01	● SRA-1	.5–500	DC–500	5.11	.09	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	13.45	●	●
	SRA-1TX	.5–500	DC–500	5.68	.04	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	59.95	●	
	SRA-1W	1–750	DC–750	5.80	.04	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	15.95	●	●
	SRA-1-1	.1–500	DC–500	4.81	.11	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	14.95	●	●
	SRA-2	1–1000	.5–500	5.66	.07	7.5	8.5	45	30	35	20	30	20	45	30	30	20	30	20	15.95	●	●
	SRA-2CM	5–1000	DC–1000	5.27	.04	7.0	8.5	60	50	35	30	30	25	50	45	30	25	25	20	14.95	●	●
	SRA-3	.025–200	DC–200	4.61	.06	7.5	8.5	60	50	45	35	35	25	45	35	40	30	30	20	15.95	●	●
	SRA-4	5–1250	.5–500	5.71	.08	7.5	8.5	50	40	40	20	30	20	50	40	40	20	30	20	17.95	●	●
	* SRA-5	5–1500	10–600	6.69	.07	8.0	8.5	50	45	35	30	30	20	45	40	30	25	25	15	24.95	●	●
	SRA-6	.003–100	DC–100	4.58	.05	7.5	8.5	60	50	45	30	35	25	60	45	40	25	30	20	24.95	●	●
	SRA-8	.0005–10	DC–10	5.69	.11	7.5	8.5	60	50	50	40	45	35	60	50	50	40	45	35	29.95	●	●
case A06	SRA-11	5–2000	10–600	6.72	.07	8.5	9.0	50	45	35	25	30	20	45	40	30	20	25	15	20.95	●	●
	SRA-12	800–1250	50–90	6.21	.13	7.5	7.5	32	25	35	25	35	25	30	20	30	20	30	20	29.95	●	●
	SRA-149	5–500	DC–500	5.61	.07	6.5	8.0	60	50	55	45	53	40	50	40	35	25	30	24	9.95	●	●
	SRA-2000	100–2000	DC–600	8.60	.15	9.5	9.5			37 (typ.)		20 (min.)				30 (typ.)		20 (min.)		21.95	●	●
	† SRA-2400	750–2400	DC–400	5.95	.26	9.0	9.0	30	20	30	20	30	20	30	8	30	8	30	8	22.95	●	●
	* * † SRA-3500	500–3500	DC–1000	7.28	.31	9.5	9.5	30	17	30	17	30	17	20	8	20	8	20	8	28.95	●	●
□ SBL case A06	SBL-1	1–500	DC–500	5.60	.09	7.0	8.0	60	45	45	35	40	25	45	35	40	25	30	20	4.75	●	●
	SBL-1X	10–1000	5–500	5.88	.10	7.5	8.0	50	40	40	30	30	20	50	45	40	35	35	25	6.45	●	●
	SBL-1Z	10–1000	DC–500	6.27	.09	7.5	9.0	50	40	35	25	25	20	40	25	25	18	19	15	7.45	●	●
	SBL-1-1	0.1–400	DC–400	4.84	.04	7.0	8.0	50	45	45	30	35	25	45	30	40	25	30	20	7.45	●	●
	SBL-3	.025–200	DC–200	4.81	.05	7.5	8.5	55	50	45	30	35	25	45	35	40	30	30	20	7.45	●	●
	○ SBL-11	5–2000	10–600	7.08	.11	8.5	9.0	50	45	35	25	30	20	45	40	30	20	25	15	19.95	●	●
SIMA case A06	SIMA-5	2–1500	DC–1000	7.01	.08	8.0	9.0	65	44	44	23	31	22	54	38	30	18	25	11	24.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

m=mid band (2 f_L to f_U/2)

NOTES:

† Phase Detection, Polarity Positive

* SRA–5 case style is A06.

● HTRB tested, 5-year guarantee

** Conversion loss 10 dB max. at IF=1000 MHz.

○ Pin connections same as the SRA–11

□ NON–HERMETIC

$\bar{X}$ = Average of conversion loss at center of mid-band frequency (f_L + f_U/4).

σ = Standard deviation.

1. For quality control procedures, environmental specifications, and Hi–Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings: RF power 50 mW, peak IF current 40 mA, see Table of Contents.
3. Prices and specifications subject to change without notice.

pin connections see case style outline drawing

Series	GRA	SRA						SBL			SIMA
models	all models	-1 -1TX -1-1 -3	-2 -4	-6 -8	-1W -2CM	-5 -11 -12 -2000 -2400‡ -3500	-149***	-1 -1-1 -3	-1X	-1Z	-5
LO	1	8	8	8	8	8	8	8	8	1	8
RF	6	1	3,4*	1	1	1	2	1	3,4*	8	1
IF	4	3,4*	1	3,4*	3,4*	3	5,6*	3,4*	1	3	3
GND◆	2,3,5	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	1	2,5,6,7	2,5,6,7	2,5,6,7	4
CASE GND	—	2	2,5,6,7	—	2,5,6,7	2,5,6,7	3,4,7	—	2,5,6,7	2,5,6,7	2,5,6,7

* Pins must be connected together externally ‡ LO = 1; RF = 8; IF 3

*** Blue bead is pin #4

◆ Ground externally. All measurements made with GND pin(s) grounded externally.

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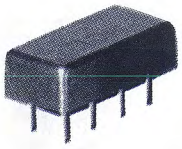
Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *


TAK


TSM

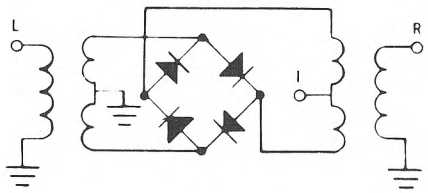

SAM


ROSE

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{x}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO–IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
TAK case A04	TAK-5	.01–250	DC–250	4.65	.02	7.0	8.5	60	50	50	35	40	35	55	45	45	30	35	25	20.95	●	●
	TAK-5R	.05–200	DC–200	4.70	.05	6.5	8.0	55	50	45	35	45	35	50	45	40	30	40	30	20.95	●	●
	TAK-6	.5–600	DC–600	5.58	.04	7.5	8.5	60	50	50	30	40	25	55	45	45	30	30	20	20.95	●	●
	TAK-6R	0.5–600	DC–600	5.40	.11	7.0	8.0	55	50	45	30	35	30	45	40	40	25	30	25	20.95	●	●
	TAK-7	2–1000	5–500	5.86	.08	7.5	8.5	45	30	35	20	30	20	45	30	35	20	30	20	20.95	●	●
TSM case A11	TSM-1	1–600	DC–600	5.71	.04	7.5	8.5	60	45	45	35	35	25	55	45	40	30	35	25	19.95	●	●
	TSM-2	1–1000	DC–1000	5.55	.08	7.5	10.0	55	45	40	20	35	18	50	40	40	20	25	18	20.95	●	●
	TSM-3	0.1–500	DC–500	4.75	.04	7.5	8.5	60	50	50	35	35	25	55	45	45	30	35	25	21.95	●	●
	†TSM-5	5–1500	DC–1000	6.16	.04	8.5	9.5	60	45	35	25	30	25	60	45	35	25	25	16	27.95	●	●
SAM case A03	SAM-1	1–600	DC–600	5.67	.05	7.0	8.5	55	45	45	30	35	20	50	40	40	25	30	20	16.95	●	●
	SAM-2	1–1000	DC–1000	5.68	.08	7.5	9.5	55	45	40	25	35	20	50	40	40	25	30	25	20.45	●	●
	SAM-3	0.1–500	DC–500	5.04	.07	7.0	8.5	60	50	50	35	35	30	50	40	45	30	30	20	19.95	●	●
	SAM-4	5–1250	0.5–1000	5.98	.18	8.5	8.5	55	40	35	25	30	20	50	40	35	25	30	20	23.95	●	●
	SAM-5	5–1500	0.5–1000	5.81	.08	7.5	8.5	55	40	35	25	30	20	50	40	35	25	30	20	29.95	●	●
ROSE case PP94	ROSE-1	1–600	DC–600	5.08	.03	6.5	7.5	40	30	35	25	30	20	55	40	40	20	25	18	11.95	●	●
	ROSE-2	1–1000	DC–1000	5.60	.23	7.0	8.0	61	45	37	22	25	18	55	40	26	17	16	12	16.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)
m=mid band (2 f_L to $f_U/2$)

schematic



MIL-M-28837/1, NSN GUIDE

MCL NO.	NSN	MIL-M-28837/1*
GRA-1	5895-00-480-2849	
GRA-3	5895-01-169-1815	
GRA-8	5895-01-217-5627	
SAM-1	5895-01-117-2926	
SAM-2	5985-01-165-6621	
SAM-3	5895-01-062-9973	
SAM-5	5895-01-036-9507	
SBL-1	5895-01-126-4913	
SBL-1X	5895-01-179-8084	
SRA-1	5895-00-008-8272	03
SRA-1-1	5962-01-113-5431	
SRA-1-TX	5895-01-163-9247	
SRA-1-1-TX	5895-01-151-6753	
SRA-11-TX	5895-01-163-9248	
SRA-1W	5895-01-163-0433	09
SRA-3	5895-01-021-5914	
SRA-4	5826-01-155-6545	
SRA-6	5895-01-124-0117	
SRA-8	5985-01-081-0977	
SRA-11	5895-01-273-0883	
SBL-3	5895-01-326-6030	
TAK-5	5895-01-271-0842	
TAK-6	5895-01-231-2372	
TSM-1	5895-01-121-7958	

*units are not QPL-listed

pin connections see case style outline drawing

TAK				TSM	SAM			ROSE
–5 –6	–7	–5R	–6R	all models (△)	–1 –3	–4 –5	–2	–1
8	8	8	1	8	8	8	8	1
1	3,4*	1	8	1	1	3,4*	1	3
3,4*	1	3,4*	5,6*	3,4*	3,4*	1	3,4*	2
2,5,6,7	2,5,6,7	2,5,6,7	2,3,4,7	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	—
2	2,5,6,7	—	3,4,7	2	2	2,5,6,7	2,5,6,7	4

△TSM-5, CASE GROUND 2,7; TSM-2 CASE GROUND 2, 5, 6, 7.
* Pins must be connected together externally.

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CAPO now available! computer-automated performance data see model index

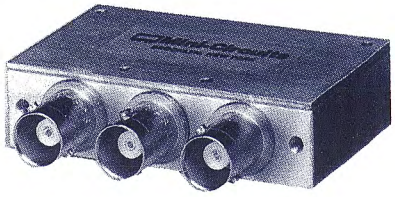
widest-variety of connector types

Frequency Mixers

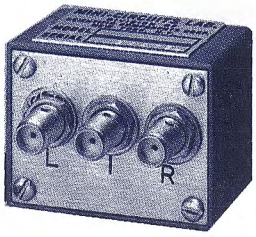
LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

case style selection

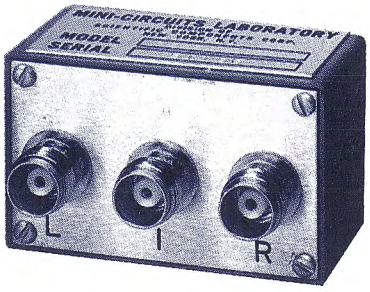
outline drawings see Table of Contents



ZP



ZLW△



ZAD

	MODEL NO.	FREQUENCY MHz LO/RF f_L-f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO-IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZP case GG60	ZP10514	.2-500	DC-500	5.18	.026	7.0	8.5	55	45	50	35	35	30	50	40	36	30	30	20	62.95	•	
ZLW case M21 △	ZLW-1	.5-500	DC-500	5.81	.08	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	51.95	•	
	ZLW-1W	1-750	DC-750	5.74	.05	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	56.95	•	
	ZLW-1-1	.1-500	DC-500	4.82	.07	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	53.95	•	
	ZLW-2	1-1000	DC-1000	5.68	.08	7.5	9.5	55	45	40	25	35	20	50	40	40	25	30	20	56.95	•	
	ZLW-3	.025-200	DC-200	4.61	.06	7.5	8.5	60	50	45	35	35	25	45	35	40	30	30	20	53.95	•	
	ZLW-5	5-1500	10-600	5.81	.08	7.5	8.5	55	40	35	25	30	20	50	40	35	25	30	20	61.95	•	
	ZLW-6	.003-100	DC-100	4.58	.05	7.5	8.5	60	50	45	30	35	25	60	45	40	25	30	25	64.95	•	
	ZLW-8	.0005-10	DC-10	5.66	.08	7.5	8.5	60	50	50	40	45	35	60	50	50	40	45	35	69.95	•	
	ZLW-11	5-2000	10-600	6.85	.10	8.5	9.0	50	45	35	25	30	20	45	40	30	20	25	15	71.95	•	
	ZLW-12	800-1250	50-90	6.21	.13	—	7.5	35	25	35	25	35	25	30	20	30	20	30	20	71.95	•	
ZAD case M22	ZAD-1	.5-500	DC-500	5.24	.10	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	43.95	•	
	ZAD-1W	1-750	DC-750	5.56	.05	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	45.95	•	
	ZAD-1-1	.1-500	DC-500	4.83	.04	7.5	8.5	50	45	45	30	35	25	45	30	40	25	30	20	44.95	•	
	ZAD-2	1-1000	.5-500	5.66	.07	7.5	8.5	45	30	35	20	30	20	45	30	35	20	30	20	49.95		
	ZAD-3	.025-200	DC-200	4.61	.06	7.5	8.5	60	50	45	35	35	25	45	35	40	30	30	20	45.95	•	
	ZAD-4	5-1250	.5-500	5.71	.08	7.5	8.5	50	40	40	20	30	20	50	40	40	20	30	20	51.95	•	
	ZAD-6	.003-100	DC-100	4.65	.08	7.5	8.5	60	50	45	30	35	25	60	45	40	25	30	20	51.95	•	
	ZAD-8	.0005-10	DC-10	5.79	.05	7.5	8.5	60	50	50	40	45	35	60	50	50	40	45	35	54.95	•	
	ZAD-11	5-2000	10-600	7.12	.12	8.5	9.0	50	45	35	25	30	20	45	40	30	20	25	15	61.95	•	
	ZAD-12	800-1250	50-90	6.21	.13	7.5	7.5	35	25	35	25	35	25	30	20	30	20	30	20	61.95	•	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

m=mid band (2f_L to f_U/2)

NOTES:

1. For quality control procedures, environmental specifications, and Hi-Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings: RF power 50 mW, peak IF current 40 mA.
3. For connector types and case mounting options, see case style outline drawing, see Table of Contents.
4. Prices and specifications subject to change without notice.

△ Available only with SMA connectors.

$\bar{X}$ = Average of conversion loss at center of mid-band frequency (f_L + f_U/4).

σ = Standard deviation.

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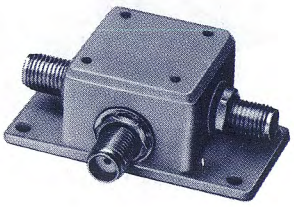
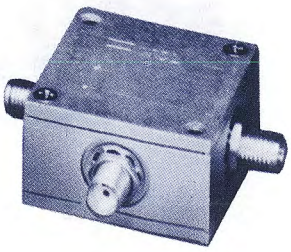
Mini-Circuits

ULTRA-REL™ MIXERS

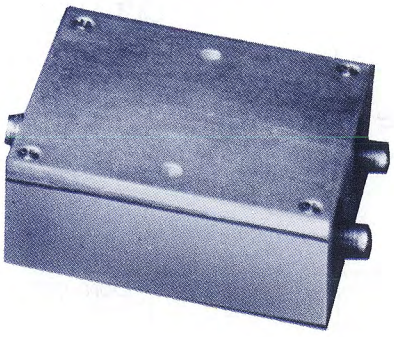
5-YR. GUARANTEE *



ZEM△



ZFM



ZAM△

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO–IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZEM case V37	ZEM-2B	10-1000	DC-1000	5.74	.07	7.0	8.5	55	50	30	25	25	20	55	45	30	20	25	20	59.95	•	
	ZEM-4300	300-4300	DC-1000	6.65	.06	—	9.5	40	20	—	—	30	17	15	8	—	—	15	8	79.95	•	
ZFM case K18	ZFM-1W	10-750	DC-750	5.42	.14	7.0	8.0	50	45	45	30	35	25	45	40	40	25	27	20	51.95	•	
	ZFM-2	1-1000	DC-1000	5.72	.06	7.5	8.5	50	45	40	25	30	25	45	40	35	25	25	20	53.95	•	
	ZFM-3	0.04-400	DC-400	4.78	.03	7.0	8.0	60	50	50	35	35	25	55	40	45	30	35	25	61.95	•	
	†ZFM-4	5-1250	DC-1250	5.70	.34	7.5	8.5	50	45	40	30	30	25	45	40	35	25	25	20	61.95	•	
	ZFM-11	1-2000	5-600	7.03	.17	8.5	9.0	50	45	35	25	25	20	45	40	27	20	25	20	89.95	•	
	ZFM-12	800-1250	50-90	5.67	.12	—	7.5	35	25	35	25	35	25	30	20	30	20	30	20	79.95	•	
	△ZFM-2000	100-2000	DC-600	7.49	.20	9.5	9.5	—	—	37	20	—	—	—	—	—	—	30	20	71.95	•	
	△ZFM-4212	2000-4200	DC-1300	5.44	.088	—	8.5	—	—	25	17	—	—	—	—	18	10	—	—	54.95	•	
△ ZAM case F14	ZAM-42	1500-4200	DC-500	5.67	.11	—	8.5	25	14	25	14	25	14	18	10	18	10	18	10	54.95	•	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

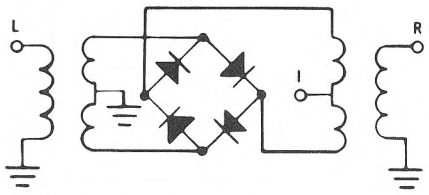
m=mid band (2 f_L to $f_U/2$)

†Phase detection, polarity positive

$\bar{X}$ = Average of conversion loss at center of mid-band frequency ($f_L + f_U/4$).

σ = Standard deviation.

schematic



NSN GUIDE

MCL NO.	NSN
ZAD-1	5985-00-280-7750
ZAD-4	5895-01-127-0376
ZAD-6	5895-01-344-7843
ZEM-2	5895-01-235-7834
ZFM-2	4935-01-230-3782
ZFM-3 (SMA)	5895-01-214-7362
ZLW-1W	5895-00-607-7010
ZLW-2	6920-01-037-1974

coaxial connections

see case style outline drawing

Series	ZP	ZLW	ZAD (ex-2, -4)	ZAD -2, -4	ZMA	ZEM		ZFM	ZAM
models	all models	all models	all models		all models	-4300	-2B	all models	all models
L	L	1	1	1	1	2	1	1	2
R	R	3	3	2	2	1	2	2	1
I	X	2	2	3	3	3	3	3	3

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

broadband high dynamic range

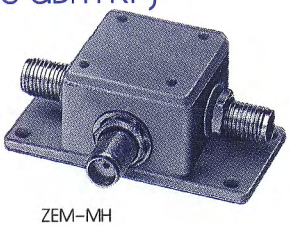
Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

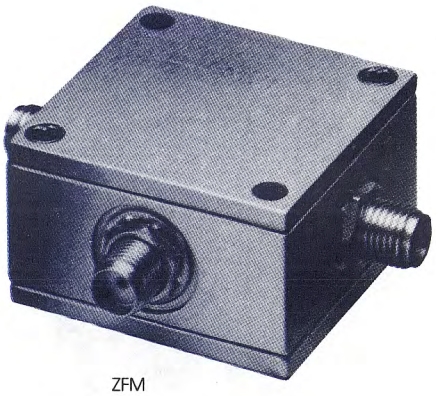
50 KHz to 3 GHz

case style selection

outline drawings see Table of Contents



ZEM-MH



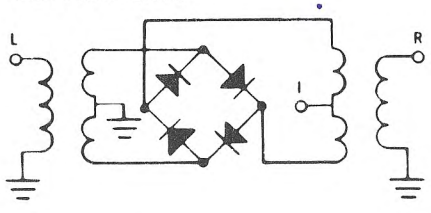
ZFM

	MODEL NO.	FREQUENCY MHz LO/RF f_L-f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	CONVERSION LOSS dB Total Range Max.	LO-RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO-IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
o□RMS-LH	RMS-1LH	2-500	DC-500	5.36	.08	7.0	8.0	58	45	44	25	30	20	55	40	40	25	28	17	7.95	●	●
case TT100	RMS-2LH	5-1000	DC-1000	6.44	.10	8.0	9.5	58	40	39	20	22	16	52	30	30	17	18	11	8.95	●	●
	RMS-5LH	10-1500	DC-900	5.27	.09	8.0	9.8	58	35	38	20	25	18	56	30	38	14	17	6	14.95	●	●
o□LRMS-LH	LRMS-1LH	2-500	DC-500	5.36	.08	7.0	8.0	58	45	44	25	30	20	55	40	40	25	28	17	7.95	●	●
case QQQ130	LRMS-2LH	5-1000	DC-1000	6.44	.10	8.0	9.5	58	40	39	20	22	16	52	30	30	17	18	11	8.95	●	●
	LRMS-5LH	10-1500	DC-900	5.27	.09	8.0	9.8	58	35	38	20	25	18	56	30	38	14	17	6	14.95	●	●
TFM	TFM-15	10-3000	10-800	6.75	.08	8.0	8.5	35	25	35	25	35	25	30	20	30	20	30	20	49.95	●	
case B13	TFM-150*	10-2000	DC-1000	6.19	.11	8.0	8.0	32	25	35	25	35	25	33	20	30	20	30	20	45.45	●	●
case B02	TFM-2LH	2-1000	DC-1000	5.70	.177	7.5	9.2	62	45	44	25	37	25	58	40	45	25	31	18	16.95	●	●
LMX	LMX-123	10-3000	10-1000	5.94	.08	8.0	8.5	35	25	35	20	30	15	35	25	30	25	30	20	69.95	●	
case BB48	LMX-148	10-1500	DC-1500	6.48	.08	7.0	10	45	40	35	30	25	20	40	35	35	25	20	12	29.95	●	●
	LMX-1481	3-1100	DC-1100	6.7	.12	8.5	9.8	65	45	40	25	30	18	57	38	30	20	20	14	23.95	●	●
SRA	SRA-2CR	10-1000	5-500	5.68	.12	7.5	8.0	50	40	40	30	30	20	40	25	30	18	25	15	17.95	●	●
case A01	SRA-215	.05-1500	.05-500	5.20	.08	7.5	9.0	25	20	35	25	30	20	25	20	35	25	25	15	28.95	●	●
	SRA-220	.05-2000	.05-500	5.59	.11	8.0	9.0	25	20	40	30	30	20	25	20	40	30	25	15	31.95	●	●
ZFM	ZFM-15	10-3000	10-800	6.13	.14	8.0	8.5	35	25	35	25	35	25	30	20	30	20	30	20	89.95	●	
case K18	ZFM-150*	10-2000	DC-1000	6.05	.12	8.0	8.0	32	25	35	25	35	20	33	20	30	20	25	20	69.95	●	
o□SCM-LH	SCM-1LH	1-500	DC-500	5.75	.20	7.0	8.0	60	40	50	35	40	30	50	40	45	35	40	25	6.25	●	●
case YY101	SCM-2LH	5-1000	DC-500	7.15	.20	8.4	9.7	65	40	50	25	44	20	58	40	50	25	28	15	7.45	●	●
	SCM-5LH	1250-1800	DC-500	6.0	.46	—	8.8		26 (Typ.)		17 (Min.)				18 (Typ.)		8 (Min.)			13.95	●	●
	SCM-2500LH	500-2500	DC-500	5.6	.20	6.8	10.0		35 (Typ.)		20 (Min.)				18 (Typ.)		10 (Min.)			13.95	●	●
□SBL-LH	SBL-1LH	2-500	DC-500	5.8	.03	7.0	8.0	75	45	68	35	56	25	61	35	45	25	36	20	5.75	●	●
case A06	SBL-1-1LH	.2-400	DC-400	5.2	.06	7.0	9.0	67	45	64	30	51	25	62	30	52	25	34	20	8.45	●	●
	SBL-1XLH	10-1000	5-500	6.0	.12	7.5	8.5	50	40	40	25	30	20	70	45	55	40	45	30	7.45	●	●
	SBL-2LH	5-1000	DC-1000	5.9	.09	7.5	9.5	67	45	61	30	57	30	68	40	54	30	43	20	8.45	●	●
	SBL-3LH	.07-250	DC-250	4.9	.22	7.0	8.5	60	45	60	35	45	30	57	35	53	30	42	25	8.45	●	●
	SBL-11LH	5-2000	10-600	7.0	.11	8.5	9.5	60	45	45	30	30	20	50	35	30	20	25	16	20.95	●	●
□SYM-LH	SYM-11LH	1-2000	10-600	7.0	.10	8.3	9.85	60	40	45	25	37	25	59	40	33	20	25	20	11.95	●	●
case TTT-167																						
▽□TUF-LH	TUF-1LH	2-600	DC-600	6.0	.17	7.0	8.0	70	50	50	30	42	25	65	45	50	30	41	22	6.25	●	●
case B02	TUF-2LH	50-1000	DC-1000	5.2	.3	7.0	8.5	58	40●	44	30●	39	25	60	35●	50	25●	38	20	7.20	●	●
	†TUF-3LH	0.15-400	DC-400	4.8	.37	7.0	8.0	67	50	51	30	40	25	67	40	45	25	34	20	8.10	●	●
	TUF-5LH	20-1500	DC-1000	6.9	.27	8.5	9.0	53	40	42	30	38	25	40	25	30	18	22	8	11.45	●	●
	TUF-11ALH	1400-1900	40-500	7.0	.20	8.6	8.6	—	—	36	20	—	—	—	—	28	15	—	—	18.95	●	●
	TUF-860LH	800-1050	DC-250	6.3	.27	7.9	7.9	—	—	35	25	—	—	—	—	27	18	—	—	11.45	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

m=mid band (2 f_L to $f_U/2$)

schematic



NSN GUIDE

MCL NO.	NSN
ZFM-150	5895-01-217-6878
TFM-15	5895-01-292-2759
TFM-3MH	5895-01-302-7047

NOTES:

□ NON-HERMETIC

* Below 10 MHz IF, conversion loss increases up to 6 dB higher as frequency decreases to DC.

o Available on tape and reel. Please consult factory

▽ For surface mount version, add suffix SM (case style NNN-150) which is available on tape and reel.

● L = 50-100 MHz.
M = 100-500 MHz.

† Positive Polarity.

1. For quality control procedures, environmental specifications, and Hi-Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings, RF power 50 mW/level 10, 200 mW/level 13, except RMS-MH 150 mW. Peak IF current 40 mA, see Table of Contents.
3. For connector types and case mounting options, see case style outline drawings, see Table of Contents.
4. Prices and specifications subject to change without notice.

$\bar{X}$ = Average of conversion loss at center of mid-band frequency (f_L + $f_U/4$).

σ = Standard deviation.

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ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

LEVEL 13 (+13dBm LO, up to +9 dBm RF)
25 KHz to 4.3 GHz



LRMS RMS SYM TFM-TUF SBL-SIMA SRA ROK LMX SCM

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{x}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO–IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
○□RMS–MH case TT100	RMS–1MH	2–500	DC–500	5.65	.08	7.0	8.0	58	45	44	25	30	20	55	40	36	25	28	17	8.95	●	●
	RMS–2MH	5–1000	DC–1000	6.72	.08	8.5	9.5	55	40	39	20	22	16	52	35	30	17	18	12	9.95	●	●
	RMS–2UMH	10–1000	20–500	7.0	.1	8.5	9.5	52	40	43	30	33	25	53	30	44	25	39	22	14.45	●	●
	RMS–5MH	10–1500	DC–900	5.67	.09	9.0	9.5	58	40	40	20	26	18	50	30	38	18	17	8	15.95	●	●
○□LRMS–MH case QQQ130	LRMS–1MH	2–500	DC–500	5.65	.08	7.0	8.0	58	45	44	25	30	20	55	40	36	25	28	17	8.95	●	●
	LRMS–2MH	5–1000	DC–1000	6.72	.08	8.5	9.5	55	40	39	20	22	16	52	35	30	17	18	12	9.95	●	●
	LRMS–2UMH	10–1000	20–500	7.0	.1	8.5	9.5	52	40	43	30	33	25	53	30	44	25	39	22	14.45	●	●
	LRMS–5MH	10–1500	DC–900	5.67	.09	9.0	9.5	58	40	40	20	26	18	50	30	38	18	17	8	15.95	●	●
SIMA–MH case A06	SIMA–5MH	2–1500	DC–1000	7.11	.11	8.6	9.0	70	44	44	23	31	22	57	38	30	20	25	15	28.95	●	●
TFM–MH case B02	TFM–1MH	2–500	DC–500	5.80	.05	7.5	8.5	50	45	40	30	30	20	45	40	35	25	25	20	24.95	●	●
	TFM–3MH	1–250	DC–250	4.79	.23	7.0	8.5	50	45	40	30	28	23	45	40	35	25	26	20	24.95	●	●
case B13	TFM–12MH	0.5–2000	0.2–600	6.99	.16	8.0	9.5	60	45	35	30	30	25	55	40	30	25	25	20	48.95	●	●
	TFM–42MH	10–4200	10–1000	7.46	.12	8.5	11	35	25	40	25	35	25	35	20	35	25	27	20	69.95	●	
LMX–MH case BB48	LMX–123MH	10–2500	10–500	6.80	.074	8.5	9.6	42	22	35	20	28	20	33	20	36	20	36	15	70.95	●	●
	LMX–125MH	0.5–500	DC–500	5.80	.07	7.0	9.0	45	40	45	40	40	30	45	40	40	35	35	25	62.95	●	●
□SBL–MH case A06	SBL–1MH	1–500	DC–500	5.73	.08	7.5	8.5	50	35	45	30	35	25	45	30	40	25	30	20	10.45	●	●
	SBL–1ZMH	2–1100	DC–500	6.63	.10	8.0	9.0	50	40	40	30	30	20	40	30	25	20	25	15	12.45	●	●
SRA–MH case A01	SRA–1MH	.5–500	DC–500	5.65	.04	7.0	8.5	50	45	45	30	35	25	45	35	40	25	30	20	14.95	●	●
	SRA–3MH	.025–200	DC–200	4.77	.07	7.5	8.5	60	50	45	35	35	25	45	35	40	30	30	20	16.95	●	●
case A06	SRA–2010MH	10–2000	DC–600	7.50	.20	8.5	9.8	50	45	45	30	40	25	45	45	35	30	35	20	38.95	●	●
ROK–MH case QQ96	ROK–186MH	5–2500	10–1000	6.57	.11	8.5	9.5	33	25	35	25	25	20	33	20	31	25	27	20	47.95	●	●
ZEM–MH case V37	ZEM–4300MH	300–4300	DC–1000	6.42	.15	—	8.5	40	20	—	—	40	20	14	7	—	—	12	7	89.95	●	
□SYM–MH case TTT–167	SYM–11MH	50–2000	50–1000	6.6	.10	8.0	9.9	55	35	44	25	30	20	40	25	36	20	29	20	15.95	●	●
▽□TUF–MH case B02	TUF–1MH	2–600	DC–600	6.3	.12	7.0	8.0	68	50	50	30	43	25	65	45	48	30	37	22	7.25	●	●
	TUF–2MH	50–1000	DC–1000	6.0	.25	7.5	9.0	58	40●	47	30●	37	25	55	35●	47	20●	32	18	8.20	●	●
	TUF–3MH	0.15–400	DC–400	5.0	.33	7.0	8.0	60	50	46	30	35	25	60	40	42	25	35	20	9.10	●	●
	TUF–5MH	20–1500	DC–1000	7.0	.25	8.5	9.0	50	40	41	30	35	25	38	25	28	18	20	8	12.45	●	●
	TUF–11AMH	1400–1900	40–500	7.4	.20	8.6	8.6	—	—	33	20	—	—	—	—	24	15	—	—	19.95	●	●
	TUF–860MH	800–1050	DC–250	6.8	.32	8.3	8.3	—	—	35	25	—	—	—	—	27	18	—	—	12.45	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

m=mid band (2 f_L to f_U/2)

pin connections see case style outline drawing

Series	RMS/LRMS	TUF	LMX/MH	SRA/SCM	ZFM	TFM–MH/LH		SBL–LH/–MH					SRA–MH		ROK–MH	SIMA–MH	ZEM–MH	SYM
Models	all models	all models	all models	all models except –2CR**	all models	–2LH –1MH –3MH –12MH	–42MH	–1LH –1–1LH –3LH –1MH	–2LH	–1XLH	–11LH	–1ZMH	–1MH –3MH	–2010MH	all models	–5MH	–4300MH	all models
LO	1	4	8	8	1	4	1	8	8	8	8	1	8	8	5	8	2	2
RF	4	1	5	1	2	1	4	1	1	3,4*	1	8	1	1	11	1	1	1
IF	5	2	4	3	3	2	2	3,4*	3,4*	1	3	3	3,4*	3	2	3	3	3
GND◆	2,3,6	3	1,2,3,6,7	2,5,6,7	—	3	3	2,5,6,7	7	—	—	2,5,6,7	2,5,6,7	2,5,6,7	GND:	4	—	4,5,6
CASE GND	—	3	1,2,3,6,7	2,5,6,7	—	3	3	—	2,5,6	2,5,6,7	2,5,6,7	2,5,6,7	2	2,5,6,7 4 open	8,1,3,4,6, 7,9,10,12	2,5,6,7	—	—

*pins must be connected together externally **model SRA–2CR LO is pin 1, RF is pin 8 ◆Ground externally. All measurements made with GND pin(s) grounded externally.

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

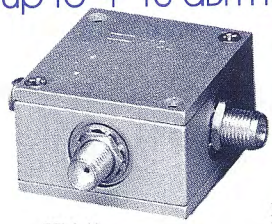
very high dynamic range

Frequency Mixers

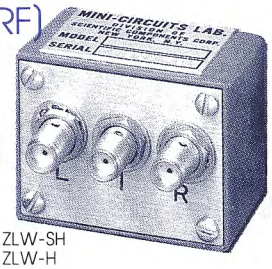
LEVEL 17 (+17 dBm LO, up to +10 dBm RF)

case style selection

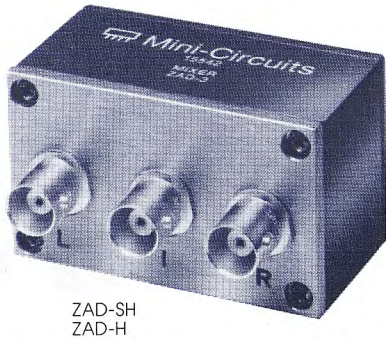
outline drawings see Table of Contents



ZFM-H



ZLW-SH
ZLW-H



ZAD-SH
ZAD-H

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO–IF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	LOCAL
SRA–H case A01	●SRA-1H	.5–500	DC–500	6.01	.08	7.5	8.5	55	45	45	30	35	25	45	35	40	30	30	20	20.95	●	●
	●SRA-1WH	1–750	DC–750	5.85	.11	7.5	8.5	50	40	45	25	35	25	45	35	40	30	30	20	24.95	●	●
	●SRA-2H	2–1000	DC–1000	6.34	.14	7.5	10	50	40	35	25	35	25	45	30	30	20	25	20	38.95	●	●
	●SRA-3H	.05–200	DC–200	5.18	.05	7.0	7.5	50	45	40	30	35	25	45	35	40	30	30	20	22.95	●	●
	SRA-6H	.01–50	DC–50	4.97	.06	6.0	7.0	50	45	45	30	35	25	50	40	47	35	32	25	38.95	●	●
	SRA-11H	10–3000	10–1000	6.83	.09	10	12	27	20	25	18	23	16	27	20	25	18	23	16	47.95	●	●
	SRA-173H	5–1200	DC–1200	5.38	.05	7.0	8.5	40	35	35	25	35	20	40	35	35	20	30	20	31.95	●	●
SIMA–H case A06	SIMA-5H	2–1500	DC–1000	6.94	.07	8.5	8.5	65	35	44	23	40	22	54	25	30	23	25	13	32.95	●	●
□SYM–H case TTT-167	SYM-11H	50–2000	50–1950	6.3	.10	7.5	9.0	45	35	40	25	37	25	40	25	32	20	30	20	17.95	●	●
GRA–H case D08	GRA-1H	.5–500	DC–500	5.87	.09	7.5	8.5	55	45	45	30	35	25	45	35	40	30	30	20	21.95	●	●
	GRA-3H	.05–200	DC–200	4.85	.07	7.0	7.5	55	45	45	30	35	25	45	35	40	30	30	20	24.95	●	●
	GRA-6H	.01–50	DC–50	5.04	.05	6.0	7.0	50	45	45	30	35	25	50	40	47	35	32	25	34.95	●	●
ZLW–H case M21	●ZLW-1H	.5–500	DC–500	6.13	.08	7.5	8.5	55	45	45	30	35	25	45	35	40	30	30	20	56.95	●	
	●ZLW-1WH	1–750	DC–750	6.07	.13	7.5	8.5	50	45	45	25	35	25	45	35	40	25	30	20	59.95	●	
	●ZLW-2H	2–1000	DC–1000	6.34	.14	7.5	10	50	40	35	25	35	25	45	35	30	20	25	20	64.95	●	
	●ZLW-3H	.05–200	DC–200	5.18	.05	7.0	7.5	55	45	45	30	35	25	45	35	40	30	30	20	58.95	●	
	ZLW-11H	10–3000	10–1000	6.83	.09	10	12	27	20	25	18	23	16	27	20	25	18	23	16	99.95	●	
ZAD–H case M22	●ZAD-1H	.5–500	DC–500	6.16	.08	7.5	8.5	50	45	45	30	35	25	45	35	40	30	30	20	48.95	●	
	●ZAD-1WH	1–750	DC–750	6.16	.09	7.5	8.5	50	45	45	25	35	25	45	35	40	25	30	20	52.95	●	
	●ZAD-2H	2–1000	DC–1000	6.22	.15	7.5	10	50	40	35	25	35	25	45	35	30	20	25	20	59.95	●	
	●ZAD-3H	.05–200	DC–200	4.89	.09	7.0	7.5	55	45	45	30	35	25	45	35	40	30	30	20	50.95	●	
	ZAD-11H	10–3000	10–1000	6.83	.09	10	12	27	20	25	18	23	16	27	20	25	18	23	16	89.95	●	

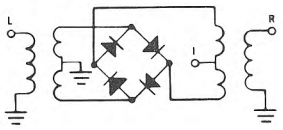
L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

m=mid band (2 f_L to $f_U/2$)

Two-Tone 3rd order IM below IF

each tone (0dBm, 200 and 202 MHz), LO (+17dBm, 180 MHz). All models 60dB typ. 55 dB min. except 55 dB typ. 45 dB min. for TFM-3H, TAK-3H, ZFM-3H, ZLW-3SH, ZAD-3SH

schematic



NOTES:

□ NON-HERMETIC

▽ For surface mount version, add suffix SM (case style NNN-150) available on tape and reel; see orientation Fig. T-007

● HTRB tested

1. For quality control procedures, environmental specifications, and Hi-Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings: RF power 200 mW, peak IF current 40 mA, see Table of Contents.
3. For connector types and case mounting options, see case style outline drawings, see Table of Contents.
4. Prices and specifications subject to change without notice.

$\bar{X}$ = Average of conversion loss at center of mid-band frequency ($f_L + f_U/4$).

σ = Standard deviation.

MIL-M-28837/1, NSN GUIDE

MCL NO.	NSN	MIL-M-28837/1*
GRA-1H	5895-01-284-6870	
GRA-3H	5895-01-171-0974	
SRA-1H	6625-00-594-0223	08
SRA-1WH	5895-00-576-0716	
SRA-2H	5895-01-063-1078	
SRA-3H	5895-01-117-4537	
SRA-11H	5895-01-192-0173	
SRA-11H-TX	5895-01-137-9278	
ZAD-1WH	5895-01-045-4647	
ZAD-3H	5895-01-149-0771	
ZLW-1H	5985-01-080-7637	
TAK-1H	5895-01-167-9721	
TAK-1WH	5895-01-282-0079	
TAK-3H	5895-01-274-2678	
TFM-1H	5895-01-129-0110	
TFM-2H	5895-01-235-1274	
ZAD-11H	5985-01-288-9999	
ZAD-3SH	5895-01-264-8994	
ZFM-3H	5895-01-290-0300	

*units are not QPL-listed

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50 KHz to 1.2 GHz

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ULTRA·REL™ MIXERS

5-YR. GUARANTEE *

LEVEL 17S (+17 dBm LO, up to +14 dBm RF)



SRA-H SIMA-H GRA-H RMS-H LRMS-H TFM-H TUF TAK-H SYM-H

	MODEL NO.	FREQUENCY MHz LO/RF f_L-f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	LO-IF ISOLATION, dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
○□RMS-H	RMS-1H	2-500	DC-500	6.25	.034	7.0	8.5	55	44	44	25	33	20	50	34	45	25	37	22	10.95	●	●
case TT-100	RMS-1WH	5-750	DC-750	7.00	.11	8.5	8.8	55	40	43	22	28	20	52	30	38	22	29	20	11.95	●	●
	RMS-2H	5-1000	DC-900	6.98	.054	8.5	9.3	55	40	39	22	33	20	52	30	45	22	30	17	11.95	●	●
	RMS-2UH	10-1000	10-750	7.10	.083	8.5	9.6	50	40	38	30	30	23	50	30	40	25	34	22	14.45	●	●
	RMS-5H	10-1500	DC-900	6.36	.05	8.0	9.8	65	40	36	20	22	15	50	30	30	18	17	7	17.95	●	●
○□LRMS-H	LRMS-1H	2-500	DC-500	6.25	.034	7.0	8.5	55	44	44	25	33	20	50	34	45	25	37	22	10.95	●	●
case QQQ-130	LRMS-1WH	5-750	DC-750	7.00	.11	8.5	8.8	55	40	43	22	28	20	52	30	38	22	29	20	11.95	●	●
	LRMS-2H	5-1000	DC-900	6.98	.054	8.5	9.3	55	40	39	22	33	20	52	30	45	22	30	17	11.95	●	●
	LRMS-2UH	10-1000	10-750	7.10	.083	8.5	9.6	50	40	38	30	30	23	50	30	40	25	34	22	14.45	●	●
	LRMS-5H	10-1500	DC-900	6.36	.05	8.0	9.8	65	40	36	20	22	15	50	30	30	18	17	7	17.95	●	●
TFM-H	TFM-1H	2-500	DC-500	6.14	.11	7.5	8.5	50	45	40	30	30	20	45	40	35	25	25	20	25.95	●	●
case B02	TFM-2H	5-1000	DC-1000	6.12	.12	7.0	10	50	45	40	30	30	20	45	40	35	25	25	17	36.95	●	●
	TFM-3H	.1-250	DC-250	4.58	.11	7.0	8.5	50	45	40	30	28	23	45	40	35	25	26	20	25.95	●	●
case B13	TFM-4H	5-1200	DC-1200	5.24	.05	8.0	9.0	50	40	35	25	30	20	50	40	35	20	30	20	39.45	●	●
TAK-H	TAK-1H	2-500	DC-500	5.93	.08	7.5	8.5	50	40	40	30	30	25	45	35	35	25	25	20	21.45	●	●
case A05	TAK-1WH	5-750	DC-750	5.71	.08	7.5	9.0	50	40	40	30	30	25	45	35	35	25	30	20	25.95	●	●
	TAK-3H	.05-300	DC-300	4.82	.09	7.0	8.5	55	45	40	30	30	25	50	40	35	25	25	20	23.45	●	●
ZFM-H	ZFM-1H	2-500	DC-500	6.14	.11	7.5	8.5	50	45	40	30	30	25	45	35	35	25	25	20	64.95	●	
case K18	ZFM-2H	5-1000	DC-1000	6.12	.12	7.0	10	50	40	40	30	30	20	45	40	35	25	25	17	71.95	●	
	ZFM-3H	.05-300	DC-300	5.18	.11	7.0	8.5	55	45	40	30	30	25	50	40	35	25	25	20	64.95	●	
	ZFM-4H	5-1200	DC-1200	4.97	.11	8.0	9.0	50	40	35	25	30	20	50	40	35	20	30	20	73.95	●	
ZLW-SH	ZLW-1SH	2-500	DC-500	5.93	.08	7.5	8.5	50	40	40	30	30	25	45	35	35	25	25	20	62.95	●	
case M21	ZLW-1WSH	5-750	DC-750	5.83	.07	7.5	9.0	50	45	40	30	30	20	45	40	35	25	30	20	66.95	●	
	ZLW-3SH	.05-300	DC-300	4.65	.09	7.0	8.5	55	45	40	30	30	25	50	40	35	25	25	20	64.95	●	
ZAD-SH	ZAD-1SH	2-500	DC-500	5.98	.08	7.5	8.5	50	40	40	30	30	25	45	35	35	25	25	20	54.95	●	
case M22	ZAD-1WSH	5-750	DC-750	5.64	.08	7.5	9.0	50	45	40	30	30	20	45	40	35	25	30	20	56.95	●	
	ZAD-3SH	.05-300	DC-300	5.08	.09	7.0	8.5	55	45	40	30	30	25	50	40	35	25	25	20	55.95	●	
□TUF-H	TUF-1H	2-600	DC-600	5.9	.18	7.0	8.0	68	50	50	30	43	25	62	45	48	30	33	22	9.25	●	●
case B02	TUF-2H	50-1000	DC-1000	6.2	.22	7.5	9.0	58	40	47	30	42	25	58	35	44	25	28	18	10.20	●	●
	TUF-3H	0.15-400	DC-400	5.0	.33	7.0	8.0	60	50	50	35	40	30	60	40	45	25	35	20	11.10	●	●
	TUF-5H	20-1500	DC-1000	7.5	.17	8.5	9.0	62	55	50	40	38	25	40	25	29	18	20	8	14.45	●	●
	TUF-11AH	1400-1900	40-500	7.3	.28	9.0	9.0	—	—	35	25	—	—	—	—	30	15	—	—	21.95	●	●
	TUF-860H	800-1050	DC-250	6.8	.31	8.3	8.3	—	—	38	25	—	—	—	—	24	18	—	—	14.45	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

m=mid band ($2f_L$ to $f_U/2$)

pin and coaxial connections see case style outline drawing

Series	TUF-H TFM-H	TAK-H		ZFM-H	ZLW-H ZLW-SH	ZAD-H ZAD-SH	RMS-H LRMS-H	SRA					GRA-H	SIMA-H	SYM-H
Models	all models	-1H -3H	-1WH	all models	all models	all models	all models	-1H -3H -6H▲	-1WH -2H	-11H	-173H Configuration 1	-173H Configuration 2	all models	-5H	all models
LO	4	8	8	1	1	1	1	8	8	8	3,4*	8	1	8	2
RF	1	1	1	2	3	3	4	1	1	1	1	1	6	1	1
IF	2	3,4*	3,4*	3	2	2	5	3,4*	3,4*	3	8	3,4*	4	3	3
GND◆	3	2,5,6,7	2,5,6,7	—	—	—	2,3,6	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	2,3,5	4	4,5,6
CASE GND	3	2	2,5,6,7	—	—	—	—	2	2,5,6,7	2,5,6,7 4	2,5,6,7	2,5,6,7	—	2,5,6,7	—
NOT USED															

*pins must be connected externally ◆Ground externally. All measurements made with GND pin(s) grounded externally. ▲Pin 2 is not case grounded

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

ultra-low distortion

Frequency Mixers

LEVEL 23 (+23 dBm LO, up to +15 dBm RF)

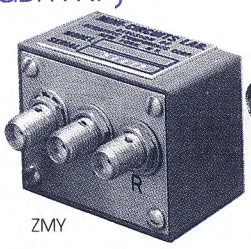
10 KHz to 2.5 GHz

case style selection

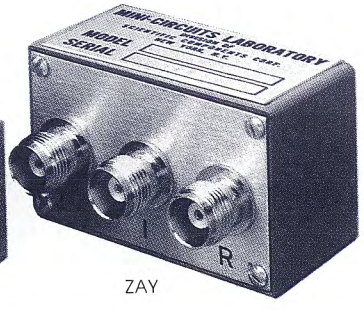
outline drawings see Table of Contents



RAY



ZMY



ZAY

	MODEL NO.	FREQUENCY MHz LO/RF f_L-f_U	FREQUENCY MHz IF	CONVERSION LOSS dB Mid-Band m $\bar{X}$	σ	Max.	Total Range Max.	LO-RF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO-IF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
RAY case A01	• RAY-1	5-500	DC-500	6.57	.09	7.5	8.5	55	45	40	30	30	25	55	45	40	30	30	20	40.95	•	•
	• RAY-2	10-1000	DC-1000	6.89	.22	8.5	10	50	35	40	30	35	25	50	35	35	25	25	20	64.45	•	•
	• RAY-3	.07-200	DC-200	5.53	.08	7.5	8.0	55	45	40	30	30	25	55	45	40	30	30	20	40.95	•	•
	RAY-6	0.03-50	DC-50	5.36	.15	7.5	8.5	60	50	45	30	35	25	60	45	40	25	30	20	52.45	•	•
	RAY-6U	0.01-100	DC-100	5.09	.15	7.0	8.0	60	50	50	40	40	30	50	45	40	30	35	25	46.95	•	•
	RAY-11	100-2500	DC-500	6.23	.21	9.0	9.0	35	25	32	25	32	25	14	10	20	10	20	10	74.95	•	•
ZMY case M21	• ZMY-1	5-500	DC-500	6.62	.10	7.5	8.5	55	45	40	30	30	25	55	45	40	30	30	20	67.95	•	
	• ZMY-2	10-1000	DC-1000	6.89	.22	8.5	10	50	35	40	30	35	25	50	35	35	25	25	20	84.95	•	
	• ZMY-3	.07-200	DC-200	5.53	.08	7.5	8.0	55	45	40	30	30	25	55	45	40	30	30	20	69.95	•	
ZAY case M22	• ZAY-1	5-500	DC-500	6.57	.09	7.5	8.5	55	45	40	30	30	25	55	45	40	30	30	20	64.95	•	
	• ZAY-2	10-1000	DC-1000	6.89	.22	8.5	10	50	35	40	30	35	25	50	35	35	25	25	20	84.95	•	
	• ZAY-3	.07-200	DC-200	5.53	.08	7.5	8.0	55	45	40	30	30	25	55	45	40	30	30	20	64.95	•	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

m=mid band ($2f_L$ to $f_U/2$)

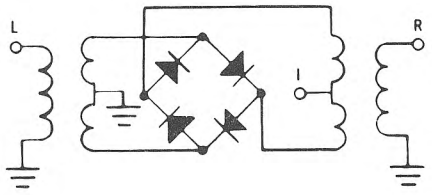
NOTES:

- HTRB tested
1. For quality control procedures, environmental specifications, and Hi-Rel, MIL and TX description see Table of Contents.
2. Absolute Maximum Ratings; RF power 350 mW for level 23, 23S and 500 mW for level 27. Peak IF current 40 mA.
3. For connector types and case mounting options, see case style outline drawing, see Table of Contents.
4. Prices and specifications subject to change without notice.

$\bar{X}$ = Average of conversion loss at center of mid-band frequency ($f_L + f_U/4$).

σ = Standard deviation.

schematic



pin and coaxial connectors

see case style outline drawing

Series	RAY				ZMY	ZAY	SAY	ZFY	VAY
Models	-1 -3	-2	-6 -6U**	-11	all models	all models	all models	all models	all models
LO	8	8	8	1	1	1	8	1	8
RF	1	1	1	8	3	3	1	2	1
IF	3,4*	3,4*	3,4*	3	2	2	3	3	3
GND◆	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	—	—	2,5,6,7	—	2,5,6,7
CASE GND	2	2,5,6,7	—	2,5,6,7	—	—	2,5,6,7	—	2,5,6,7
NOT USED	—	—	—	—	—	—	4	—	4

*pins must be connected externally

**Pin 2: case gnd. Pin 5,6,7: gnd.

◆Ground externally. All measurements made with GND pin(s) grounded externally.

MIL-M-28837/1*, NSN GUIDE

MCL NO.	NSN
RAY-1	5895-01-105-6188
RAY-2	5895-01-111-7368
RAY-3	5895-01-064-5082
RAY-6	5895-01-317-5882
SAY-11	5895-01-199-3893
VAY-1	5895-01-232-5890
ZMY-1B	5895-01-213-3888
ZMY-2	4935-01-080-7636

*units are not QPL listed

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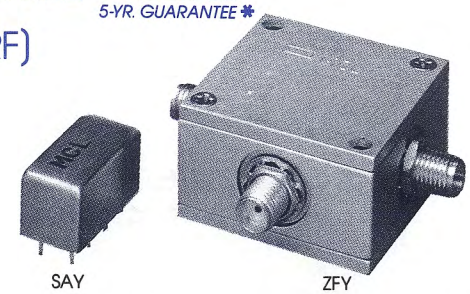
Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

Level 23S (+23dBm LO, up to +20dBm RF)

100 KHz to 2.4 GHz



SAY ZFY

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	IF	CONVERSION LOSS dB Mid-Band m $\bar{x}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO–IF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
SAY	SAY-1	0.1–500	.01–500	4.85	.18	6.0	7.5	40	20	46	35	40	30	37	23	46	35	40	30	62.95	•	•
case A01	SAY-2	0.1–1000	.01–500	5.40	.24	7.5	9.5	40	20	40	30	30	25	37	23	40	25	25	20	67.95	•	•
	SAY-11	10–2400	5–1000	7.40	0.9	8.5	10	28	20	26	20	25	20	28	20	26	20	25	20	72.95	•	•
ZFY	ZFY-1	0.1–500	.01–500	4.85	.18	6.0	7.5	40	20	46	35	40	30	37	23	46	35	40	30	74.95	•	
case K18	ZFY-2	0.1–1000	.01–500	5.40	.24	7.5	9.5	40	20	40	30	30	25	37	23	40	25	25	20	79.95	•	
	ZFY-11	10–2400	5–1000	7.40	.09	8.5	10	28	20	26	20	25	20	28	20	26	20	25	20	84.95	•	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

m=mid band (2 f_L to f_u/2)

Level 27 (+27dBm LO, up to +24dBm RF)

0.5 MHz to 500 MHz



VAY

	MODEL NO.	FREQUENCY MHz LO/RF f_L–f_U	IF	CONVERSION LOSS dB Mid-Band m $\bar{x}$	σ	Max.	Total Range Max.	LO–RF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	LO–IF ISOLATION, dB L Typ.	Min.	M Typ.	Min.	U Typ.	Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
VAY	VAY-1	0.5–500	.02–500	5.79	.15	7.5	8.5	47	40	46	35	35	25	35	28	46	35	35	25	84.95	•	
case A01																						

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

m=mid band (2 f_L to f_u/2)

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

most widely-used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-3
GRA-3
ZLW-3
ZAD-3



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.025	30.025	7.21	6.94	6.77	.025	61.68	58.72	56.56	57.08	53.27	51.07
.040	30.040	6.05	5.80	5.65	.040	57.71	55.35	53.96	54.31	51.43	49.68
.050	30.050	5.74	5.52	5.37	.050	56.72	54.61	53.34	53.56	51.09	49.47
.100	30.100	5.32	5.16	4.95	.100	55.43	53.51	52.62	52.38	50.41	49.13
.200	30.200	5.21	4.98	4.86	.200	55.00	53.27	52.45	51.97	50.18	49.00
.500	30.500	5.14	4.92	4.82	.500	54.58	53.12	52.30	51.86	50.13	48.94
1.000	31.000	5.00	4.82	4.72	1.000	53.86	53.18	52.24	51.81	50.48	49.14
2.000	32.000	4.95	4.77	4.67	2.000	53.82	53.13	52.17	51.42	50.55	49.22
5.000	35.000	4.94	4.76	4.66	5.000	54.18	53.42	52.39	52.01	50.99	49.53
10.000	40.000	5.00	4.81	4.69	10.000	54.39	53.68	52.71	52.35	51.27	49.73
20.000	50.000	5.11	4.87	4.75	20.000	54.46	53.67	52.78	51.61	50.52	49.12
38.482	68.482	5.19	4.96	4.84	38.482	54.62	53.25	52.25	51.07	48.52	46.85
50.000	80.000	5.16	4.94	4.84	50.000	54.76	53.49	52.53	49.96	47.54	45.77
69.247	99.247	5.10	4.90	4.78	69.247	54.38	53.53	52.77	47.69	45.77	44.16
84.630	54.630	5.07	4.86	4.78	84.630	54.10	53.31	52.51	45.33	44.13	42.88
100.000	70.000	4.95	4.81	4.73	100.000	53.91	53.55	52.96	43.50	42.70	41.62
123.087	93.087	5.02	4.87	4.81	123.087	55.23	55.31	55.03	40.89	40.58	39.80
153.852	123.852	5.11	4.96	4.89	153.852	52.25	52.97	52.92	38.71	38.04	37.79
176.926	146.926	5.30	5.19	5.10	176.926	47.72	49.53	51.11	37.78	38.76	38.46
200.000	170.000	5.37	5.28	5.21	200.000	43.90	45.61	47.46	36.16	38.31	40.01

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.28	1.16	1.09	1.39	2.06	2.93	5.000	1.53	1.42	1.33	.025	−227.82	+.96
10.000	1.29	1.17	1.09	1.38	2.04	2.90	10.000	1.54	1.43	1.33	.030	−237.32	+1.02
16.143	1.29	1.17	1.09	1.36	2.01	2.83	16.143	1.55	1.44	1.34	.050	−248.89	+1.03
20.000	1.29	1.16	1.09	1.34	1.99	2.80	20.000	1.55	1.44	1.34	.100	−255.16	+1.01
27.286	1.28	1.16	1.08	1.39	2.05	2.85	27.286	1.55	1.45	1.35	.500	−258.65	+1.02
38.429	1.27	1.15	1.08	1.43	2.08	2.86	38.429	1.57	1.46	1.36	2.000	−256.76	+1.02
44.000	1.27	1.15	1.07	1.42	2.07	2.86	44.000	1.58	1.47	1.37	5.000	−253.42	+1.00
50.000	1.26	1.14	1.07	1.42	2.07	2.84	50.000	1.59	1.49	1.39	10.000	−256.79	+.99
60.714	1.25	1.13	1.06	1.41	2.05	2.80	60.714	1.62	1.52	1.42	20.000	−252.96	+.98
77.429	1.23	1.11	1.06	1.41	2.02	2.77	77.429	1.67	1.57	1.47	38.482	−249.19	+.98
94.143	1.21	1.10	1.06	1.42	2.02	2.76	94.143	1.73	1.63	1.53	53.864	−257.10	+1.07
100.000	1.20	1.09	1.06	1.42	2.02	2.75	100.000	1.76	1.65	1.55	69.247	−254.46	+1.11
110.857	1.18	1.09	1.08	1.44	2.03	2.75	110.857	1.81	1.70	1.61	84.630	−256.99	+1.21
122.000	1.17	1.08	1.09	1.45	2.03	2.76	122.000	1.87	1.75	1.64	100.000	−257.87	+1.33
138.714	1.16	1.09	1.12	1.47	2.05	2.74	138.714	1.99	1.85	1.76	115.395	−255.22	+1.28
149.857	1.15	1.11	1.14	1.51	2.07	2.72	149.857	2.05	1.92	1.81	130.778	−249.16	+1.29
166.571	1.15	1.13	1.17	1.53	2.11	2.76	166.571	2.16	2.01	1.91	153.852	−254.87	+1.35
177.714	1.16	1.15	1.20	1.56	2.13	2.79	177.714	2.24	2.08	1.98	169.235	−255.80	+1.58
188.857	1.17	1.18	1.23	1.59	2.14	2.82	188.857	2.31	2.16	2.05	184.617	−255.26	+1.77
200.000	1.19	1.21	1.25	1.61	2.15	2.80	200.000	2.39	2.24	2.11	200.000	−253.61	+1.72

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	22	31	27	45	29	45	33	48	40	51
1	–	34	+0	45	11	62	19	46	25	41	30	46
2	93	>78	62	>77	62	74	61	76	60	>78	62	>78
3	>97	69	62	70	63	71	59	66	60	62	59	64
4	>97	>78	>77	>78	74	>77	77	>78	>77	>78	76	77
5	>97	>78	>77	>78	>77	>77	>77	>78	76	75	73	>77
6	>97	>78	>78	76	>78	>77	77	>78	>77	>78	>77	>77
7	>97	>77	77	>78	>78	>77	>77	>78	76	76	>77	>78
8	>97	>77	>77	>77	>77	>78	>78	>77	>78	>77	77	>78
9	>97	>77	>78	>78	>77	>77	>78	>77	>78	76	>77	>77
10	>96	>77	>79	77	76	77	>78	>77	>78	>78	>77	74

LO Harmonic Order

test conditions: RF IN: 10.10 MHZ; −14.06 DBM
LO IN: 40.01 MHZ; +6.97 DBM
IF OUT: 29.91 MHZ; −18.83 DBM

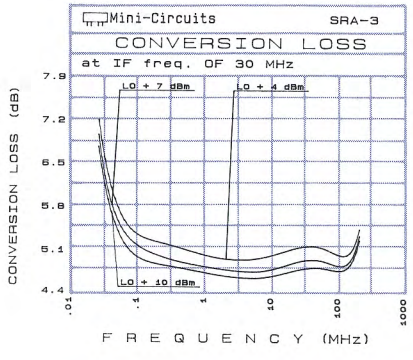
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	32	41	38	54	42	57	48	64	60	70
1	–	33	+0	51	11	45	19	50	25	55	31	51
2	81	78	60	>87	58	81	56	69	56	69	58	67
3	86	54	57	54	51	55	58	52	49	52	49	55
4	>97	84	76	86	75	86	74	82	71	82	72	82
5	>97	72	73	71	65	72	62	71	60	68	59	66
6	>96	>87	85	>88	85	>87	87	85	>88	84	>88	82
7	>97	>87	70	85	70	81	69	79	67	76	66	73
8	>97	>87	85	>88	87	>86	>87	>87	>87	86	>88	>88
9	>97	86	80	84	78	>88	77	>87	76	83	74	84
10	>96	84	87	>87	86	>87	86	>88	87	>87	86	>88

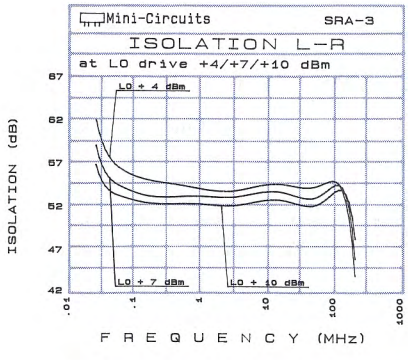
LO Harmonic Order

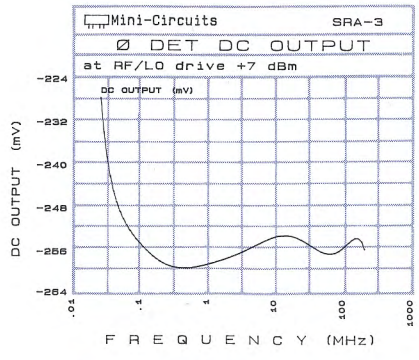
test conditions: RF IN: 10.10 MHZ; −4.06 DBM
LO IN: 40.01 MHZ; +6.97 DBM
IF OUT: 29.91 MHZ; −8.87 DBM

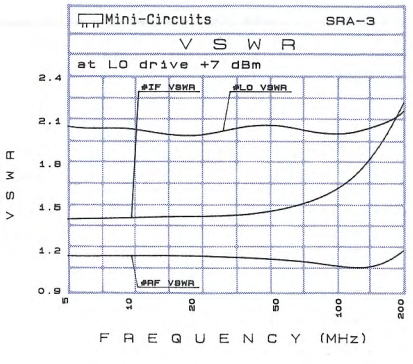
typical performance curves

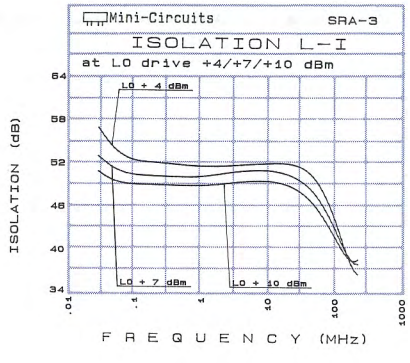
(production unit)

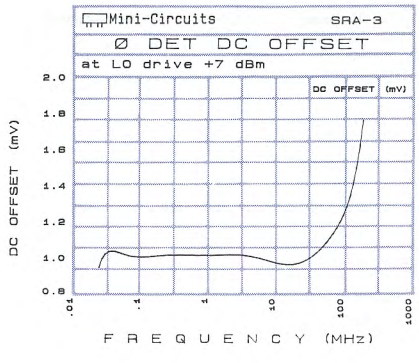












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

GRA-6
SRA-6
ZLW-6
ZAD-6



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.003	30.00	6.43	6.08	5.85	>64.00	61.88	59.98	>64.00	63.93	62.81
.100	30.10	6.22	5.90	5.63	>64.00	62.42	60.32	>64.00	63.98	63.03
.200	30.20	6.22	5.92	5.52	>64.00	62.44	60.51	>64.00	64.17	63.17
.500	30.50	6.22	5.87	5.59	>64.00	62.74	60.50	>64.00	64.06	63.48
.800	30.80	6.19	5.87	5.54	>64.00	62.70	60.52	>64.00	64.22	63.19
1.000	31.00	6.12	5.82	5.46	>64.00	62.48	60.50	>64.00	64.07	63.36
2.000	32.00	6.20	5.85	5.42	>64.00	62.34	60.33	>64.00	63.72	63.16
5.000	35.00	6.23	5.93	5.58	>64.00	61.61	59.62	>64.00	63.44	61.59
10.000	40.00	6.28	5.96	5.62	58.73	56.55	55.24	59.27	56.72	55.57
20.000	50.00	6.43	6.13	5.67	50.42	49.50	49.52	50.36	49.60	49.77
22.225	52.23	6.43	6.08	5.56	48.95	48.53	48.63	48.74	48.53	48.79
29.632	59.63	6.45	6.15	5.62	44.51	44.72	45.32	43.64	43.96	44.58
37.039	7.04	6.43	6.11	6.04	41.84	42.63	43.62	42.26	43.10	44.11
44.446	14.45	6.52	6.17	6.09	40.48	41.27	42.13	40.30	41.40	42.53
50.000	20.00	6.55	6.25	6.26	38.93	39.99	41.13	39.16	40.43	41.73
62.964	32.96	6.77	6.42	6.46	34.58	35.83	37.01	36.69	37.97	39.05
70.371	40.37	6.81	6.51	6.18	33.01	34.72	36.60	34.40	35.50	36.14
77.779	47.78	7.13	6.81	6.43	32.20	34.07	35.62	32.19	32.41	32.56
85.186	55.19	7.43	7.08	6.83	32.50	33.63	34.68	31.56	31.31	30.96
92.593	62.59	7.43	7.13	6.78	34.01	34.08	34.08	32.70	31.97	30.63
100.000	70.00	7.56	7.24	6.87	36.49	36.43	34.99	33.82	32.88	30.92

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.35	1.25	1.15	1.85	2.77	4.14	1.73	1.60	1.44
7.795	1.36	1.25	1.15	1.80	2.73	3.93	1.74	1.61	1.45
10.000	1.35	1.25	1.15	1.79	2.68	3.84	1.75	1.61	1.46
13.382	1.35	1.25	1.15	1.74	2.59	3.67	1.76	1.63	1.48
18.971	1.33	1.24	1.15	1.82	2.60	3.72	1.79	1.66	1.51
20.000	1.33	1.23	1.14	1.81	2.58	3.75	1.79	1.67	1.51
27.353	1.30	1.21	1.12	1.78	2.63	3.66	1.85	1.72	1.57
32.941	1.27	1.18	1.10	1.79	2.61	3.53	1.92	1.77	1.63
38.529	1.23	1.15	1.08	1.81	2.55	3.51	1.99	1.84	1.70
41.323	1.21	1.13	1.07	1.81	2.55	3.48	2.02	1.88	1.74
46.912	1.17	1.10	1.06	1.79	2.56	3.47	2.10	1.97	1.81
50.000	1.15	1.08	1.06	1.80	2.56	3.45	2.17	2.02	1.86
52.500	1.13	1.07	1.07	1.81	2.56	3.44	2.20	2.07	1.90
60.882	1.08	1.06	1.11	1.83	2.56	3.42	2.32	2.18	2.03
66.470	1.06	1.08	1.14	1.84	2.55	3.36	2.40	2.28	2.13
72.058	1.05	1.10	1.17	1.86	2.53	3.30	2.47	2.35	2.22
80.441	1.06	1.13	1.19	1.93	2.57	3.33	2.52	2.42	2.30
88.823	1.08	1.15	1.21	2.05	2.71	3.45	2.52	2.43	2.33
94.411	1.08	1.15	1.20	2.09	2.79	3.60	2.51	2.40	2.32
100.000	1.07	1.14	1.18	2.16	2.86	3.68	2.49	2.39	2.30

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
.003	−241.92	+0.00
.007	−236.39	+.02
.010	−235.94	+.02
.040	−235.42	+.02
.070	−235.38	+.02
.100	−231.29	+.01
.300	−226.88	+.01
.700	−227.59	+.01
1.000	−227.36	+.01
5.000	−226.73	+.01
14.329	−227.40	+.03
23.848	−228.70	+.07
33.367	−225.12	+.09
42.886	−220.78	+.12
50.000	−219.72	+.08
61.924	−212.18	+.46
70.000	−209.35	+.60
80.962	−204.70	+1.05
90.481	−188.36	+1.33
100.000	−170.55	+2.08

Measurements at RF & LO Power +7 dBm

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>88	–	31	51	33	41	27	48	35	60	44	62
1	>88	22	–	29	12	34	21	42	37	55	44	60
2	80	55	51	56	51	57	50	60	53	73	57	73
3	81	46	39	45	39	45	36	47	50	64	59	71
4	85	68	63	71	67	69	71	75	66	79	68	81
5	85	60	55	64	55	60	53	69	62	74	64	74
6	85	72	70	73	71	70	68	75	78	80	81	81
7	87	71	64	68	68	65	61	68	65	73	71	77
8	86	82	83	80	75	78	78	81	81	80	80	80
9	86	81	74	83	79	>84	83	76	80	81	79	81
10	85	82	83	83	82	>84	81	>84	>84	80	81	80

Harmonic LO Order

test conditions: RF = 10.100 MHZ INPUT P. = −3.94DBM
LO = 40.010 MHZ INPUT P. = +6.82DBM
IF = 29.990 MHZ IF = AMPLIT. = −9.26 DBM

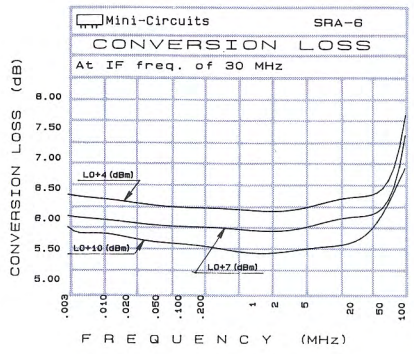
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>79	–	22	35	22	29	16	36	23	48	31	49
1	>79	20	–	28	12	38	19	36	36	51	47	52
2	>79	68	63	67	61	65	56	70	58	71	61	71
3	>79	65	59	62	59	61	66	66	64	70	63	70
4	>79	>73	>73	>73	>73	>73	72	71	71	71	71	70
5	>79	>73	>73	>73	71	>73	>73	>73	71	70	71	70
6	>79	>73	>73	>73	>73	>73	>73	>73	70	70	69	71
7	>79	71	>73	>73	>73	72	>73	>73	69	70	70	71
8	>79	>73	>73	>73	>73	>73	>73	72	>73	70	71	71
9	>79	72	>73	>73	>73	71	>73	>73	>73	71	69	70
10	>79	>73	>73	>73	>73	>73	>73	>73	>73	70	70	71

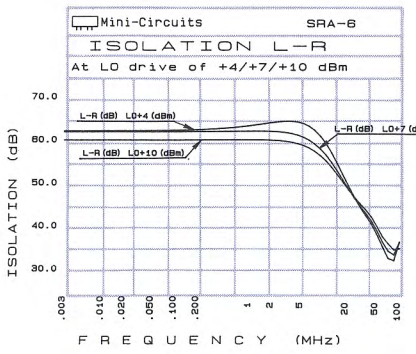
Harmonic LO Order

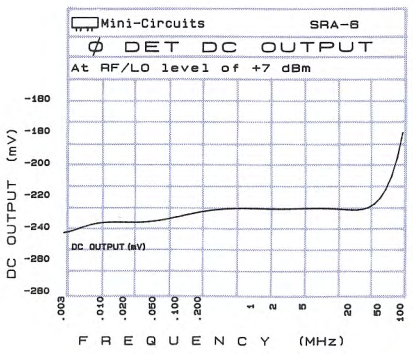
test conditions: RF = 0.100 MHZ INPUT P. = −13.96DBM
LO = 40.010 MHZ INPUT P. = +6.82DBM
IF = 29.990 MHZ IF AMPLIT. = −19.35 DBM

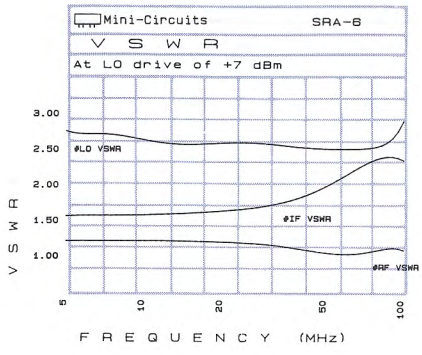
typical performance curves

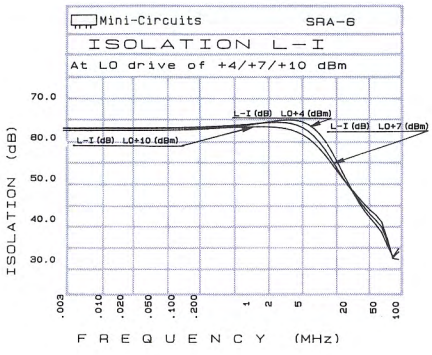
(production unit)

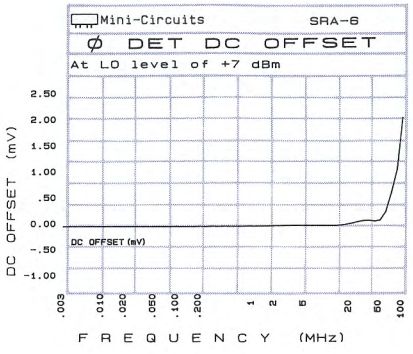












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

GRA-8
SRA-8
ZLW-8
ZAD-8



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.001	3.00	5.43	5.26	4.97	63.49	67.32	68.05	>64.00	>67.00	>70.00
.002	3.00	5.18	4.96	4.76	63.34	67.15	67.96	>64.00	>67.00	>70.00
.005	3.01	4.98	4.92	4.61	63.46	67.23	67.72	>64.00	>67.00	>70.00
.010	3.01	4.96	4.88	4.59	63.99	67.03	67.90	>64.00	>67.00	>70.00
.020	3.02	5.04	4.84	4.64	>64.00	66.98	68.02	>64.00	>67.00	>70.00
.050	3.05	5.04	4.84	4.61	>64.00	66.86	68.43	>64.00	>67.00	>70.00
.100	3.10	5.00	4.79	4.59	>64.00	>67.00	68.45	>64.00	>67.00	>70.00
.200	3.20	5.06	4.88	4.63	>64.00	>67.00	68.61	>64.00	>67.00	>70.00
.500	3.50	5.07	4.86	4.64	>64.00	66.98	68.77	>64.00	>67.00	>70.00
.700	3.70	5.11	4.83	4.66	>64.00	>67.00	68.83	>64.00	>67.00	>70.00
1.000	4.00	5.13	4.88	4.66	>64.00	66.64	67.78	>64.00	>67.00	>70.00
1.430	4.43	5.12	4.91	4.71	>64.00	65.85	65.86	>64.00	>67.00	>70.00
2.000	5.00	5.16	4.91	4.72	63.68	64.48	63.99	>64.00	>67.00	>70.00
2.858	5.86	5.15	4.97	4.78	59.08	57.58	56.32	>64.00	>67.00	>70.00
4.287	7.29	5.22	5.16	4.88	54.41	53.00	52.31	>64.00	>67.00	>70.00
5.001	8.00	5.24	5.17	4.89	51.08	50.13	50.21	>64.00	>67.00	>70.00
6.429	9.43	5.36	5.18	4.97	48.83	48.56	48.77	>64.00	>67.00	>70.00
7.143	4.14	5.24	5.21	4.95	45.65	45.59	45.96	>64.00	>67.00	>70.00
8.572	5.57	5.34	5.23	5.11	43.01	43.14	43.64	>64.00	>67.00	>70.00
10.000	7.00	5.54	5.22	5.22						

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
.101	1.58	1.41	1.30	1.78	3.30	7.11	1.62	1.47	1.38
.201	1.54	1.37	1.27	1.64	2.70	4.36	1.58	1.44	1.35
.420	1.54	1.38	1.28	1.57	2.54	3.76	1.58	1.43	1.35
.740	1.53	1.37	1.28	1.55	2.46	3.67	1.59	1.44	1.36
1.001	1.54	1.37	1.28	1.56	2.41	3.56	1.58	1.44	1.36
1.698	1.54	1.38	1.29	1.51	2.32	3.35	1.59	1.44	1.37
2.001	1.53	1.38	1.28	1.50	2.29	3.30	1.59	1.44	1.36
2.656	1.54	1.38	1.29	1.46	2.21	3.16	1.60	1.45	1.37
3.294	1.54	1.37	1.28	1.39	2.10	2.93	1.60	1.45	1.37
4.253	1.53	1.37	1.28	1.31	1.98	2.76	1.62	1.47	1.39
5.001	1.53	1.37	1.29	1.29	1.95	2.67	1.64	1.50	1.42
5.530	1.52	1.37	1.28	1.29	1.94	2.63	1.64	1.50	1.42
6.169	1.52	1.36	1.28	1.31	1.96	2.64	1.65	1.52	1.43
7.001	1.50	1.37	1.28	1.35	2.01	2.74	1.68	1.55	1.46
7.446	1.50	1.36	1.28	1.38	2.03	2.75	1.69	1.56	1.47
8.085	1.49	1.36	1.28	1.39	2.02	2.71	1.71	1.58	1.49
8.404	1.49	1.36	1.27	1.39	1.98	2.67	1.72	1.58	1.51
9.043	1.48	1.36	1.28	1.35	1.94	2.58	1.74	1.62	1.54
9.362	1.48	1.36	1.28	1.34	1.92	2.55	1.75	1.61	1.54
10.000	1.48	1.35	1.27	1.34	1.90	2.51	1.78	1.65	1.57

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
.001	−275.22	−.11
.005	−271.22	−.13
.010	−264.26	−.13
.020	−261.87	−.13
.050	−262.01	−.12
.100	−259.74	−.12
.200	−260.96	−.12
.500	−262.44	−.13
.700	−264.77	−.13
1.000	−265.78	−.13
2.000	−266.07	−.13
3.334	−259.84	−.13
4.167	−258.11	−.12
5.000	−255.19	−.12
5.834	−250.59	−.12
6.667	−246.55	−.09
7.000	−247.09	−.10
7.500	−246.77	−.13
8.333	−247.65	−.09
10.000	−247.81	−.11

Measurements at RF & LO Power +7 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	30	39	35	44	33	51	41	60	50	69
1	–	16	–	26	12	37	20	40	28	43	42	53
2	84	69	66	70	65	63	58	57	49	65	54	75
3	80	45	56	47	45	45	46	45	45	47	47	55
4	>95	71	70	75	70	77	71	76	>85	73	66	79
5	>96	60	56	65	56	64	55	69	54	68	53	62
6	>94	83	>87	81	81	82	78	81	79	86	78	88
7	96	69	80	68	76	69	78	72	71	77	67	79
8	>95	>87	>85	>86	>85	86	>87	>85	>87	86	>86	84
9	>96	84	77	80	74	76	79	80	78	83	81	79
10	>94	>86	87	>87	>85	>88	88	>86	>86	>86	>87	>85

Harmonic LO Order

test conditions: RF.=IN: FREQ.7.1002 MHZ DRIVE −4.04 DBM
LO.=IN: FREQ.10.01 MHZ DRIVE +7.07 DBM
IF=MEASURED: FREQ.2.9102 AMP. −9.12 DBM

RF ORDER HARMONIC

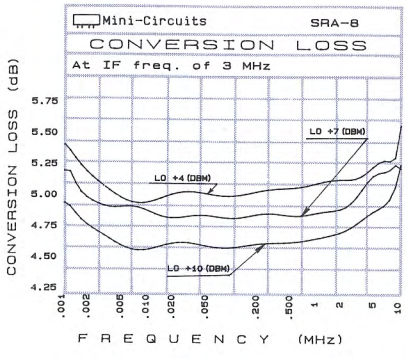
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	20	29	25	33	21	38	27	54	35	64
1	–	16	–	25	12	31	19	34	26	38	35	46
2	>96	73	65	70	66	69	71	65	60	67	61	>76
3	>94	59	61	63	63	65	60	61	56	60	55	68
4	>96	>77	>76	>76	>77	>76	>76	>76	>78	>76	>76	>77
5	>96	>76	>75	77	>75	>75	>76	76	76	>77	74	>77
6	>96	75	>76	>77	76	>77	>77	76	>76	>76	>76	75
7	>95	>76	>76	>76	>76	>77	>75	>77	>77	>76	>77	>77
8	>96	>76	>77	>77	>76	>76	>76	>76	>77	>76	>77	>76
9	>95	>77	>76	>76	>78	76	>77	>77	>77	>75	>77	>75
10	>94	77	>76	>76	>77	>76	>76	>77	>76	>77	>75	>77

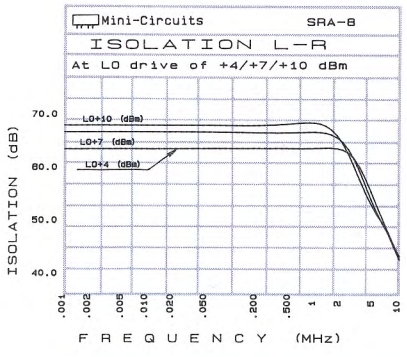
Harmonic LO Order

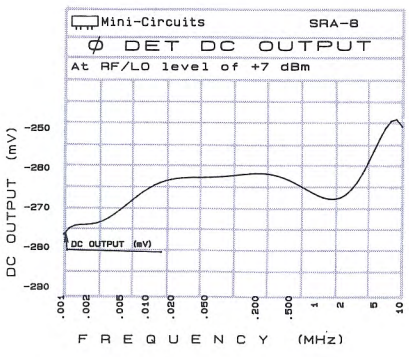
test conditions: RF.=IN: FREQ.7.1002 MHZ DRIVE −13.94 DBM
LO.=IN: FREQ.10.01 MHZ DRIVE +7.07 DBM
IF=MEASURED: FREQ.2.9102 AMP. −18.95 DBM

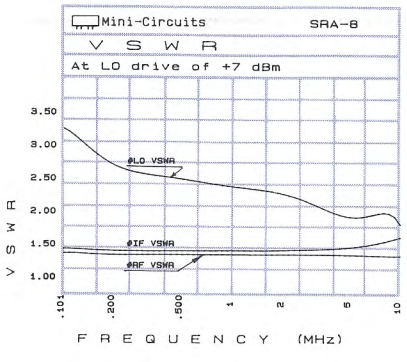
typical performance curves

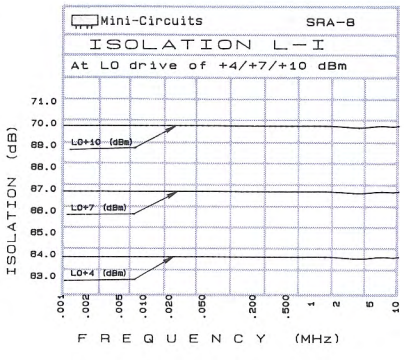
(production unit)

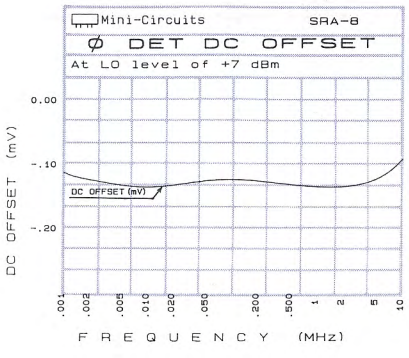












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-1-1
ZLW-1-1
ZAD-1-1

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.100	30.10	6.29	5.97	5.79	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
.500	30.50	5.39	5.10	4.97	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
1.000	31.00	5.26	5.03	4.88	> 64.00	> 67.00	> 70.00	> 64.00	60.45	58.45
2.000	32.00	5.17	4.95	4.83	> 64.00	> 67.00	> 70.00	> 64.00	60.33	58.40
5.000	35.00	5.09	4.94	4.79	> 64.00	> 67.00	> 70.00	> 64.00	60.77	58.85
10.000	40.00	5.11	4.92	4.82	> 64.00	> 67.00	> 70.00	> 64.00	61.39	59.31
20.000	50.00	5.23	5.01	4.91	> 64.00	> 67.00	> 70.00	> 64.00	61.65	59.31
50.000	80.00	5.11	4.95	4.85	> 64.00	> 67.00	60.40	> 64.00	61.63	57.18
69.828	99.83	5.07	4.92	4.82	> 64.00	57.89	55.46	> 64.00	55.93	53.10
100.000	70.00	4.98	4.82	4.77	53.52	51.38	50.35	51.19	49.30	48.15
173.070	143.07	5.09	4.99	4.92	42.69	42.54	43.78	40.65	40.81	42.06
200.000	170.00	5.19	5.08	4.99	43.25	43.50	43.78	40.60	41.01	41.28
224.690	194.69	5.33	5.23	5.09	40.97	41.57	42.12	38.49	39.41	40.10
259.110	229.11	5.35	5.21	5.12	38.29	38.74	39.32	36.72	36.85	37.59
293.520	263.52	5.41	5.32	5.28	36.69	37.88	39.26	35.47	36.40	37.52
345.140	315.14	5.80	5.71	5.62	35.04	36.54	37.94	32.97	33.55	34.49
396.760	366.76	6.04	5.68	5.37	36.38	37.59	38.39	34.55	34.68	33.66
431.180	401.18	6.70	5.98	5.36	37.85	37.76	38.44	36.93	36.68	35.35
465.590	435.59	7.52	7.01	6.30	37.33	37.18	37.12	35.95	36.08	35.13
500.000	470.00	8.25	7.80	7.14	37.02	38.33	40.41	33.62	34.17	32.40

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.38	1.27	1.20	1.50	2.30	3.45	2.13	1.92	1.78
10.000	1.38	1.27	1.20	1.42	2.24	3.20	2.12	1.91	1.77
20.000	1.37	1.27	1.20	1.51	2.26	3.25	2.12	1.90	1.76
34.118	1.35	1.25	1.18	1.47	2.20	3.09	2.13	1.91	1.77
50.000	1.33	1.23	1.16	1.43	2.16	3.02	2.15	1.92	1.78
77.795	1.28	1.18	1.12	1.41	2.11	2.89	2.16	1.93	1.80
100.000	1.25	1.15	1.09	1.40	2.08	2.88	2.21	1.96	1.85
121.470	1.21	1.12	1.07	1.47	2.09	2.94	2.24	2.00	1.87
150.590	1.16	1.09	1.07	1.50	2.12	2.86	2.34	2.05	1.93
179.710	1.13	1.10	1.10	1.51	2.18	2.87	2.42	2.13	1.99
200.000	1.12	1.11	1.14	1.53	2.22	2.96	2.44	2.19	2.04
223.390	1.12	1.15	1.19	1.58	2.23	2.93	2.51	2.24	2.08
267.060	1.16	1.22	1.27	1.69	2.38	3.05	2.60	2.32	2.17
296.180	1.20	1.27	1.33	1.71	2.43	3.15	2.66	2.37	2.24
325.300	1.24	1.31	1.38	1.80	2.44	3.20	2.68	2.41	2.25
354.420	1.27	1.34	1.41	1.93	2.56	3.26	2.66	2.37	2.25
383.530	1.29	1.36	1.41	2.09	2.75	3.42	2.65	2.37	2.23
412.650	1.29	1.35	1.40	2.17	2.85	3.56	2.69	2.37	2.24
441.770	1.26	1.31	1.36	2.22	2.95	3.69	2.65	2.34	2.19
470.890	1.19	1.23	1.28	2.29	3.00	3.82	2.63	2.31	2.16
500.000	1.13	1.16	1.21	2.32	3.10	3.77	2.70	2.32	2.18

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
.100	−252.07	+.02
.200	−255.06	+.03
.500	−256.56	+.02
1.000	−257.44	+.02
2.000	−256.78	+.02
5.000	−258.91	+.02
10.000	−257.73	+.02
20.000	−259.14	+.03
50.000	−256.04	+.02
73.912	−260.65	+.03
100.000	−261.64	+.05
159.130	−256.39	+.09
200.000	−257.48	+.15
223.040	−261.16	+.20
265.650	−248.60	+.26
300.000	−236.58	+.14
372.170	−208.88	−.07
400.000	−197.61	−.18
457.380	−180.61	−.37
500.000	−182.97	+.07

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>89	–	41	48	40	59	33	49	33	52	41	72
1	>89	20	–	31	11	39	18	39	27	43	43	52
2	76	56	69	61	64	63	65	64	52	56	48	64
3	85	51	44	50	45	58	45	52	41	55	45	53
4	85	73	64	74	66	72	66	76	67	72	66	67
5	85	>83	59	67	63	69	57	66	54	66	53	73
6	85	80	82	79	77	>83	74	>84	75	>84	74	>83
7	84	80	76	82	69	79	72	77	74	76	70	74
8	86	80	79	80	80	>83	>83	>83	83	>84	>84	>84
9	86	79	80	80	80	80	81	>83	77	82	>83	81
10	85	80	80	80	80	80	81	>83	>83	>83	>83	>83

Harmonic LO Order

test conditions: RF = 185.100 MHZ INPUT P. −3.91DBM
LO = 155.010 MHZ INPUT P. +6.83DBM
IF = 30.090 MHZ IF = AMPLIT. −9.36 DBM

RF ORDER HARMONIC

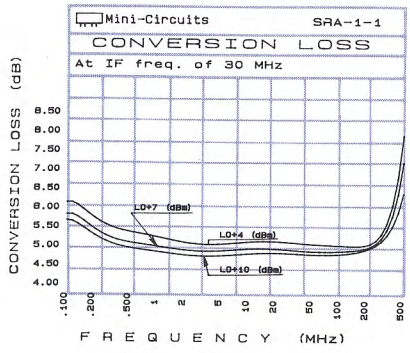
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>80	–	34	37	29	47	21	34	20	43	26	60
1	>80	20	–	32	12	36	17	40	26	40	42	48
2	>80	62	61	64	59	67	60	63	54	58	52	68
3	>80	72	59	67	63	67	57	>73	57	66	58	>73
4	>80	>73	>73	>73	>73	>74	>74	>74	>73	>73	>73	>73
5	>80	>73	>73	>73	>73	>73	>74	>74	>74	>73	>73	>73
6	>80	69	>73	>73	>73	>73	>73	>74	>74	>74	>73	>73
7	>80	70	70	>73	>73	>73	>73	>73	>74	>74	>74	>73
8	>80	69	70	69	68	>73	>73	>73	>73	>74	>74	>74
9	>80	69	69	70	71	70	>73	>73	>73	>73	>73	>74
10	>79	70	70	70	70	70	70	>73	>73	>73	>73	>73

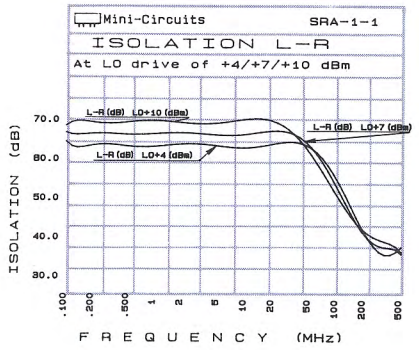
HARMONIC LO ORDER

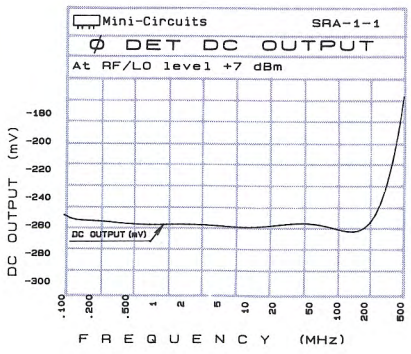
test conditions: RF 185.100 MHZ INPUT P. −13.96DBM
LO 155.010 MHZ INPUT P. +6.83DBM
IF = 30.090MHZ IF = AMPLIT. −19.44 DBM

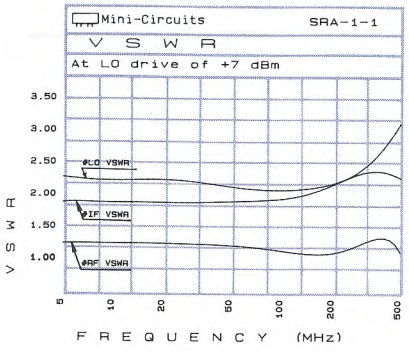
typical performance curves

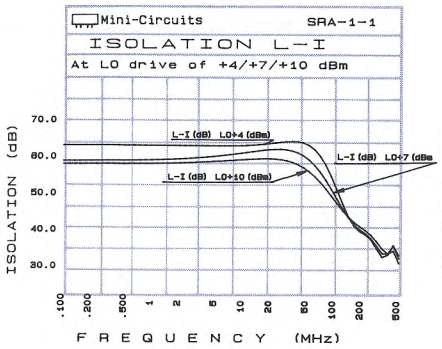
(production unit)

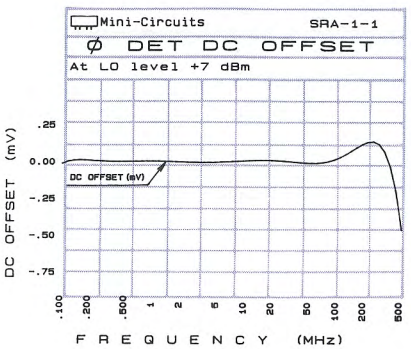












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

SRA-1W
ZAD-1W
ZFM-1W
ZLW-1W

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	6.40	6.42	6.47	>64.00	>67.00	>70.00	>64.00	>67.00	64.91
2.000	32.00	6.15	5.97	6.07	>64.00	>67.00	>70.00	>64.00	>67.00	64.71
5.000	35.00	5.80	5.50	5.73	>64.00	>67.00	>70.00	>64.00	>67.00	64.82
10.000	40.00	5.92	5.66	5.47	>64.00	>67.00	>70.00	>64.00	>67.00	65.02
20.000	50.00	5.93	5.60	5.41	>64.00	>67.00	>70.00	>64.00	>67.00	64.65
50.000	80.00	5.85	5.60	5.50	>64.00	>67.00	>70.00	>64.00	62.28	61.08
100.000	70.00	5.75	5.47	5.47	>64.00	>67.00	59.87	54.37	55.09	54.33
130.140	100.14	5.74	5.52	5.42	>64.00	57.96	55.48	51.69	51.55	51.11
200.000	170.00	5.81	5.62	5.55	51.92	50.48	49.20	46.26	45.84	44.92
285.110	255.11	5.64	5.47	5.44	46.41	45.61	44.78	41.42	40.64	40.18
362.590	332.59	5.90	5.71	5.53	43.45	42.62	42.43	38.16	37.34	37.26
414.250	384.25	6.10	5.97	5.63	40.29	40.09	40.38	35.59	36.21	36.95
500.000	470.00	6.39	6.14	5.93	40.14	39.49	39.46	33.46	33.17	33.44
543.390	513.39	6.45	6.24	5.97	38.53	37.59	37.08	32.09	31.35	31.13
595.040	565.04	6.61	6.21	6.28	37.16	37.44	37.78	32.18	31.39	31.01
646.700	616.70	6.61	6.16	5.91	35.85	36.31	37.13	33.13	33.58	33.33
672.530	642.53	6.88	6.27	5.93	36.55	36.63	37.42	30.97	31.60	31.99
698.360	668.36	7.13	6.43	5.95	36.25	36.64	37.41	29.19	29.86	30.40
724.180	694.18	7.46	6.68	6.13	36.48	36.68	37.16	28.44	28.78	29.14
750.000	720.00	7.84	6.98	6.25	35.61	35.77	36.24	27.28	27.45	27.86

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.15	1.20	1.23	2.15	3.31	4.93	1.64	1.46	1.35
10.000	1.07	1.12	1.16	2.07	3.09	4.57	1.64	1.46	1.35
20.000	1.05	1.10	1.15	2.12	3.15	4.56	1.64	1.46	1.36
50.000	1.08	1.12	1.17	2.04	2.99	4.21	1.65	1.47	1.37
78.484	1.10	1.14	1.19	2.00	2.99	4.06	1.67	1.50	1.40
100.000	1.11	1.16	1.21	2.00	2.84	3.86	1.68	1.51	1.42
155.970	1.15	1.20	1.25	1.99	2.88	3.83	1.77	1.60	1.51
200.000	1.18	1.23	1.28	1.96	2.75	3.59	1.86	1.68	1.59
259.280	1.24	1.30	1.35	1.96	2.74	3.56	1.99	1.81	1.71
310.940	1.29	1.35	1.41	2.00	2.74	3.58	2.12	1.93	1.81
362.590	1.34	1.40	1.46	2.08	2.78	3.61	2.26	2.05	1.94
414.250	1.39	1.45	1.50	2.07	2.78	3.56	2.35	2.13	2.01
465.900	1.43	1.48	1.53	2.10	2.80	3.48	2.43	2.22	2.09
517.560	1.45	1.50	1.54	2.15	2.82	3.52	2.45	2.24	2.11
569.220	1.47	1.49	1.53	2.18	2.85	3.52	2.45	2.23	2.11
620.870	1.49	1.51	1.54	2.30	2.93	3.47	2.38	2.20	2.09
672.530	1.55	1.58	1.60	2.39	2.94	3.57	2.27	2.10	2.00
698.360	1.62	1.64	1.68	2.41	3.03	3.52	2.24	2.05	1.97
724.180	1.69	1.72	1.75	2.43	3.01	3.55	2.16	1.99	1.91
750.000	1.80	1.83	1.86	2.45	3.01	3.56	2.11	1.93	1.84

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
1.000	−225.12	−.06
2.000	−228.82	−.06
5.000	−229.29	−.06
10.000	−231.45	−.05
20.000	−226.19	−.04
49.322	−222.81	−.04
73.483	−223.49	−.05
100.000	−228.62	−.05
145.970	−229.46	−.04
200.000	−226.10	+0.00
266.770	−229.57	+0.00
387.580	−193.60	+.08
460.060	−199.61	−.23
500.000	−207.29	−.12
556.700	−187.14	+.32
605.030	−160.57	+.22
677.510	−144.43	+.16
701.670	−137.65	−.18
725.830	−124.38	−.31
750.000	−115.97	−.53

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>80	–	14	23	11	32	11	25	26	46	40	49
1	>80	18	–	36	10	34	34	35	47	51	61	55
2	>80	>74	53	>72	55	66	51	71	49	59	59	69
3	>80	70	58	68	57	67	53	70	>73	67	67	68
4	>80	68	>74	>74	>72	>72	>72	>72	>73	>73	67	68
5	>80	68	68	>74	>74	>72	>72	>72	>72	>73	73	68
6	>80	69	68	69	>74	>74	>72	>72	>72	>72	>74	73
7	>80	69	68	68	68	>74	>74	>72	>72	>72	>72	>74
8	>80	69	69	68	68	67	>74	>74	>72	>72	>72	>72
9	>80	69	70	69	69	68	68	>74	>74	>72	>72	>72
10	>80	69	68	69	69	67	68	68	>74	73	>72	>72

Harmonic LO Order

test conditions: RF = 500.100 MHZ INPUT P. = −14.06DBM
LO = 470.010 MHZ INPUT P. = +7.15DBM
IF = 30.090MHZ IF AMPLIT. = −20.66 DBM

RF ORDER HARMONIC

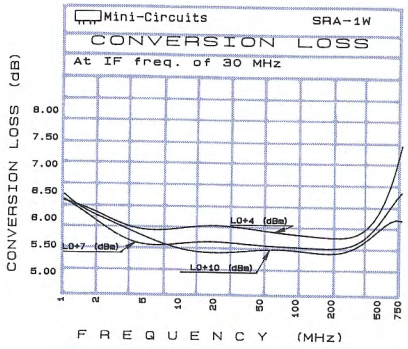
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	–	22	34	23	48	22	37	38	59	53	63
1	>90	18	–	37	11	36	38	40	59	54	59	60
2	76	64	44	65	47	58	42	77	42	50	54	70
3	85	54	46	54	41	57	37	59	64	54	58	66
4	84	78	76	69	61	75	59	69	61	76	64	74
5	83	77	71	83	58	64	54	66	51	64	69	72
6	84	77	79	76	>84	83	73	79	69	77	68	>84
7	85	79	76	77	78	>84	79	>82	73	80	66	77
8	86	79	79	79	78	78	>84	>84	>82	>81	>81	>82
9	85	77	79	78	79	79	78	84	>84	>82	>82	>81
10	85	79	79	79	80	78	78	77	>84	84	>81	>82

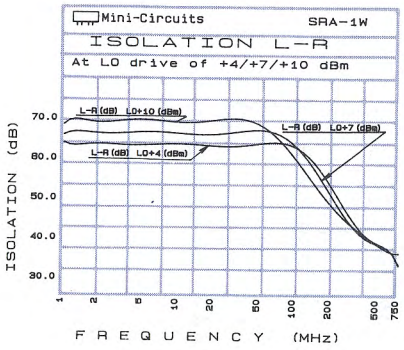
Harmonic LO Order

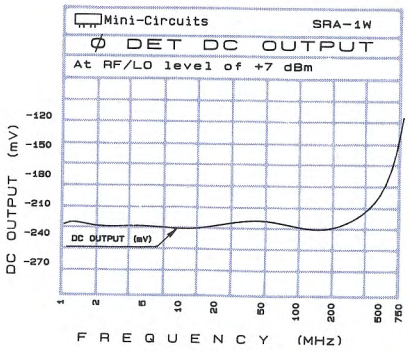
test conditions: RF = 500.100 MHZ INPUT P. = −3.98DBM
LO = 470.010 MHZ INPUT P. = +7.15DBM
IF = 30.090MHZ IF AMPLIT. = −10.65 DBM

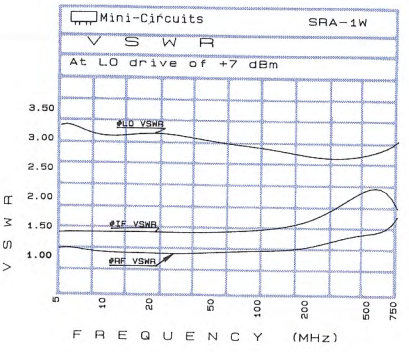
typical performance curves

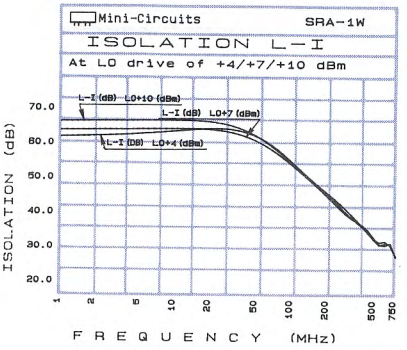
(production unit)

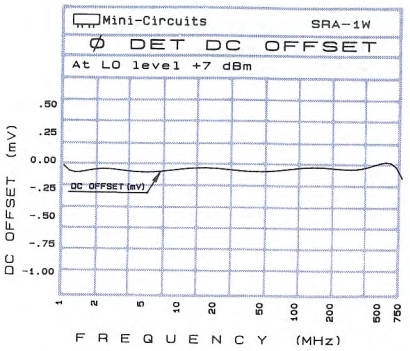












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-2
TAK-7
ZAD-2

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	6.07	5.81	5.46	62.60	62.40	>66.00	>64.00	66.60	>70.00
10.000	40.00	6.08	5.74	5.59	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
20.000	50.00	6.30	5.87	5.69	>64.00	63.37	61.98	>64.00	>67.00	65.75
50.000	80.00	6.12	5.77	5.63	55.60	55.36	54.47	59.32	58.05	57.23
100.000	70.00	6.19	5.79	5.61	49.88	49.04	48.78	53.06	52.36	51.54
160.320	130.32	6.26	5.85	5.67	45.01	45.18	45.58	49.33	48.76	47.95
200.000	170.00	6.37	5.92	5.76	42.87	43.67	44.12	47.83	47.23	46.11
284.570	254.57	6.33	5.95	5.78	39.78	41.08	41.57	45.98	44.56	43.24
346.690	316.69	6.46	6.00	5.80	37.76	39.04	39.72	46.26	43.59	42.36
408.820	378.82	6.63	6.15	6.03	36.41	36.94	37.09	45.83	43.85	42.15
500.000	470.00	6.65	6.25	6.02	34.76	35.65	36.13	42.46	41.57	41.15
533.070	503.07	6.60	6.19	5.99	33.76	34.41	34.81	41.86	42.87	40.89
595.200	565.20	6.36	5.96	5.83	31.57	33.15	32.76	38.80	37.76	37.80
688.390	658.39	5.98	5.57	5.36	30.43	31.77	33.15	38.78	38.59	39.85
750.510	720.51	6.09	5.59	5.38	29.69	30.90	32.19	40.24	40.39	41.51
800.000	770.00	6.10	5.60	5.40	29.15	30.50	31.72	41.59	41.73	42.48
843.700	813.70	6.02	5.64	5.42	28.90	30.24	31.53	41.01	41.84	41.85
905.830	875.83	5.98	5.62	5.46	28.01	28.94	30.05	37.68	47.26	38.04
967.950	937.95	6.15	5.81	5.66	27.16	28.12	28.44	36.14	35.84	35.75
1000.000	970.00	6.36	6.10	5.89	26.28	27.73	27.35	33.59	32.72	33.16

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.94	1.73	1.58	2.14	3.13	4.78	1.32	1.39	1.45
10.000	1.94	1.73	1.59	2.01	2.99	4.46	1.23	1.31	1.37
20.000	1.93	1.73	1.59	2.14	3.08	4.50	1.19	1.28	1.35
50.000	1.95	1.74	1.61	2.02	2.94	4.34	1.19	1.29	1.35
100.000	1.99	1.80	1.67	1.98	2.86	3.95	1.23	1.31	1.38
137.670	2.05	1.86	1.73	1.96	2.78	3.79	1.26	1.34	1.40
200.000	2.17	1.97	1.88	1.93	2.72	3.68	1.31	1.38	1.44
237.170	2.25	2.06	1.95	1.91	2.74	3.68	1.33	1.40	1.46
303.500	2.35	2.17	2.05	1.94	2.74	3.60	1.34	1.41	1.47
369.840	2.42	2.23	2.12	2.04	2.85	3.76	1.31	1.37	1.43
436.170	2.40	2.21	2.11	2.10	2.86	3.68	1.24	1.30	1.35
500.000	2.31	2.11	2.01	2.14	2.92	3.68	1.15	1.20	1.24
568.840	2.17	1.98	1.86	2.25	2.94	3.76	1.12	1.17	1.21
635.170	2.01	1.78	1.66	2.34	3.02	3.79	1.32	1.35	1.39
701.510	1.90	1.66	1.49	2.47	3.13	3.97	1.65	1.68	1.73
767.840	1.81	1.56	1.39	2.61	3.33	4.10	2.10	2.12	2.17
800.000	1.77	1.55	1.37	2.68	3.40	4.14	2.37	2.37	2.44
867.340	1.76	1.57	1.46	2.74	3.45	4.19	2.99	3.00	3.00
933.680	1.66	1.56	1.52	2.75	3.47	4.14	3.62	3.57	3.55
1000.000	1.43	1.41	1.41	2.72	3.30	4.04	4.13	4.05	3.96

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Mini-Circuits

ULTRA-REL™ MIXERS
5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	–	36	27	43	47	37	49	32	60	48	64
1	>90	17	–	37	16	37	33	42	35	50	57	59
2	77	52	60	51	58	54	69	75	56	54	43	75
3	>90	46	39	51	38	47	39	46	48	51	47	54
4	>90	78	78	62	69	58	77	60	71	76	70	67
5	>90	77	77	68	52	60	47	59	46	61	68	63
6	>90	78	78	77	82	75	77	73	>82	73	77	79
7	>90	78	79	77	77	75	71	69	65	65	60	66
8	>90	80	80	79	78	79	>83	81	>82	79	>82	73
9	>90	79	78	78	78	79	79	>83	77	74	67	72
10	>90	79	79	80	79	79	79	78	>83	84	>82	>82

Harmonic LO Order

test conditions: RF = 500.100 MHZ INPUT P. = −3.95DBM
LO = 470.010 MHZ INPUT P. = +6.86DBM
IF = 30.090MHZ IF AMPLIT. = −10.56 DBM

RF ORDER HARMONIC

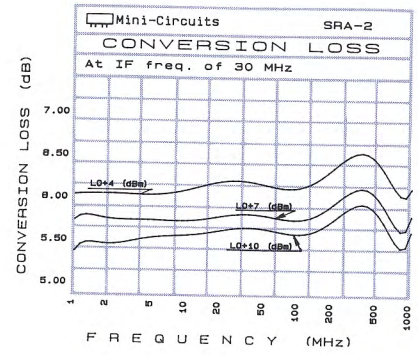
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>80	–	27	17	35	35	24	33	18	45	31	51
1	>80	18	–	34	18	31	29	34	28	42	44	43
2	>80	57	61	52	61	53	66	68	64	56	45	67
3	>80	67	55	65	52	65	52	67	68	64	57	69
4	>80	68	>74	73	>72	>72	>72	>72	>74	>73	68	68
5	>80	69	69	>74	>74	>72	>72	>72	>72	>74	>74	68
6	>80	68	69	68	>74	>74	>72	>72	>72	>72	>74	73
7	>80	69	68	68	69	73	>74	>72	>72	>72	>72	>74
8	>80	68	69	69	69	68	>74	>74	>72	>72	>72	>72
9	>80	69	68	69	68	69	67	>74	>74	>72	>72	>72
10	>80	69	68	70	69	68	69	68	>74	>74	>72	>72

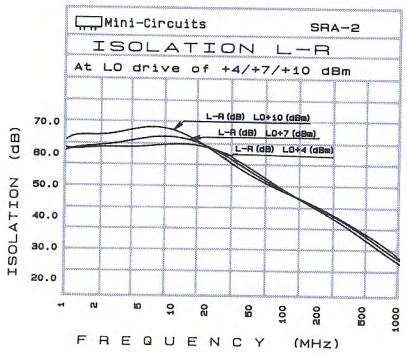
Harmonic LO Order

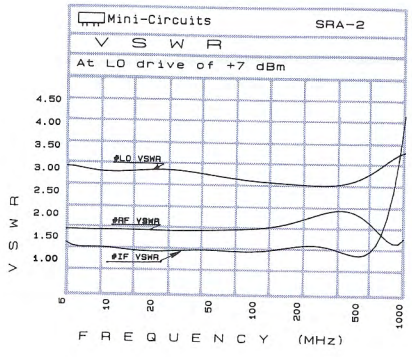
test conditions: RF = 500.100 MHZ INPUT P. = −13.94DBM
LO = 470.010 MHZ INPUT P. = +6.86DBM
IF = 30.090 MHZ IF AMPLIT. = −20.53 DBM

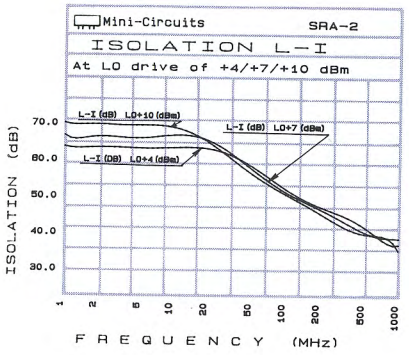
typical performance curves

(production unit)









In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-11
ZLW-11
ZAD-11



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	5.92	5.85	5.80	46.33	46.19	48.51	>64.00	>67.00	>70.00
10.000	40.00	6.02	5.88	5.81	46.80	46.23	48.89	>64.00	>67.00	>70.00
20.000	50.00	6.35	6.11	5.99	46.84	46.26	48.68	>64.00	>67.00	>70.00
50.000	80.00	6.61	6.37	6.24	46.25	45.89	47.69	>64.00	>67.00	69.02
100.000	70.00	6.49	6.25	6.14	44.81	44.70	45.68	>64.00	64.66	64.72
200.000	170.00	6.94	6.62	6.39	41.62	41.17	41.39	57.90	55.90	54.53
311.920	281.92	7.16	6.71	6.44	39.17	38.72	38.07	50.53	50.11	51.19
465.390	435.39	7.66	7.06	6.64	36.28	37.94	35.08	44.95	46.15	47.44
618.850	588.85	7.95	7.40	7.00	33.62	38.38	32.75	43.83	45.38	47.50
772.310	742.31	7.79	7.53	7.35	33.55	38.07	32.37	44.19	45.67	46.26
849.040	819.04	7.49	7.22	7.09	32.38	37.13	31.82	42.69	43.78	44.40
1000.000	970.00	7.28	7.05	6.96	30.89	36.28	29.71	37.21	38.27	39.01
1156.000	1126.00	7.04	6.76	6.66	31.61	35.18	29.94	44.42	43.23	41.99
1386.200	1356.20	8.05	7.53	7.24	38.48	41.65	36.24	41.70	38.52	36.21
1462.900	1432.90	8.10	7.62	7.34	41.17	41.43	33.31	43.90	41.57	39.61
1500.000	1470.00	7.94	7.48	7.24	39.84	41.94	35.06	44.76	42.71	40.60
1616.400	1586.40	7.34	6.96	6.78	38.73	43.41	40.48	46.03	43.97	43.05
1800.000	1770.00	7.07	6.79	6.60	40.00	41.03	41.30	40.95	38.23	35.95
1923.300	1893.30	6.90	6.64	6.51	39.95	38.49	40.75	32.70	30.27	28.57
2000.000	1970.00	6.99	6.69	6.52	39.23	39.35	39.94	29.79	27.98	26.39

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	3.06	3.19	3.19	2.29	3.03	4.59	3.11	3.21	3.24
10.000	2.54	2.54	2.51	1.90	2.69	4.03	1.90	2.08	2.20
50.000	2.48	2.45	2.43	1.81	2.70	4.02	1.55	1.79	1.93
100.000	2.64	2.62	2.58	1.81	2.61	3.85	1.48	1.68	1.81
200.000	3.00	2.96	2.92	1.83	2.46	3.45	1.38	1.55	1.67
300.560	3.25	3.21	3.17	1.83	2.31	3.19	1.34	1.49	1.59
374.450	3.42	3.31	3.28	1.86	2.27	3.05	1.38	1.52	1.62
500.000	3.40	3.42	3.37	1.76	2.13	2.75	1.53	1.67	1.76
670.000	3.25	3.19	3.18	1.70	2.08	2.48	1.90	2.08	2.17
817.780	3.00	2.96	2.93	1.81	1.93	2.27	2.30	2.56	2.66
1000.000	2.50	2.41	2.35	1.83	1.73	1.98	3.00	3.20	3.35
1100.000	2.24	2.10	2.01	1.79	1.58	1.78	3.90	4.07	4.20
1200.000	2.05	1.86	1.73	1.63	1.45	1.64	4.72	4.75	4.91
1408.900	2.28	2.12	2.02	1.41	1.17	1.47	4.12	4.12	4.14
1500.000	2.44	2.27	2.12	1.25	1.17	1.52	9.74	9.63	9.79
1630.600	2.32	2.19	2.06	1.15	1.32	1.68	13.39	13.09	13.29
1704.400	2.22	2.08	2.00	1.11	1.39	1.83	12.71	12.26	12.44
1852.200	1.97	1.87	1.81	1.18	1.59	1.99	10.96	11.10	10.89
1926.100	1.85	1.79	1.72	1.26	1.70	2.16	10.31	9.90	9.79
2000.000	1.77	1.67	1.62	1.33	1.74	2.14	9.23	8.72	8.72

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	34	23	48	33	57	44	60	62	62
1	–	16	–	29	23	36	36	37	52	58	49	54
2	94	61	54	61	44	66	49	69	48	63	55	61
3	>94	68	44	66	38	53	51	66	53	51	62	66
4	93	>84	72	75	65	82	57	75	60	80	61	69
5	>95	82	80	82	65	>84	56	70	70	75	65	65
6	>90	>77	>83	>84	77	>83	74	>84	66	>83	68	>85
7	89	>77	>77	>84	>84	>84	80	>84	69	79	>85	>83
8	>89	>78	>78	>77	>85	>86	>83	>84	>84	>84	75	>83
9	>89	78	>79	>78	>77	>84	>83	>84	>84	>84	81	>84
10	89	>79	>78	>76	>79	>77	>83	>83	>83	>82	>84	>84

Harmonic LO Order

test conditions: RF.=IN: FREQ.1000.1 MHZ DRIVE −4 DBM
LO.=IN: FREQ.970.01 MHZ DRIVE +6.97 DBM
IF=MEASURED: FREQ.30.09 AMP. −11.21 DBM

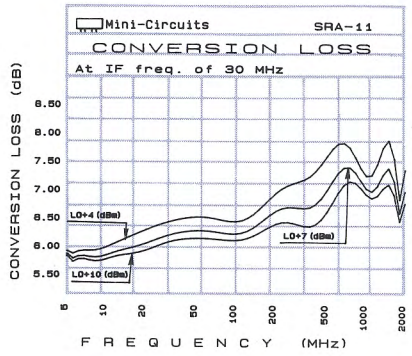
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	24	13	37	21	38	33	40	49	45
1	–	16	–	29	23	36	34	33	48	52	40	45
2	>94	66	66	68	52	70	53	>73	53	65	58	62
3	>94	>73	64	>73	57	71	69	>73	67	67	74	66
4	>95	>74	>73	>73	74	>75	>74	>73	>73	>75	>74	75
5	>95	>74	>73	>74	>73	>74	>74	>74	>73	>73	>75	>74
6	>89	>69	>75	>74	>74	>73	>74	>75	>74	>74	>74	>74
7	>89	>66	>67	>74	>75	>75	>74	>75	>74	>74	>73	>74
8	>90	>67	>67	>68	>74	>74	>72	>73	>74	>74	>74	>73
9	>89	>67	>70	67	>68	>74	>74	>73	>73	>74	>74	>74
10	>88	>68	68	>68	>67	>68	>73	>74	>74	>73	>74	>74

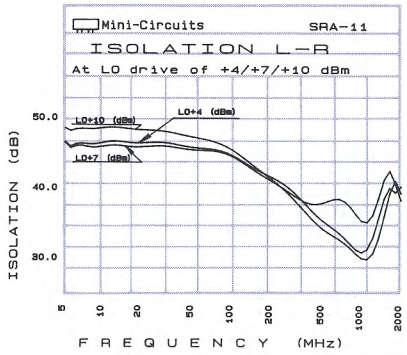
Harmonic LO Order

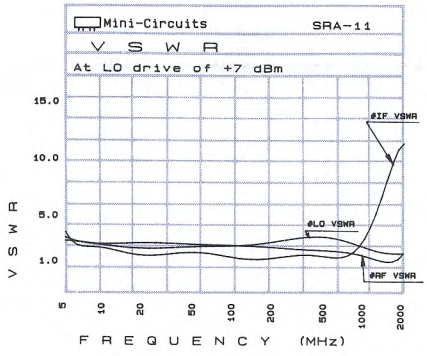
test conditions: RF.=IN: FREQ.1000.1 MHZ DRIVE −14.01 DBM
LO.=IN: FREQ.970.01 MHZ DRIVE +6.94 DBM
IF=MEASURED: FREQ.30.09 AMP. −21.27 DBM

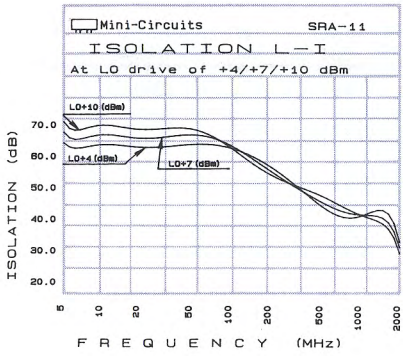
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-2000
ZFM-2000



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
100.000	130.000	8.09	7.88	7.75	100.000	64.43	63.45	62.54	48.08	46.41	45.11
200.000	230.000	7.62	7.16	6.86	200.000	60.82	60.41	59.67	43.64	40.82	38.84
267.650	237.647	7.90	7.37	7.03	267.650	58.02	58.33	57.88	41.46	38.59	36.54
435.290	405.294	8.54	7.73	7.27	435.290	52.16	51.41	51.14	36.86	34.21	32.30
500.000	470.000	8.54	7.83	7.35	500.000	53.94	52.88	52.24	36.19	33.31	31.53
602.940	572.941	8.44	7.78	7.34	602.940	52.69	52.63	52.35	34.91	32.54	30.83
714.710	684.706	8.40	7.91	7.61	714.710	53.94	54.29	53.52	32.49	30.27	28.90
770.590	740.588	8.42	8.02	7.75	770.590	54.82	54.64	53.30	32.22	30.10	28.76
938.240	908.235	8.01	7.66	7.50	938.240	72.62	60.47	56.80	31.93	29.50	27.72
994.120	964.118	7.85	7.51	7.34	994.120	72.58	59.11	54.41	31.68	29.33	27.52
1000.000	970.000	7.90	7.53	7.38	1000.000	70.20	59.12	54.02	31.65	29.29	27.40
1161.760	1131.765	7.91	7.40	7.25	1161.760	51.32	49.13	45.90	30.38	27.43	25.04
1273.530	1243.529	7.93	7.46	7.23	1273.530	47.56	43.70	40.67	29.58	26.26	23.74
1385.290	1355.294	8.11	7.55	7.33	1385.290	41.94	36.51	33.53	27.61	24.00	21.64
1441.180	1411.177	8.21	7.71	7.44	1441.180	37.98	34.04	31.73	29.52	26.34	24.11
1552.940	1522.941	8.34	7.73	7.39	1552.940	38.61	36.54	35.20	40.54	38.03	36.22
1720.590	1690.588	7.90	7.45	7.18	1720.590	41.45	42.35	42.11	38.58	34.48	32.05
1888.240	1858.235	7.87	7.47	7.22	1888.240	42.68	44.03	44.93	35.35	33.01	31.27
1944.120	1914.118	7.92	7.51	7.26	1944.120	42.70	43.94	44.77	34.30	32.64	31.00
2000.000	1970.000	7.92	7.54	7.30	2000.000	42.43	43.18	43.84	33.28	32.15	30.88

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
100.000	5.52	5.22	4.95	1.66	2.43	3.37	5.000	1.28	1.38	1.51	100.000	179.72	−0.20
199.750	5.59	5.25	4.80	1.66	2.36	3.22	10.000	1.77	1.85	1.99	200.000	215.16	−0.12
294.750	5.36	5.06	4.78	1.71	2.39	3.24	20.000	1.74	1.86	2.02	211.760	225.25	−0.17
442.000	4.78	4.59	4.36	1.79	2.43	3.24	50.000	1.48	1.60	1.75	379.410	235.89	0.14
537.000	4.47	4.34	4.17	1.81	2.42	3.20	60.780	1.45	1.57	1.72	500.000	243.13	−0.30
589.250	4.29	4.17	4.03	1.83	2.42	3.19	100.000	1.39	1.51	1.66	547.060	240.39	0.19
750.750	3.61	3.55	3.47	1.95	2.34	2.97	116.560	1.37	1.49	1.63	658.820	243.58	−0.43
879.000	3.21	3.13	3.03	2.10	2.34	2.87	172.340	1.31	1.43	1.56	714.710	251.26	0.30
997.750	2.72	2.55	2.46	2.18	2.24	2.66	200.000	1.27	1.39	1.52	882.350	250.69	−0.06
1026.250	2.69	2.52	2.41	2.18	2.22	2.61	228.130	1.24	1.36	1.49	994.120	259.69	0.26
1073.750	2.63	2.46	2.30	2.18	2.17	2.52	283.910	1.20	1.32	1.43	1050.000	250.35	0.49
1121.250	2.56	2.35	2.26	2.16	2.08	2.37	300.000	1.20	1.31	1.42	1161.760	267.63	1.44
1249.500	2.42	2.23	2.12	2.07	1.83	2.01	339.690	1.19	1.30	1.41	1273.530	266.21	1.25
1415.750	2.26	2.11	2.01	1.83	1.44	1.51	395.470	1.24	1.33	1.44	1385.290	270.37	−3.01
1501.250	2.13	1.99	1.89	1.71	1.29	1.39	451.250	1.35	1.43	1.54	1441.180	248.20	−0.77
1563.000	2.17	2.03	1.93	1.55	1.16	1.36	500.000	1.47	1.56	1.68	1552.940	260.26	4.92
1705.500	2.25	2.12	2.10	1.32	1.12	1.51	507.030	1.49	1.58	1.71	1720.590	235.06	2.01
1852.750	2.40	2.23	2.09	1.10	1.41	1.84	562.810	1.68	1.79	1.95	1888.240	226.68	0.92
1952.500	2.44	2.28	2.16	1.24	1.68	2.18	581.410	1.75	1.88	2.05	1944.120	249.76	0.51
2000.000	2.43	2.26	2.14	1.33	1.79	2.30	600.000	1.83	1.96	2.15	2000.000	225.49	−0.12

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA•REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF Order Harmonic

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	0	13	2	31	36	36	36	42	52	47
1	-	28	+0	32	23	29	33	33	39	43	47	52
2	89	56	52	65	49	66	45	70	65	65	59	61
3	94	69	61	70	57	71	69	69	67	69	68	64
4	95	>74	71	>73	72	>73	>73	>73	72	72	71	>74
5	>97	>73	72	>73	71	>73	>74	72	72	70	72	71
6	>90	>67	72	>72	>73	>73	71	72	72	>72	>72	>72
7	>89	>66	>67	>73	>73	>73	>72	>73	>73	>74	>73	71
8	90	>69	>67	>68	71	>73	>73	71	>74	>73	>74	>73
9	90	>68	67	>67	>67	72	>73	>73	>72	>73	72	>73
10	>91	>68	>68	>66	66	>67	>73	72	>73	>72	>73	73

LO Harmonic Order

test condition RF IN: 1000.10 MHz; −15.10 dBM
LO IN: 970.01 MHz; +7.04 dBM
IF OUT: 30.09 MHz; −22.78 dBM

RF Order Harmonic

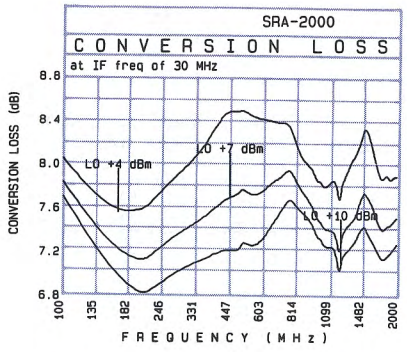
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	24	13	43	46	49	52	73	70	61
1	-	29	+0	32	23	30	34	37	43	49	55	62
2	69	48	46	57	42	57	38	62	60	61	62	58
3	95	52	44	51	39	56	52	56	52	52	55	62
4	95	82	64	66	60	74	56	76	54	79	71	70
5	>96	77	78	77	70	72	57	73	69	77	65	68
6	90	>78	>83	>83	74	80	76	80	69	>82	67	>83
7	88	75	>78	>82	>83	>84	>82	>83	72	83	81	>83
8	>91	>79	>77	>77	>83	83	82	>82	82	83	81	>83
9	90	>78	>78	>77	76	>83	>83	>83	>83	>84	82	>83
10	>91	>78	>78	>79	>77	>77	>83	81	>83	>82	>83	>84

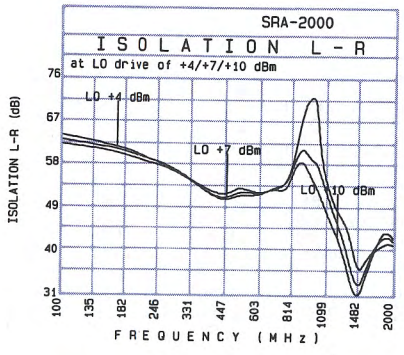
LO Harmonic Order

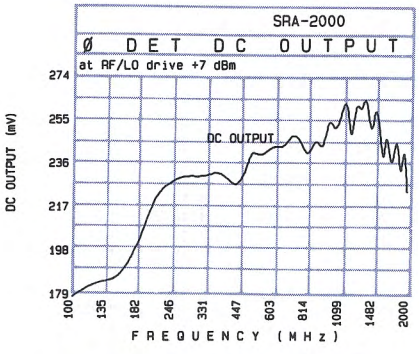
test condition RF IN: 1000.10 MHz; −5.10 dBM
LO IN: 970.01 MHz; +7.04 dBM
IF OUT: 30.09 MHz; −12.78 dBM

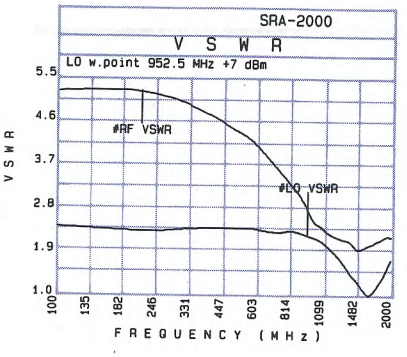
typical performance curves

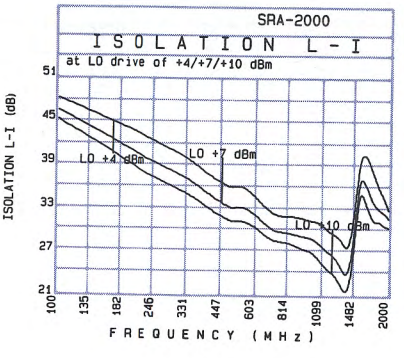
(production unit)

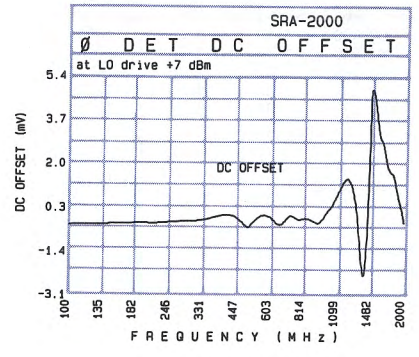












In Stock...Immediate Delivery

most economical

Frequency Mixers

Models
SBL-1

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	6.99	6.67	6.45	62.73	>67.00	68.01	61.88	65.61	>70.00
2.000	32.00	6.50	6.24	6.05	61.86	>67.00	67.46	61.93	>67.00	>70.00
5.000	35.00	5.96	5.74	5.60	61.73	64.84	66.12	62.43	>67.00	>70.00
10.000	40.00	5.85	5.58	5.46	61.35	64.19	65.15	61.72	64.81	66.04
20.000	50.00	5.96	5.67	5.51	60.14	62.22	62.01	60.33	61.69	61.30
32.188	62.19	5.86	5.60	5.51	58.85	59.04	58.99	58.27	57.74	57.09
50.000	80.00	5.84	5.60	5.49	56.98	56.71	55.75	54.84	54.39	53.61
78.970	48.97	5.83	5.56	5.44	54.05	52.21	50.75	51.16	49.67	48.53
100.000	70.00	5.74	5.52	5.43	51.39	49.41	48.33	48.54	46.90	46.10
156.940	126.94	5.69	5.53	5.47	45.18	44.20	43.99	42.22	41.66	41.56
200.000	170.00	5.85	5.68	5.60	41.88	41.56	41.75	39.00	38.98	39.65
203.720	173.72	5.83	5.67	5.56	41.46	41.05	41.34	38.60	38.52	39.23
250.500	220.50	5.80	5.63	5.47	40.14	40.04	40.21	37.21	37.29	37.77
297.290	267.29	5.77	5.61	5.48	36.89	36.90	37.90	33.86	33.97	34.98
344.070	314.07	5.93	5.81	5.72	36.80	37.11	37.44	33.43	33.88	34.36
375.260	345.26	6.28	6.13	5.97	34.83	36.02	37.25	31.69	32.79	34.20
406.440	376.44	6.27	6.15	6.07	33.09	34.80	36.66	29.68	31.05	32.79
437.630	407.63	6.38	6.08	5.88	32.48	33.79	35.38	29.38	30.39	31.81
468.820	438.82	6.48	6.00	5.73	32.24	32.80	34.05	29.76	30.12	30.96
500.000	470.00	6.90	6.31	5.99	32.48	32.36	33.04	30.19	30.37	30.65

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
1.001	1.83	1.80	1.86	2.45	3.75	5.47	1.67	1.44	1.30
16.121	1.07	1.14	1.20	1.92	2.81	3.95	1.68	1.45	1.31
20.000	1.06	1.14	1.20	1.94	2.89	3.95	1.68	1.44	1.31
31.242	1.06	1.14	1.20	1.93	2.83	3.88	1.68	1.44	1.32
50.000	1.07	1.15	1.20	1.83	2.69	3.54	1.69	1.46	1.33
76.605	1.08	1.16	1.21	1.84	2.72	3.70	1.71	1.48	1.36
100.000	1.09	1.17	1.22	1.82	2.62	3.38	1.74	1.52	1.39
121.970	1.11	1.18	1.24	1.82	2.62	3.53	1.79	1.55	1.42
152.210	1.13	1.20	1.25	1.88	2.66	3.42	1.85	1.62	1.50
182.450	1.15	1.22	1.27	1.83	2.62	3.21	1.93	1.69	1.57
200.000	1.12	1.26	1.27	1.87	2.58	3.22	1.98	1.77	1.62
242.940	1.19	1.26	1.32	1.89	2.56	3.19	2.11	1.88	1.74
273.180	1.21	1.28	1.34	1.90	2.59	3.17	2.21	1.99	1.86
318.540	1.23	1.30	1.35	1.99	2.64	3.25	2.35	2.11	1.95
348.780	1.24	1.31	1.36	2.01	2.59	3.18	2.38	2.15	2.03
379.030	1.24	1.30	1.34	2.03	2.60	3.15	2.45	2.24	2.09
409.270	1.23	1.28	1.32	2.12	2.72	3.19	2.46	2.24	2.11
424.390	1.21	1.27	1.31	2.20	2.77	3.27	2.50	2.30	2.16
454.630	1.19	1.24	1.28	2.30	2.82	3.34	2.46	2.32	2.14
500.000	1.16	1.21	1.25	2.40	3.01	3.54	2.43	2.23	2.12

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
10.000	−233.19	+0.00
20.000	−230.80	−.01
38.000	−225.55	+0.00
50.000	−225.92	+0.00
66.000	−226.43	+0.00
80.000	−230.22	+.01
100.000	−231.28	+.03
136.000	−229.89	+.08
178.000	−223.93	+.17
200.000	−223.43	+.15
234.000	−223.86	+.23
262.000	−229.61	+.25
304.000	−218.66	+.32
360.000	−194.91	+.72
402.000	−179.58	+.97
444.000	−163.75	+.88
458.000	−160.12	+.78
472.000	−155.46	+.60
486.000	−150.45	+.39
500.000	−142.53	+.23

Measurements at RF & LO Power +7 dBm

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Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>93	–	45	50	36	56	49	65	47	66	52	68
1	>93	25	–	39	12	47	22	46	29	49	55	62
2	74	62	55	71	60	69	53	72	61	71	54	75
3	81	44	33	49	35	59	36	60	36	64	37	51
4	>93	80	70	66	58	75	62	79	59	78	69	76
5	>93	61	46	62	50	59	60	63	67	66	53	65
6	>93	88	78	78	74	75	69	75	70	78	66	76
7	>93	81	64	67	63	73	56	71	55	78	55	69
8	>93	>88	84	88	84	>86	83	>86	76	81	78	81
9	93	82	83	83	75	79	67	75	64	84	60	77
10	93	>87	87	>87	86	>88	86	>86	>86	>86	81	>86

Harmonic LO Order

test conditions: RF = 185.100 MHZ INPUT P. = +0.00DBM
LO = 155.010 MHZ INPUT P. = +6.92DBM
IF = 30.090 MHZ IF AMPLIT. = -6.11 DBM

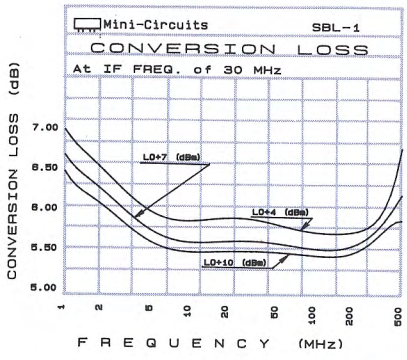
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>84	–	36	38	24	41	35	45	30	52	31	52
1	>84	25	–	88	12	50	19	41	21	37	40	47
2	82	63	55	68	54	66	52	64	52	66	54	74
3	>84	66	53	66	58	71	55	75	52	65	54	73
4	>84	>76	75	>76	75	>77	76	>77	75	>76	74	>76
5	>84	>76	>76	>76	>76	>76	>77	>77	73	>76	71	>76
6	>84	>78	>76	>76	>76	>76	>76	>77	>77	>77	>76	>76
7	>84	>78	>78	>76	>76	>76	>76	>76	>77	>77	>77	>76
8	>84	>78	>78	>78	>78	>76	>76	>76	>76	>77	>77	>77
9	>84	>78	>78	>78	>78	>78	>76	>76	>76	>76	>76	>77
10	>83	>77	78	>78	>78	>78	>78	>76	>76	>76	>76	>76

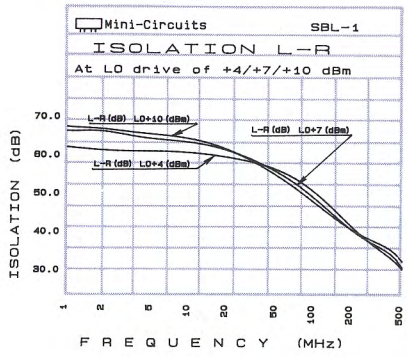
Harmonic LO Order

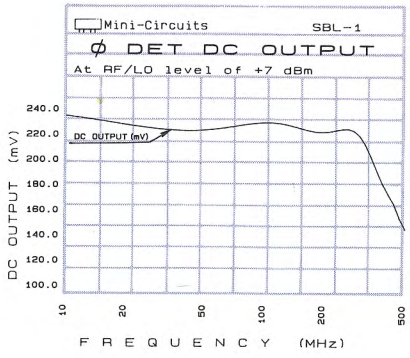
test conditions: RF = 185.100 MHZ INPUT P. = −10.03DBM
LO = 155.010 MHZ INPUT P. = +6.92DBM
IF = 30.090 MHZ IF AMPLIT. = −15.84 DBM

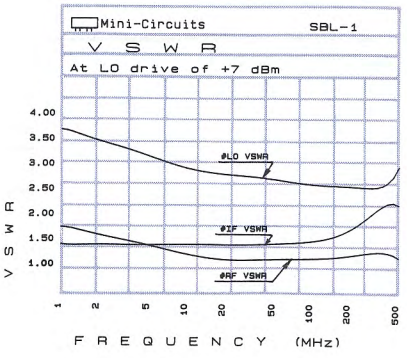
typical performance curves

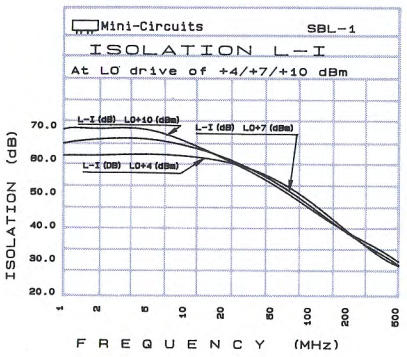
(production unit)

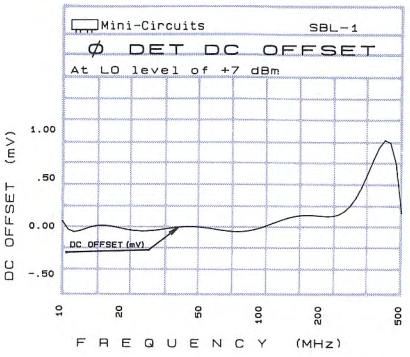












most economical

Frequency Mixers

Models
SBL-1X

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
10.000	40.00	6.29	5.91	5.70	50.68	52.58	54.27	55.71	57.65	58.94
20.000	50.00	6.55	6.07	5.85	50.33	51.57	52.78	55.05	56.10	56.31
50.000	80.00	6.34	5.97	5.76	48.45	48.88	48.88	51.91	51.40	50.84
100.000	70.00	6.32	6.02	5.79	45.57	44.82	44.29	47.39	46.42	45.36
160.320	130.32	6.46	6.05	5.84	42.61	42.05	41.40	43.63	42.49	41.59
200.000	170.00	6.59	6.14	5.89	41.43	40.99	39.98	41.84	40.75	39.77
253.500	223.50	6.71	6.19	5.95	40.54	40.18	38.99	40.75	39.56	38.54
315.630	285.63	6.66	6.25	6.01	39.31	38.29	37.09	39.48	37.94	37.02
377.760	347.76	6.83	6.34	6.11	36.67	35.80	35.11	38.56	36.81	35.91
439.880	409.88	6.97	6.56	6.34	34.91	33.93	33.09	37.98	35.80	34.50
500.000	470.00	6.99	6.55	6.31	32.30	31.47	30.75	37.04	35.23	34.36
564.130	534.13	6.57	6.24	6.01	30.82	30.58	30.10	34.75	33.53	33.09
626.260	596.26	6.26	5.86	5.67	29.12	29.34	29.13	35.60	34.86	33.59
657.320	627.32	6.35	5.95	5.71	29.01	29.13	29.15	36.32	35.78	34.99
719.450	689.45	6.31	5.84	5.60	28.83	28.51	28.62	35.42	35.11	35.80
781.580	751.58	6.26	5.77	5.51	28.12	28.01	27.67	35.25	34.75	34.77
812.640	782.64	6.43	5.92	5.59	27.51	27.68	27.45	34.28	33.85	33.92
874.760	844.76	6.30	5.87	5.58	26.96	27.52	27.88	32.62	32.09	32.28
936.890	906.89	6.25	5.87	5.63	26.56	27.40	28.21	30.70	30.31	30.84
1000.000	970.00	6.33	6.04	5.90	26.20	27.28	28.39	30.15	30.12	30.53

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
10.000	1.11	1.11	1.16	1.68	2.50	3.70	2.06	1.70	1.49
20.000	1.06	1.07	1.14	1.76	2.58	3.78	2.04	1.68	1.48
38.167	1.03	1.07	1.15	1.64	2.46	3.62	2.03	1.73	1.49
50.000	1.03	1.08	1.16	1.64	2.54	3.63	2.06	1.74	1.50
100.000	1.02	1.10	1.18	1.64	2.40	3.40	2.11	1.77	1.54
137.670	1.02	1.12	1.20	1.61	2.34	3.24	2.12	1.82	1.60
200.000	1.06	1.16	1.25	1.57	2.31	3.11	2.24	1.96	1.73
270.340	1.11	1.23	1.31	1.65	2.35	3.18	2.44	2.14	1.92
336.670	1.17	1.29	1.37	1.73	2.38	3.22	2.55	2.31	2.09
403.000	1.22	1.34	1.42	1.78	2.48	3.24	2.71	2.41	2.20
469.340	1.26	1.37	1.44	1.88	2.51	3.16	2.77	2.49	2.29
500.000	1.26	1.36	1.44	1.97	2.60	3.24	2.80	2.52	2.31
568.840	1.25	1.33	1.39	2.01	2.65	3.29	2.78	2.48	2.25
635.170	1.21	1.27	1.35	2.08	2.64	3.23	2.68	2.37	2.18
701.510	1.23	1.27	1.36	2.25	2.84	3.35	2.57	2.31	2.08
767.840	1.38	1.40	1.47	2.39	3.02	3.53	2.52	2.22	1.98
800.000	1.51	1.51	1.56	2.51	3.03	3.56	2.46	2.17	1.94
867.340	1.91	1.88	1.90	2.57	3.15	3.62	2.42	2.09	1.84
900.510	2.14	2.10	2.11	2.61	3.11	3.60	2.36	2.02	1.77
1000.000	2.99	2.89	2.87	2.68	3.07	3.50	2.24	1.95	1.71

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mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	90	–	31	23	43	46	41	42	32	53	67	61
1	90	18	–	34	18	32	34	36	35	43	61	58
2	77	47	56	46	58	45	55	64	57	56	40	58
3	90	46	37	47	38	52	35	47	48	51	56	54
4	90	77	79	59	69	54	67	53	70	82	73	62
5	90	75	77	70	52	61	49	58	48	71	82	63
6	90	76	78	77	81	68	70	67	70	62	76	75
7	90	78	75	78	77	75	71	64	65	66	59	78
8	90	79	80	79	78	78	83	83	75	73	75	68
9	90	79	79	78	78	78	77	83	78	74	71	71
10	90	78	79	78	79	78	78	77	83	83	80	77

Harmonic LO Order

test conditions: RF=500.100 MHZ INPUT P.=−3.91DBM
LO=470.010 MHZ INPUT P.=+7.13DBM
IF=30.090MHZ IF AMPLIT.=-10.78 DBM

RF CAL

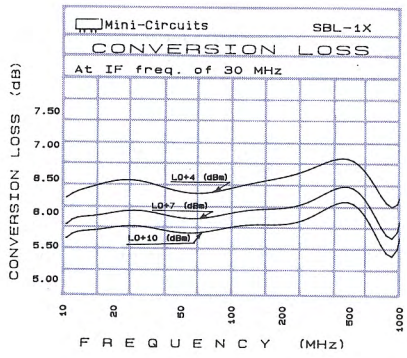
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	>80	–	22	15	33	33	30	30	16	36	31	42
1	>80	19	–	31	19	29	30	31	31	35	48	41
2	>80	50	61	48	65	47	60	66	67	51	43	66
3	>80	69	56	64	54	66	52	70	72	66	65	68
4	>80	68	>73	72	>72	>72	>72	>71	>73	>72	67	68
5	>80	68	69	72	>73	>72	>72	>72	>71	>73	>73	67
6	>80	68	68	68	>73	>73	>72	>72	>72	>71	>73	>73
7	>80	68	67	68	67	>73	>73	>72	>72	>72	>72	>73
8	>80	69	69	69	68	67	>73	>73	>72	>72	>72	>72
9	>80	68	68	69	68	68	68	>73	>73	>72	>72	>72
10	>81	68	68	68	69	68	68	68	>73	>73	>71	>72

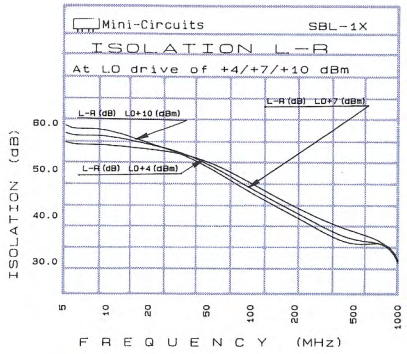
Harmonic LO Order

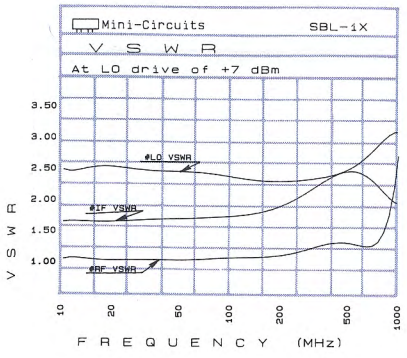
test conditions: RF=500.100 MHZ INPUT P.=−13.99DBM
LO=470.010 MHZ INPUT P.=+7.13DBM
IF=30.090 MHZ IF AMPLIT.=−20.88 DBM

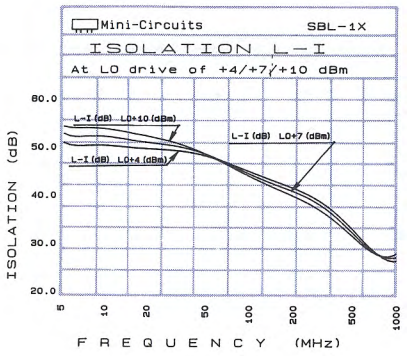
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

SAM-2
SYM-2
TFM-2P*
TSM-2
TFM-2
ZEM-2B
ZFM-2
ZLW-2



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	7.65	7.23	7.05	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
2.000	32.00	6.99	6.50	6.38	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
5.000	35.00	6.14	5.80	5.68	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
10.000	40.00	6.01	5.62	5.47	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
20.000	50.00	6.10	5.68	5.51	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
50.000	80.00	5.94	5.58	5.44	>64.00	61.94	60.30	>64.00	63.74	61.51
100.000	70.00	5.88	5.53	5.39	56.03	54.33	53.23	55.98	54.76	53.55
167.340	137.34	5.89	5.57	5.44	50.05	48.65	48.08	48.75	47.61	47.01
233.870	203.87	6.02	5.72	5.54	46.08	45.10	44.88	43.82	43.03	43.10
300.400	270.40	5.74	5.45	5.37	43.14	42.56	42.56	40.29	40.00	40.23
366.940	336.94	6.01	5.73	5.58	40.77	40.45	40.57	37.73	37.57	38.18
466.740	436.74	6.15	5.82	5.66	38.41	38.33	38.72	33.78	34.32	35.36
500.000	470.00	6.05	5.72	5.56	38.98	38.80	39.09	33.83	34.10	34.86
599.810	569.81	6.34	6.02	5.78	38.50	37.43	36.87	32.71	32.81	32.88
666.340	636.34	6.54	6.11	5.88	38.54	37.94	37.43	31.60	31.57	31.51
799.410	769.41	7.07	6.27	5.92	35.96	36.06	36.24	29.94	29.67	29.67
832.680	802.68	7.29	6.46	6.03	35.29	35.22	35.39	28.80	28.79	28.42
899.210	869.21	7.77	7.00	6.39	34.14	33.77	33.77	26.59	26.14	25.92
932.480	902.48	8.11	7.37	6.84	33.72	33.17	33.14	25.85	25.03	24.52
1000.000	969.00	8.20	7.63	7.18	33.25	32.49	32.14	24.75	23.59	22.58

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.26	1.30	1.34	1.77	2.70	4.33	1.43	1.24	1.09
10.000	1.12	1.15	1.20	1.71	2.63	3.91	1.44	1.25	1.10
20.000	1.04	1.07	1.15	1.76	2.77	3.95	1.43	1.25	1.10
50.000	1.02	1.06	1.15	1.69	2.55	3.74	1.44	1.25	1.11
100.000	1.06	1.07	1.14	1.63	2.41	3.37	1.45	1.27	1.13
155.760	1.09	1.09	1.14	1.61	2.37	3.24	1.49	1.31	1.18
200.000	1.12	1.11	1.14	1.54	2.29	3.18	1.54	1.36	1.23
306.520	1.18	1.16	1.16	1.53	2.20	2.95	1.66	1.48	1.35
366.820	1.21	1.18	1.17	1.52	2.16	2.89	1.75	1.57	1.44
427.130	1.23	1.20	1.18	1.52	2.13	2.83	1.84	1.66	1.53
500.000	1.26	1.22	1.21	1.55	2.06	2.74	1.97	1.77	1.66
547.740	1.28	1.23	1.22	1.53	2.13	2.70	2.04	1.88	1.78
608.040	1.30	1.26	1.24	1.50	2.09	2.65	2.02	1.87	1.77
668.340	1.34	1.29	1.27	1.51	2.09	2.65	2.07	1.90	1.81
728.650	1.38	1.34	1.32	1.56	2.04	2.69	2.08	1.91	1.83
788.950	1.44	1.40	1.38	1.61	2.13	2.69	2.07	1.91	1.82
849.260	1.51	1.47	1.46	1.63	2.19	2.70	2.02	1.86	1.77
909.560	1.58	1.55	1.54	1.67	2.24	2.78	1.93	1.77	1.68
969.860	1.68	1.66	1.66	1.74	2.28	2.85	1.81	1.66	1.57
1000.000	1.75	1.72	1.72	1.77	2.30	2.89	1.74	1.60	1.51

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
1.000	−230.07	+.09
2.000	−234.86	+.09
5.000	−240.18	+.08
20.000	−240.24	+.09
50.000	−236.50	+.09
100.000	−238.59	+.08
161.970	−242.90	+.06
200.000	−243.36	+.02
290.750	−246.83	+.11
322.940	−237.61	+.11
387.330	−224.03	+.01
451.720	−223.29	+.22
500.000	−229.56	+.23
580.490	−229.04	+.37
644.880	−207.44	+.48
709.270	−196.52	+1.06
773.660	−188.54	+.83
838.040	−187.28	+.49
902.430	−173.88	+.72
934.630	−171.49	+.76
1000.000	−178.52	+.64

Measurements at RF & LO Power +7 dBm
*PHASE POSITIVE

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	–	14	29	23	42	25	43	53	57	65	72
1	>90	20	–	29	12	34	25	47	35	42	57	57
2	76	52	40	58	40	58	41	50	48	66	53	68
3	86	46	49	50	49	53	49	52	48	58	57	51
4	84	73	73	65	62	66	59	66	55	65	65	70
5	85	77	76	84	63	64	60	59	60	59	68	71
6	85	78	79	78	82	79	79	76	75	75	74	79
7	85	79	78	77	79	82	80	81	80	80	79	78
8	86	79	80	79	78	78	>84	>84	>82	>82	81	>82
9	85	79	79	80	79	78	79	>84	>84	>82	>83	>82
10	86	79	79	79	79	80	79	78	>84	>84	>82	>83

Harmonic LO Order

test conditions: RF=500.100 MHZ INPUT P.=−3.98DBM
LO=470.010 MHZ INPUT P.=+6.86DBM
IF=30.090 MHZ IF AMPLIT.=−10.31 DBM

RF ORDER HARMONIC

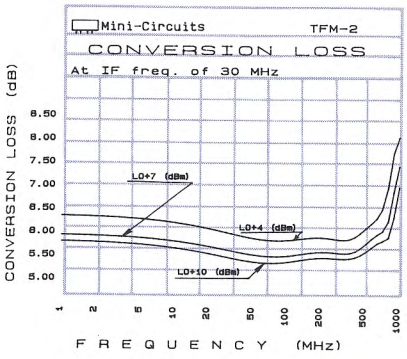
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>81	–	5	19	11	28	14	31	32	47	61	58
1	>81	19	–	32	12	30	24	44	35	36	59	49
2	>81	65	48	>72	48	64	47	58	54	63	60	65
3	>81	66	70	65	>72	64	68	64	72	68	68	66
4	>81	69	>74	>74	>72	>72	>72	>72	>74	>73	68	69
5	>81	68	68	>74	74	>72	>72	>72	>72	>74	>74	67
6	>81	69	69	68	>74	>74	>72	>72	>72	>72	>74	>74
7	>81	69	68	67	69	73	74	>72	>72	>72	>72	>74
8	>81	69	70	69	68	68	>74	>74	>72	>72	>72	>72
9	>81	69	69	69	69	69	68	>74	>74	>72	>72	>72
10	>80	69	69	70	70	69	69	68	>74	>74	>72	>72

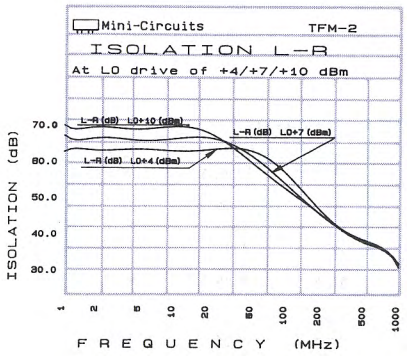
Harmonic LO Order

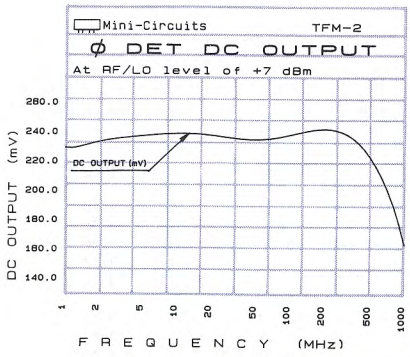
test conditions: RF=500.100 MHZ INPUT P.=−13.94DBM
LO=470.010 MHZ INPUT P.=+6.86DBM
IF=30.090MHZ IF=AMPLIT. −20.22 DBM

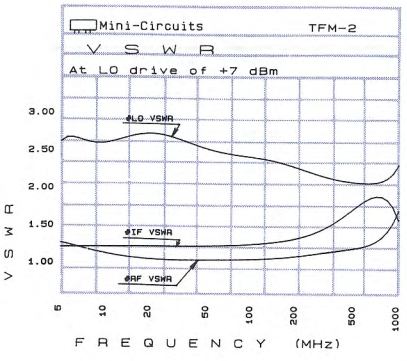
typical performance curves

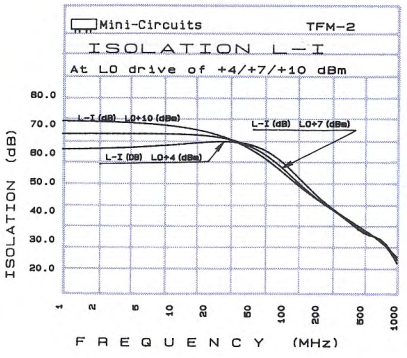
(production unit)

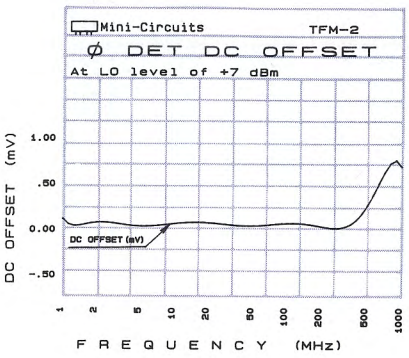












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

TFM-3
ZFM-3
LMX-3



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.040	30.04	6.45	6.15	6.01	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.050	30.05	5.82	5.52	5.36	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.070	30.07	5.44	5.12	4.99	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.100	30.10	5.30	4.92	4.76	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.500	30.50	5.10	4.77	4.60	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
1.000	31.00	5.07	4.76	4.59	>64.00	>67.00	>70.00	62.64	63.53	>70.00
5.000	35.00	4.91	4.75	4.56	>64.00	>67.00	>70.00	59.16	60.91	64.41
10.000	40.00	4.87	4.75	4.56	>64.00	>67.00	>70.00	58.46	60.97	63.86
20.000	50.00	4.98	4.74	4.60	>64.00	>67.00	63.79	57.26	58.52	60.41
60.871	90.87	4.87	4.73	4.60	51.05	50.40	50.16	49.67	49.37	49.56
100.000	70.00	4.76	4.63	4.51	44.79	44.80	44.88	43.57	44.05	44.87
162.610	132.61	4.94	4.79	4.70	38.73	39.22	39.57	38.80	39.87	40.79
200.000	170.00	5.13	4.95	4.84	36.77	37.18	37.12	36.43	37.86	38.79
230.440	200.44	5.11	4.89	4.78	35.18	35.78	35.97	36.79	37.67	38.36
281.310	251.31	5.16	5.05	4.93	33.40	33.68	33.93	34.86	35.71	35.77
315.230	285.23	5.38	5.25	5.22	34.35	34.22	34.07	33.94	33.98	33.69
349.140	319.14	5.60	5.32	5.18	36.71	35.64	34.41	36.04	34.07	32.17
366.100	336.10	5.72	5.37	5.15	36.71	35.56	34.41	37.45	34.58	31.91
383.050	353.05	5.85	5.44	5.19	36.26	35.25	34.16	36.77	34.26	31.46
400.000	370.00	6.20	5.56	5.18	35.85	34.72	33.54	34.74	32.46	29.98

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.36	1.24	1.18	1.71	2.69	4.09	1.73	1.59	1.46
10.000	1.36	1.25	1.18	1.64	2.55	3.82	1.74	1.59	1.47
20.000	1.36	1.25	1.18	1.70	2.67	3.89	1.73	1.59	1.47
29.688	1.35	1.24	1.17	1.70	2.63	3.95	1.72	1.59	1.47
50.000	1.33	1.23	1.16	1.64	2.55	3.75	1.73	1.60	1.48
66.720	1.33	1.23	1.16	1.59	2.45	3.58	1.74	1.62	1.49
100.000	1.31	1.21	1.14	1.63	2.48	3.51	1.77	1.67	1.53
116.100	1.30	1.21	1.14	1.64	2.42	3.47	1.80	1.69	1.56
153.130	1.28	1.19	1.12	1.66	2.42	3.35	1.87	1.76	1.64
177.820	1.26	1.18	1.11	1.68	2.36	3.34	1.93	1.82	1.69
200.000	1.24	1.16	1.10	1.69	2.38	3.21	1.97	1.87	1.74
227.190	1.22	1.15	1.09	1.73	2.46	3.35	2.03	1.94	1.80
251.880	1.20	1.13	1.09	1.74	2.40	3.29	2.06	1.97	1.83
264.220	1.19	1.13	1.09	1.75	2.42	3.39	2.12	2.03	1.90
288.910	1.18	1.13	1.10	1.76	2.41	3.33	2.17	2.10	1.97
325.940	1.17	1.14	1.13	1.89	2.56	3.43	2.26	2.19	2.06
350.630	1.16	1.14	1.14	1.97	2.63	3.54	2.29	2.23	2.11
375.320	1.16	1.14	1.15	2.00	2.68	3.74	2.32	2.26	2.15
387.660	1.16	1.15	1.16	2.00	2.69	3.75	2.33	2.28	2.17
400.000	1.15	1.15	1.16	1.99	2.76	3.83	2.33	2.29	2.17

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
.040	+239.68	+.03
.050	+241.65	+.02
.100	+246.04	+.02
.500	+247.27	+.01
1.000	+249.11	+.01
5.000	+239.67	+0.00
10.000	+239.13	+0.00
20.000	+238.04	+0.00
50.000	+236.98	+.02
76.820	+238.73	+.07
100.000	+239.43	+.13
150.000	+235.41	+.21
200.000	+239.94	+.20
256.370	+229.27	+.12
300.000	+224.42	+.63
328.190	+216.15	+.53
346.150	+208.91	+.60
364.100	+198.11	+.88
382.060	+190.39	+.64
400.000	+182.44	−.09

Measurements at RF & LO Power +7 dBm

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Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	42	50	47	62	49	80	50	69	57	69
1	–	35	–	42	11	45	18	57	24	60	32	55
2	88	79	70	82	68	81	65	80	61	78	59	76
3	87	56	53	55	48	55	45	56	49	53	47	54
4	>96	>87	84	>87	>87	>85	>86	>86	80	>86	74	83
5	>96	69	70	70	62	71	59	71	57	68	57	66
6	>96	>85	>86	>87	>86	>87	>86	>87	84	>86	>86	>86
7	>95	84	>85	84	>85	85	82	>86	75	>85	71	83
8	>96	>87	>87	87	>86	>86	>86	>86	>87	>86	>87	>86
9	>95	>88	81	>87	81	>86	79	>86	80	>87	81	>86
10	>95	>85	>86	>85	>87	>87	>86	>85	>86	>86	>87	>86
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF.=IN: FREQ.10.1 MHZ DRIVE −4.01 DBM
LO.=IN: FREQ.40.01 MHZ DRIVE +7.03 DBM
IF=MEASURED: FREQ.29.91 AMP. −9.18 DBM

RF ORDER HARMONIC

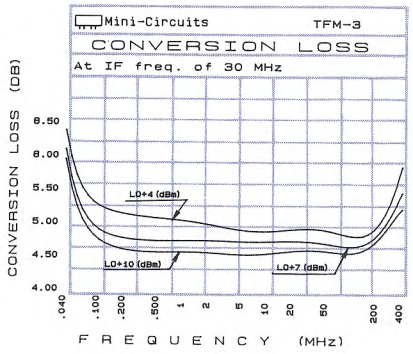
	RF CAL											
0	–	–	31	40	35	52	36	55	35	52	38	55
1	–	33	–	37	11	38	17	43	23	42	31	41
2	>95	>76	>75	>77	>76	>76	74	>76	69	>77	65	>76
3	>96	69	69	69	64	70	67	72	62	68	60	66
4	>96	>75	>76	>77	>77	>77	>77	>76	>75	>77	>77	>77
5	>95	>75	>76	>76	>76	>77	>77	76	>77	>77	75	>75
6	>95	>76	>75	>77	>76	>76	>76	>77	>76	>76	>75	>76
7	>95	>76	>76	>75	>76	>77	>77	>77	>77	>75	>77	>77
8	>95	>76	>77	>76	>76	>76	>76	>76	>77	>76	>75	>76
9	>96	>75	>77	>76	>76	>76	>76	>76	>77	>76	>77	>77
10	>96	>77	>77	>77	>76	>75	>76	>78	>76	>77	>76	>76
		0	1	2	3	4	5	6	7	8	9	10

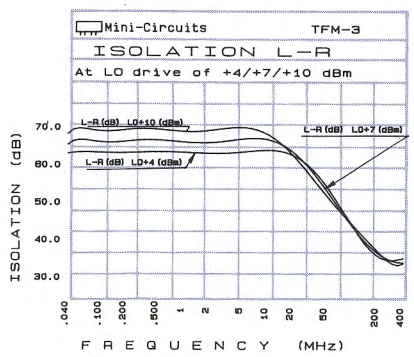
Harmonic LO Order

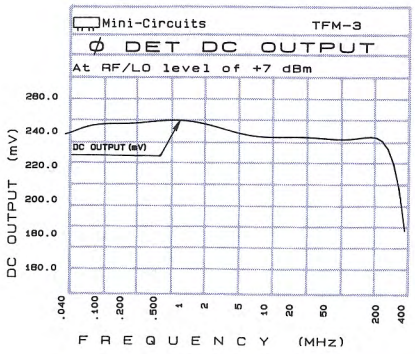
test conditions: RF.=IN: FREQ.10.1 MHZ DRIVE −14.03 DBM
LO.=IN: FREQ.40.01 MHZ DRIVE +7.08 DBM
IF=MEASURED: FREQ.29.91 AMP. −19.19 DBM

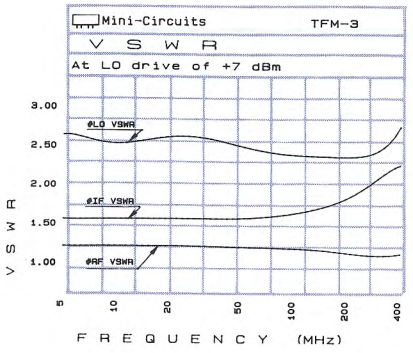
typical performance curves

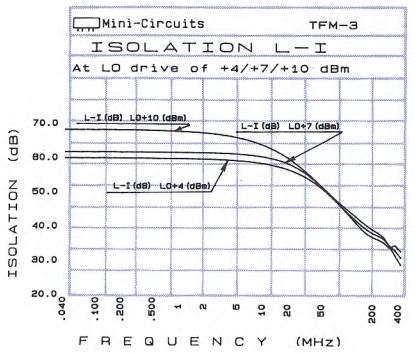
(production unit)

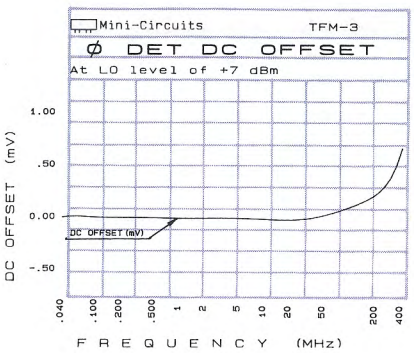












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
TFM-4
ZFM-4



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	7.39	7.08	6.85	>64.00	>67.00	66.97	>64.00	62.10	59.80
20.000	50.00	7.19	6.84	6.61	>64.00	>67.00	62.16	>64.00	59.11	57.53
50.000	80.00	6.97	6.64	6.45	52.06	50.64	50.62	51.15	49.95	48.63
100.000	70.00	6.76	6.48	6.32	45.63	44.54	44.61	45.08	43.90	42.67
138.390	108.39	6.81	6.51	6.38	39.91	38.97	39.28	39.15	38.26	37.49
227.320	197.32	6.85	6.59	6.41	38.18	37.28	37.71	37.26	36.56	36.05
271.780	241.78	6.66	6.44	6.26	35.39	34.49	34.87	34.59	34.10	33.61
360.710	330.71	6.68	6.47	6.34	33.51	32.40	32.45	33.15	32.75	31.86
449.640	419.64	6.84	6.57	6.40	33.30	31.70	31.37	31.47	31.16	30.26
538.570	508.57	6.69	6.45	6.29	33.34	31.48	30.96	31.22	30.87	29.94
583.030	553.03	6.76	6.54	6.40	31.94	30.37	29.93	31.03	30.53	29.24
671.960	641.96	7.12	6.82	6.56	30.92	29.62	29.36	29.85	29.00	27.48
760.890	730.89	7.16	6.83	6.56	30.46	29.45	29.56	28.21	27.36	25.98
849.820	819.82	7.34	6.86	6.54	30.45	29.60	29.84	27.33	26.76	25.43
894.280	864.28	7.67	7.01	6.57	30.77	30.37	30.69	24.95	25.36	24.55
983.210	953.21	7.85	7.24	6.72	30.24	29.78	30.11	23.37	23.67	22.94
1027.700	997.70	8.00	7.43	6.95	29.82	29.36	30.17	22.38	22.34	21.66
1116.600	1086.60	8.05	7.58	7.27	28.97	28.75	29.77	21.30	21.27	20.25
1200.000	1170.00	8.01	7.70	7.49	28.49	28.39	29.34	20.82	20.82	19.72
1250.000	1220.00	8.06	7.80	7.68	27.96	28.05	29.00	20.23	20.19	19.35

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	1.46	1.54	1.62	2.01	3.00	4.40	1.35	1.12	1.01
10.000	1.34	1.42	1.51	1.93	2.83	4.06	1.35	1.12	1.01
50.000	1.25	1.34	1.44	1.90	2.85	4.06	1.37	1.13	1.03
100.000	1.21	1.31	1.40	1.84	2.72	3.77	1.38	1.15	1.05
200.000	1.18	1.26	1.34	1.76	2.49	3.46	1.44	1.22	1.12
212.500	1.17	1.25	1.33	1.76	2.44	3.41	1.44	1.22	1.12
337.000	1.14	1.20	1.27	1.70	2.33	3.21	1.59	1.36	1.26
420.000	1.13	1.17	1.22	1.68	2.23	3.14	1.71	1.47	1.37
500.000	1.12	1.13	1.17	1.66	2.19	2.98	1.82	1.56	1.46
544.500	1.13	1.12	1.15	1.67	2.17	2.87	1.87	1.61	1.52
627.500	1.14	1.12	1.12	1.64	2.14	2.75	1.93	1.66	1.61
710.500	1.17	1.13	1.12	1.61	2.05	2.68	1.89	1.64	1.59
793.500	1.20	1.16	1.15	1.64	2.02	2.69	1.93	1.69	1.66
835.000	1.22	1.18	1.17	1.67	2.05	2.72	1.95	1.69	1.66
959.500	1.27	1.22	1.23	1.75	2.12	2.71	1.82	1.60	1.55
1000.000	1.30	1.24	1.26	1.79	2.11	2.76	1.75	1.54	1.49
1084.000	1.38	1.31	1.36	1.82	2.17	2.78	1.58	1.39	1.33
1167.000	1.53	1.43	1.52	1.96	2.24	2.92	1.39	1.23	1.17
1208.500	1.65	1.52	1.63	2.01	2.32	2.83	1.29	1.15	1.10
1250.000	1.79	1.62	1.75	2.14	2.36	2.99	1.20	1.07	1.08

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
5.000	+218.12	+0.00
10.000	+219.36	+0.00
50.000	+216.50	+0.00
100.000	+219.70	+.02
120.000	+223.77	+.06
185.730	+226.90	+.24
230.910	+226.80	+.41
321.270	+233.26	+.34
411.640	+207.81	+.06
500.000	+211.13	+.34
547.180	+219.10	+.10
637.550	+216.95	−.76
727.910	+198.44	−.04
818.280	+191.82	+.63
863.460	+189.28	+.69
953.820	+174.32	+.44
1000.000	+169.06	+.67
1100.000	+167.29	+.89
1200.000	+156.90	−2.15
1250.000	+152.76	−4.81

Measurements at RF & LO Power +7 dBm

Mini-Circuits™
Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	3	36	25	32	45	57	52	67	53	53
1	–	9	–	44	20	45	41	62	56	70	65	66
2	94	48	28	44	27	47	46	51	60	71	61	>77
3	>94	51	40	50	46	48	45	56	57	74	73	>76
4	93	66	67	65	57	55	46	59	55	68	72	82
5	>95	76	63	74	58	56	54	60	57	65	65	78
6	>90	>78	>83	76	74	80	56	61	62	68	68	73
7	89	>77	>76	>84	80	81	75	68	60	65	66	72
8	>89	>78	>77	>78	>83	>83	>83	>83	68	69	65	74
9	>89	>77	79	>78	78	>84	>84	>83	>83	>83	71	74
10	89	>78	>77	>78	>78	>77	>84	>84	>83	>83	>82	>82

Harmonic LO Order

test conditions: RF. IN: FREQ.1000.1 MHZ DRIVE −4 DBM
LO. IN: FREQ.970.01 MHZ DRIVE +6.97 DBM
IF MEASURED: FREQ.30.09 AMP. −11.41 DBM

RF ORDER HARMONIC

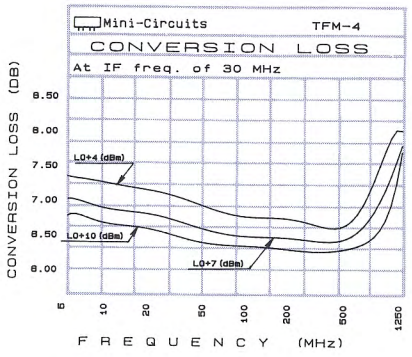
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+7	23	18	18	29	42	37	48	35	36
1	–	9	–	41	18	40	42	57	53	>66	57	55
2	>94	61	40	63	36	55	48	58	62	72	64	69
3	>94	>73	60	62	64	64	65	71	70	>73	>75	>68
4	>95	>75	>73	73	71	>73	71	>73	72	>74	>73	>74
5	>95	75	>74	>73	>73	>73	>74	>74	>73	>74	75	>74
6	>89	>68	>74	>74	>73	>73	>75	>75	>73	>73	>74	>74
7	>89	>67	69	>74	>75	>74	>73	>74	>73	>75	>74	>73
8	>90	>68	>68	>68	>73	>74	>73	>73	>74	>73	>74	>74
9	>89	>68	>70	>67	>68	>74	>74	>74	>73	75	>75	>74
10	>88	>67	>68	>68	>69	>67	>74	>74	>75	>73	>74	>74

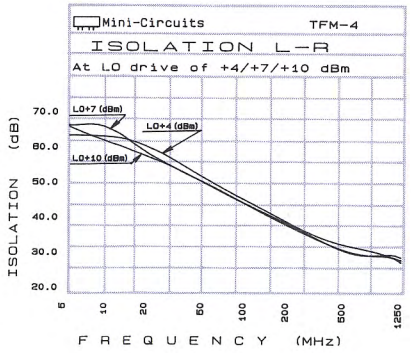
Harmonic LO Order

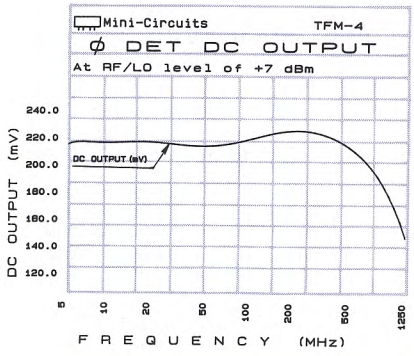
test condition: RF. IN: FREQ.1000.1 MHZ DRIVE −14.01 DBM
LO. IN: FREQ.970.01 MHZ DRIVE +6.94 DBM
IF MEASURED: FREQ.30.09 AMP. −21.38 DBM

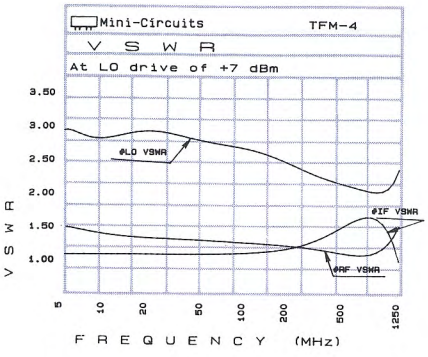
typical performance curves

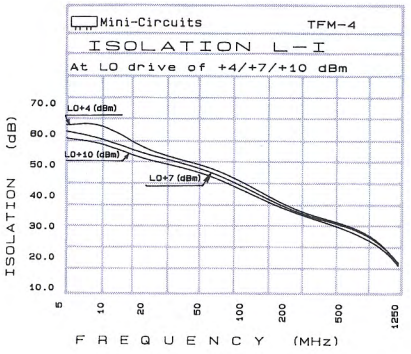
(production unit)

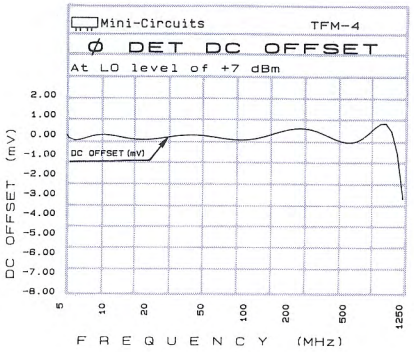












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
TFM-11
ZFM-11



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	6.34	6.05	5.92	58.56	60.95	64.12	54.78	56.30	58.16
5.000	35.00	6.04	5.78	5.64	58.80	61.86	65.69	53.80	55.70	58.00
20.000	50.00	6.10	5.81	5.64	58.87	61.93	65.38	53.47	55.12	57.37
50.000	80.00	6.28	5.94	5.79	58.00	60.22	63.38	52.47	54.24	55.98
100.000	70.00	6.24	5.92	5.80	54.71	56.59	57.37	50.08	50.92	51.84
200.000	170.00	6.94	6.50	6.18	48.17	48.94	49.72	43.91	44.33	45.26
267.530	237.53	7.11	6.52	6.15	45.01	45.81	46.78	40.82	41.60	43.04
400.800	370.80	7.59	6.74	6.33	41.09	42.38	43.83	37.40	38.67	39.67
500.000	470.00	7.58	6.83	6.44	40.01	41.61	43.58	36.21	36.88	37.46
600.700	570.70	7.64	7.03	6.64	38.46	40.10	41.61	36.37	36.28	35.49
733.960	704.29	7.78	7.24	6.86	37.95	39.39	39.90	35.43	34.20	32.72
867.230	837.52	7.64	7.09	6.79	37.34	39.07	40.00	33.52	31.66	30.22
1000.000	969.69	7.59	7.12	6.92	35.09	36.76	37.95	31.13	29.17	28.00
1067.100	1037.50	7.40	6.97	6.77	34.50	35.43	35.88	30.67	28.56	26.91
1200.400	1170.40	7.28	6.77	6.60	33.34	33.71	33.57	29.25	27.07	25.52
1333.700	1303.60	7.28	6.72	6.55	32.41	32.82	33.19	27.15	25.51	24.37
1466.900	1436.90	7.41	6.80	6.55	32.53	33.13	33.05	25.46	24.22	23.31
1600.200	1570.50	7.50	6.93	6.63	31.70	32.34	32.69	24.25	23.42	22.89
1733.500	1703.70	7.43	6.92	6.65	28.65	29.41	30.12	27.71	27.19	26.79
2000.000	1970.30	7.36	6.99	6.77	29.71	30.47	31.15	25.40	25.17	24.98

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	2.56	2.34	2.10	1.58	2.51	4.05	1.30	1.46	1.62
20.000	2.75	2.49	2.24	1.51	2.42	3.84	1.15	1.35	1.51
50.000	2.76	2.44	2.24	1.61	2.46	4.04	1.16	1.35	1.51
100.000	2.80	2.54	2.29	1.51	2.19	3.41	1.17	1.35	1.49
200.000	3.13	2.88	2.63	1.59	2.23	3.42	1.20	1.38	1.52
254.380	3.32	3.21	2.84	1.58	2.18	3.16	1.23	1.41	1.54
379.060	3.92	3.60	3.43	1.67	1.98	2.87	1.32	1.50	1.63
500.000	3.98	3.74	3.67	1.70	1.88	2.56	1.43	1.61	1.75
628.440	3.84	3.84	3.65	1.86	1.82	2.34	1.58	1.81	1.93
753.130	3.51	3.52	3.33	1.96	1.69	2.09	1.75	1.98	2.09
877.810	3.36	3.24	3.21	1.87	1.51	1.83	1.95	2.20	2.27
1000.000	2.99	3.00	2.85	1.78	1.37	1.59	2.25	2.46	2.52
1064.800	2.82	2.77	2.71	1.78	1.24	1.48	2.49	2.89	2.75
1189.500	2.56	2.54	2.41	1.55	1.14	1.41	2.92	3.06	3.18
1376.600	2.27	2.23	2.10	1.25	1.13	1.63	3.78	4.11	3.98
1501.300	2.19	2.13	2.07	1.10	1.39	1.91	4.47	4.50	4.59
1625.900	2.27	2.16	2.12	1.18	1.67	2.03	4.89	4.89	5.09
1750.600	2.02	2.27	2.26	1.26	2.36	2.10	6.71	6.28	6.76
1875.300	1.70	2.54	2.44	1.54	2.01	2.32	8.95	8.81	8.20
2000.000	2.65	2.89	2.71	1.55	1.93	2.35	8.47	8.64	8.35

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	12	56	20	38	30	47	42	61	54	67
1	–	17	–	34	39	34	37	42	54	51	52	59
2	>94	65	51	46	55	74	45	69	50	68	53	71
3	>96	55	55	68	36	65	66	55	55	58	65	61
4	>96	80	79	82	77	62	77	>84	64	82	65	76
5	>95	80	78	83	75	81	55	77	81	71	69	72
6	>90	>79	>84	>84	>86	>84	>85	74	>83	>84	77	83
7	>88	>77	>78	>85	>85	>86	>84	>84	70	>83	>84	>82
8	>89	>79	>78	>79	>85	>85	>83	>83	>84	>85	>84	>84
9	>90	>79	>78	>79	>78	>85	>83	>84	>84	>84	>83	>84
10	>90	>79	>78	>80	>78	>78	>85	>85	>84	>84	>84	>87
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -4.02 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 7 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -11.02 DBM

RF ORDER HARMONIC

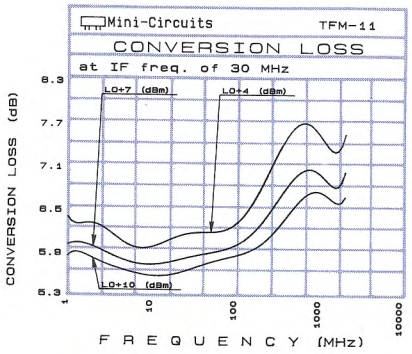
	RF CAL											
0	–	–	2	48	9	28	22	38	27	63	37	47
1	–	19	–	34	39	36	37	43	55	48	42	46
2	>95	73	60	54	61	75	53	>74	60	69	58	>68
3	97	75	73	79	>78	>79	>81	>79	>78	>80	>80	>71
4	>96	>75	>73	>73	>76	>74	>73	>74	>74	>75	>75	>75
5	>97	>75	>76	>74	>74	>76	>75	>75	>74	>74	>74	>74
6	>89	>68	>75	>75	>74	>74	>74	>75	>74	>73	>72	>75
7	>87	>66	>69	>73	>75	>75	>72	>74	>74	>74	>75	>73
8	>90	>68	>69	>67	>75	>74	>75	>74	>74	>75	>74	>73
9	>89	>68	>68	>69	>68	>75	>75	>74	>73	>74	>75	>74
10	>90	>68	>68	>68	>69	>68	>76	>73	>74	>73	>75	>74
		0	1	2	3	4	5	6	7	8	9	10

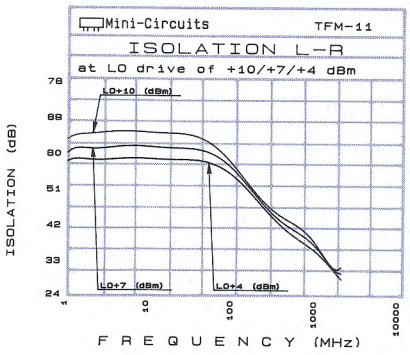
Harmonic LO Order

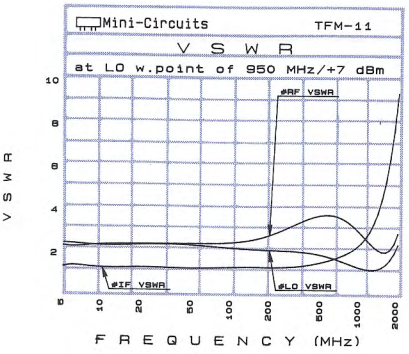
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -13.98 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 7 DBM
IF = MEASURED: FREQ.30.095 MHZ AMP. -21.05 DBM

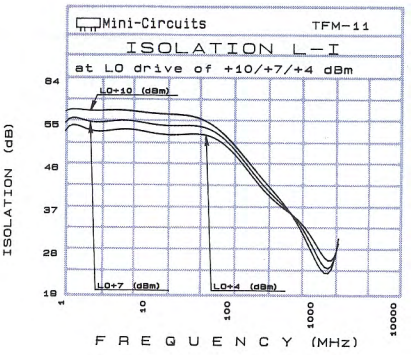
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

SRA-12
TFM-12
ZAD-12
ZFM-12
ZLW-12

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
800.000	730.00	7.00	6.67	6.54	33.86	33.42	32.78	35.19	34.21	32.91
835.530	765.53	6.87	6.56	6.47	33.38	32.78	32.12	34.77	33.92	32.60
871.050	801.05	6.86	6.57	6.48	33.06	32.33	31.77	34.08	33.41	32.37
894.740	824.74	6.73	6.41	6.33	32.93	32.16	31.52	33.69	33.06	32.03
918.420	848.42	6.63	6.31	6.20	32.90	32.06	31.50	33.40	32.78	31.86
942.100	872.10	6.64	6.33	6.23	33.02	32.10	31.51	33.26	32.59	31.62
965.790	895.79	6.62	6.29	6.22	33.15	32.20	31.53	33.01	32.33	31.40
989.470	919.47	6.51	6.18	6.11	33.32	32.44	31.64	32.80	32.15	31.06
1013.200	943.20	6.51	6.19	6.12	33.52	32.61	32.04	32.58	31.91	30.99
1036.800	966.80	6.59	6.24	6.13	33.87	33.00	32.37	32.40	31.84	30.75
1060.500	990.50	6.57	6.23	6.10	34.27	33.47	32.71	32.30	31.84	30.46
1072.400	1002.40	6.68	6.34	6.22	34.43	33.61	33.03	32.19	31.77	30.53
1096.100	1026.10	6.75	6.39	6.27	34.69	33.93	33.41	32.10	31.75	30.39
1119.700	1049.70	6.89	6.52	6.39	34.86	34.25	33.71	32.02	31.80	30.08
1143.400	1073.40	7.10	6.67	6.53	34.89	34.50	34.06	31.93	31.82	29.81
1167.100	1097.10	7.25	6.77	6.57	34.80	34.75	34.64	31.93	31.82	29.61
1190.800	1120.80	7.44	6.90	6.67	34.94	35.42	35.69	32.16	32.00	29.32
1214.500	1144.50	7.56	6.95	6.71	35.41	36.69	37.55	32.80	32.55	29.22
1238.200	1168.20	7.68	7.04	6.78	36.16	38.41	40.23	33.82	33.59	30.30
1250.000	1180.00	7.63	7.00	6.72	36.66	39.24	41.58	34.50	34.65	31.14

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
800.000	2.71	2.64	2.60	1.99	1.93	2.25	2.92	3.19	3.42
823.680	2.67	2.58	2.53	2.03	1.88	2.23	3.07	3.38	3.59
847.370	2.64	2.53	2.47	2.03	1.87	2.19	3.42	3.70	3.90
871.050	2.56	2.46	2.39	2.02	1.84	2.16	3.57	3.87	4.06
894.740	2.57	2.43	2.36	2.04	1.82	2.12	3.93	4.15	4.38
918.420	2.44	2.29	2.22	2.10	1.81	2.07	4.34	4.64	4.72
942.110	2.36	2.20	2.13	2.09	1.79	2.03	4.59	4.69	4.86
965.790	2.33	2.13	2.06	2.13	1.77	2.01	4.92	4.98	5.16
989.470	2.27	2.07	1.99	2.18	1.77	1.96	5.47	5.65	5.79
1001.300	2.23	2.04	1.95	2.17	1.77	1.95	5.54	5.74	5.83
1025.000	2.15	1.94	1.86	2.21	1.74	1.90	5.66	5.72	5.79
1048.700	2.11	1.89	1.78	2.26	1.74	1.86	6.17	6.15	6.26
1072.400	2.06	1.84	1.72	2.24	1.73	1.83	6.17	6.11	6.17
1096.100	1.99	1.78	1.66	2.19	1.69	1.77	5.85	5.83	5.85
1119.700	1.99	1.76	1.62	2.20	1.69	1.75	5.81	5.85	5.85
1143.400	1.94	1.73	1.58	2.21	1.65	1.71	4.80	4.83	4.80
1167.100	1.93	1.71	1.56	2.18	1.62	1.67	4.08	4.09	4.04
1190.800	1.93	1.73	1.58	2.15	1.59	1.66	3.31	3.30	3.28
1214.500	1.93	1.73	1.59	2.10	1.57	1.62	2.78	2.79	2.80
1250.000	1.93	1.75	1.63	2.05	1.51	1.57	3.56	3.64	3.71

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	15	31	31	48	52	81	55	77	65	72
1	–	16	–	33	67	35	35	34	46	60	60	58
2	82	69	54	56	50	64	57	65	65	66	71	>78
3	>95	61	46	60	41	52	61	52	54	81	56	69
4	>96	82	76	77	69	75	61	>85	69	76	>84	72
5	>96	82	82	79	64	73	57	66	81	63	67	65
6	>89	>81	>85	>85	82	>85	81	83	69	>86	75	>86
7	>87	>79	>79	>86	>85	>86	76	>85	70	78	79	75
8	>90	>78	>80	>79	>85	>86	>87	>85	>85	>86	79	>85
9	>89	>79	>79	>80	>80	>85	>85	>87	>84	>84	>84	>86
10	>88	>79	>79	>81	>80	81	>86	>86	>85	>87	>85	>86

Harmonic LO Order

test conditions: RF.=IN: FREQ.990.1 MHZ DRIVE -3.99 DBM
LO. IN: FREQ.920.01 MHZ DRIVE 6.98 DBM
IF=MEASURED: FREQ.70.093 MHZ AMP. -10.12 DBM

RF ORDER HARMONIC

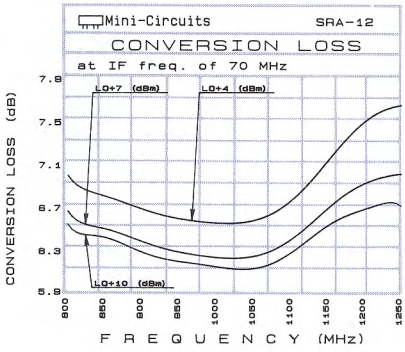
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	5	20	20	37	37	50	41	56	45	55
1	–	16	–	35	23	34	34	30	40	46	59	49
2	>95	68	69	63	54	74	72	72	70	70	63	>69
3	>95	73	63	75	58	67	>75	69	72	64	70	>69
4	>97	>77	>75	>75	>76	>75	>74	>76	>74	>76	>75	>76
5	>95	>75	>76	>75	>74	>75	>76	>76	>75	>74	>75	>74
6	>89	>70	>76	>76	>76	76	>75	77	>75	>75	>75	>76
7	>87	>68	>69	>74	>75	>76	>75	>75	>76	>75	>75	>74
8	>89	>72	>68	>70	>76	>76	>77	>74	>75	>77	77	>76
9	>89	>70	>69	>70	>69	>76	>76	>75	>74	>75	>76	>76
10	>88	>69	>69	>70	>70	>69	>77	>76	>76	>75	>75	>74

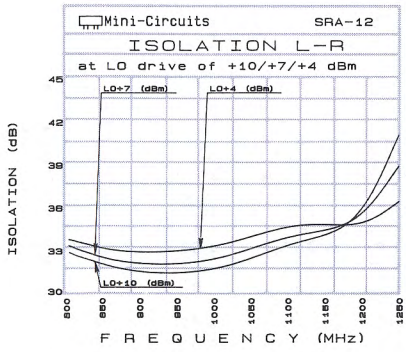
Harmonic LO Order

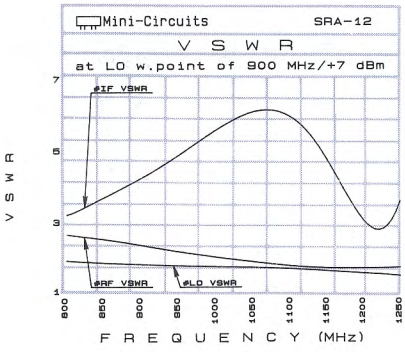
test conditions: RF.=IN: FREQ.990.1 MHZ DRIVE −14.03 DBM
LO. IN: FREQ.920.01 MHZ DRIVE 6.98 DBM
IF=MEASURED: FREQ.70.094 MHZ AMP. −20.06 DBM

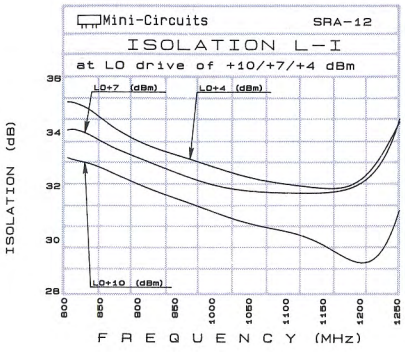
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
ASK-1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	5.61	5.34	5.16	39.10	41.73	44.04	39.04	40.78	42.48
5.000	35.00	5.28	5.14	4.90	41.35	43.83	46.14	45.93	48.03	49.94
10.000	40.00	5.24	5.10	4.87	42.10	44.31	46.27	47.06	49.23	50.33
20.000	50.00	5.33	5.10	4.89	41.21	43.27	44.87	46.03	47.31	47.18
50.000	80.00	5.21	5.07	4.86	40.33	41.89	42.46	43.68	43.53	41.68
100.000	70.00	5.09	4.98	4.82	39.93	41.22	41.75	41.82	41.32	40.36
124.930	94.93	5.18	5.07	4.90	39.54	40.40	40.49	39.25	38.91	38.11
166.240	136.24	5.29	5.14	4.98	39.26	40.04	40.44	36.95	37.11	37.23
207.550	177.55	5.31	5.19	4.98	39.26	39.72	39.36	35.80	36.06	35.67
228.210	198.21	5.20	5.11	4.90	38.88	39.43	37.92	34.36	34.77	34.32
269.520	239.52	5.24	5.17	4.97	38.87	39.11	39.52	32.97	33.40	34.08
310.830	280.83	5.50	5.34	5.16	38.11	38.68	38.01	31.41	32.44	32.86
352.140	322.14	5.48	5.31	5.09	35.92	36.90	36.78	29.97	31.38	31.89
372.790	342.79	5.49	5.36	5.21	33.94	34.94	33.83	29.59	31.09	31.65
414.100	384.10	5.53	5.33	5.15	33.25	33.57	33.66	30.29	31.83	33.34
455.410	425.41	5.79	5.57	5.35	32.21	32.53	32.17	29.66	31.14	32.51
496.720	466.72	6.07	5.67	5.35	31.01	30.97	30.86	28.78	29.46	29.39
538.030	508.03	6.18	5.75	5.39	30.80	30.78	30.29	28.51	28.57	27.79
558.690	528.69	6.15	5.72	5.45	30.06	29.47	29.81	28.45	27.11	26.81
600.000	570.00	6.27	5.82	5.52	29.46	28.98	28.82	27.11	25.59	24.20

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.23	1.15	1.13	1.89	3.01	4.50	1.49	1.35	1.27
20.000	1.19	1.12	1.06	1.91	2.92	4.12	1.49	1.36	1.27
43.388	1.17	1.10	1.04	1.91	2.87	4.04	1.48	1.36	1.26
50.000	1.16	1.09	1.04	1.91	2.86	4.01	1.48	1.36	1.26
81.776	1.15	1.08	1.03	1.82	2.67	3.67	1.48	1.36	1.26
100.970	1.14	1.08	1.03	1.83	2.75	3.72	1.50	1.36	1.27
139.360	1.12	1.06	1.03	1.82	2.68	3.43	1.49	1.37	1.27
177.750	1.10	1.04	1.03	1.88	2.68	3.41	1.51	1.38	1.28
200.000	1.08	1.03	1.03	1.83	2.64	3.36	1.53	1.39	1.30
235.330	1.06	1.01	1.04	1.86	2.61	3.40	1.55	1.42	1.32
273.720	1.03	1.03	1.07	1.91	2.72	3.52	1.58	1.45	1.34
312.100	1.04	1.06	1.10	1.98	2.70	3.47	1.61	1.47	1.38
350.490	1.08	1.10	1.13	2.05	2.84	3.48	1.65	1.51	1.41
388.880	1.13	1.15	1.18	2.12	3.08	3.67	1.69	1.55	1.44
427.270	1.18	1.20	1.23	2.17	3.20	3.67	1.71	1.59	1.49
465.660	1.24	1.26	1.27	2.25	3.16	3.72	1.75	1.63	1.54
500.000	1.29	1.31	1.32	2.30	3.29	3.80	1.78	1.67	1.58
523.240	1.33	1.34	1.35	2.40	3.28	3.94	1.80	1.69	1.61
561.630	1.39	1.40	1.40	2.49	3.48	4.10	1.84	1.73	1.65
600.000	1.46	1.47	1.46	2.65	3.57	4.30	1.85	1.73	1.66

ϕ detection

max. output/DC offset vs. freq. freq. (MHz)	max. DC output mV	DC offset mv
1.000	−228.02	+4.07
5.000	−228.76	+2.52
20.000	−227.06	+2.57
39.646	−225.37	+2.80
78.292	−226.95	+2.99
100.000	−226.11	+2.96
136.260	−227.74	+2.86
174.910	−225.41	+2.47
200.000	−228.13	+2.24
232.880	−226.65	+1.73
271.520	−218.89	+1.15
310.170	−210.92	+.58
348.810	−207.49	+.21
387.460	−206.24	−.11
426.110	−212.46	−1.04
464.750	−213.69	−1.82
500.000	−201.73	−1.83
522.720	−197.65	−2.55
561.370	−189.45	−2.83
600.000	−187.27	−3.58

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	-30	26	35	39	38	46	51	55	48		57
1	>90	21	-	35	11	41	19	49	25	41	36	54
2	77	56	58	61	56	59	54	58	54	55	62	67
3	85	49	45	53	46	58	51	55	46	55	41	51
4	85	62	69	61	68	61	66	63	65	64	65	65
5	85	82	60	67	54	73	52	70	51	70	51	74
6	85	79	>83	80	>83	>83	>83	76	>83	73	82	73
7	83	79	72	>83	69	77	69	77	65	76	63	73
8	85	79	81	80	80	>83	>83	>83	>83	>83	>83	>83
9	85	80	80	80	77	80	76	>83	79	>83	82	>83
10	85	78	79	80	80	79	80	>83	>83	>83	>83	>83

Harmonic LO Order

test conditions: RF 185.100 MHZ INPUT P. -4.06DBM
LO 155.010 MHZ INPUT P. +7.15DBM
IF = 30.090MHZIF AMPLIT. -9.55 DBM

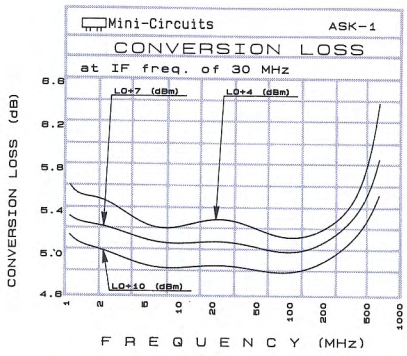
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>80	-	20	17	24	28	26	30	36	47	32	42
1	>80	21	-	35	12	38	19	51	22	33	32	43
2	75	56	60	56	59	57	58	57	57	57	66	63
3	74	70	72	>73	67	>73	60	>73	59	73	60	>73
4	75	>73	>73	>73	>73	>73	>73	>73	>73	>73	>73	>73
5	76	>73	>73	>73	>73	>73	>73	>73	>73	>73	>73	>73
6	74	70	>73	>73	>73	>73	>73	>73	>73	>73	>73	>73
7	76	69	70	>73	>73	>73	>73	>73	>73	>73	>73	>73
8	75	70	69	69	71	>73	>73	>73	>73	>73	>73	>73
9	75	69	70	70	70	70	>73	>73	>73	>73	>73	>73
10	74	69	69	70	70	70	70	>73	>73	>73	>73	>73

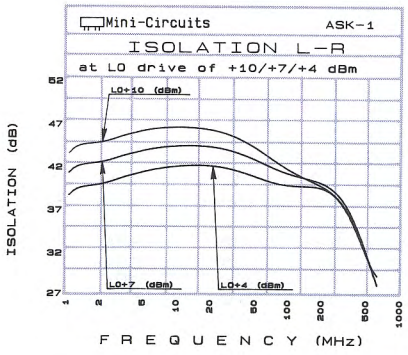
Harmonic LO Order

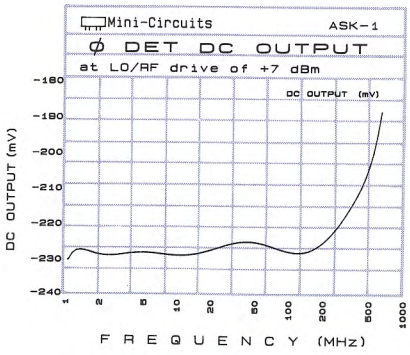
test conditions: RF 185.100 MHZ INPUT P. -13.95DBM
LO 155.010 MHZ INPUT P. +6.86DBM
IF = 30.090MHZ IF AMPLIT. -19.42 DBM

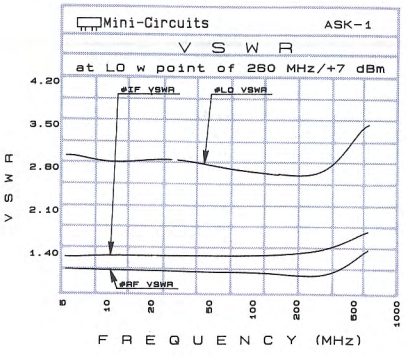
typical performance curves

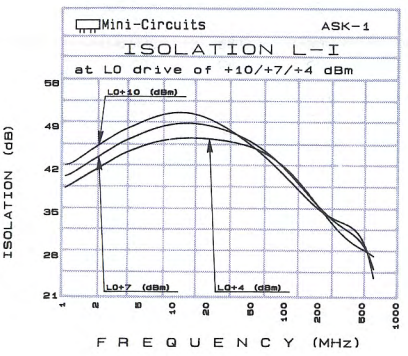
(production unit)

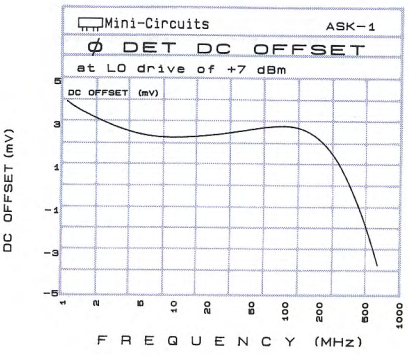












In Stock...Immediate Delivery

Plug-In

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
LMX-113



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.000	5.75	5.42	5.22	5.000	74.81	75.21	74.91	72.01	68.71	67.31
10.000	40.000	5.86	5.49	5.28	10.000	71.87	71.27	71.37	65.97	63.27	62.07
20.000	50.000	5.90	5.54	5.31	20.000	67.04	66.34	66.34	60.24	57.44	56.40
35.151	65.151	5.86	5.50	5.28	35.151	62.47	61.67	61.57	55.37	52.65	51.26
50.000	80.000	5.80	5.46	5.25	50.000	59.55	58.85	58.36	52.31	49.49	47.86
65.303	95.303	5.75	5.43	5.22	65.303	57.52	56.88	56.70	50.26	47.63	46.27
100.000	70.000	5.71	5.39	5.21	100.000	54.39	53.73	53.17	47.26	44.42	42.86
155.758	125.758	5.69	5.37	5.20	155.758	51.31	50.55	49.78	43.90	41.24	39.78
200.000	170.000	5.87	5.53	5.37	200.000	49.32	48.42	47.85	41.92	39.45	38.09
246.212	216.212	5.82	5.53	5.36	246.212	48.03	47.03	46.35	40.60	38.15	36.55
336.667	306.667	5.61	5.32	5.20	336.667	45.24	44.19	43.43	37.04	35.51	33.72
427.121	397.121	5.87	5.56	5.31	427.121	42.88	41.93	41.56	33.25	32.03	31.03
500.000	470.000	5.89	5.48	5.27	500.000	41.77	40.77	40.17	31.10	30.73	30.28
547.727	517.727	5.81	5.44	5.27	547.727	40.48	39.56	39.14	29.50	29.33	29.06
608.030	578.030	5.91	5.58	5.35	608.030	39.90	38.47	38.09	28.77	28.45	28.05
668.333	638.333	6.28	5.92	5.49	668.333	38.20	37.37	36.49	27.02	27.21	26.61
758.788	728.788	6.40	5.97	5.52	758.788	36.41	36.26	35.82	24.82	25.46	25.54
819.091	789.091	6.71	6.06	5.63	819.091	36.02	36.04	35.39	24.08	24.67	24.56
909.546	879.546	7.45	6.45	5.76	909.546	35.64	35.77	35.37	22.98	23.44	23.58
1000.000	970.000	7.89	6.93	6.05	1000.000	36.25	36.36	36.00	22.68	23.06	23.24

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.13	1.12	1.15	1.43	2.13	3.03	5.000	1.48	1.29	1.14	5.000	−241.66	−.09
10.000	1.08	1.06	1.10	1.42	2.10	3.02	10.000	1.49	1.29	1.15	10.000	−240.98	−.09
20.000	1.06	1.02	1.08	1.38	2.06	2.99	20.000	1.49	1.29	1.15	20.000	−239.06	−.09
35.151	1.05	1.02	1.08	1.47	2.18	3.14	35.151	1.48	1.29	1.14	35.151	−242.83	−.08
50.000	1.05	1.03	1.09	1.49	2.15	3.11	50.000	1.48	1.29	1.15	50.000	−247.29	−.08
65.303	1.05	1.03	1.09	1.41	2.10	3.06	65.303	1.49	1.29	1.15	65.303	−244.73	−.08
100.000	1.06	1.05	1.09	1.41	2.09	3.00	100.000	1.50	1.30	1.16	100.000	−244.01	−.10
155.758	1.09	1.07	1.11	1.41	2.05	2.94	155.758	1.53	1.33	1.19	155.758	−243.97	−.13
200.000	1.11	1.09	1.12	1.40	2.04	2.88	200.000	1.55	1.35	1.21	200.000	−257.45	−.03
246.212	1.13	1.12	1.14	1.43	2.06	2.96	246.212	1.58	1.38	1.24	246.212	−260.20	−.04
336.667	1.17	1.16	1.18	1.47	2.03	2.80	336.667	1.64	1.43	1.29	336.667	−228.67	+.74
427.121	1.22	1.21	1.22	1.56	2.10	2.89	427.121	1.70	1.50	1.35	427.121	−232.21	+.38
500.000	1.27	1.26	1.27	1.65	2.19	3.00	500.000	1.75	1.55	1.40	500.000	−252.32	+.34
547.727	1.30	1.29	1.30	1.69	2.25	3.06	547.727	1.80	1.59	1.45	547.727	−242.11	+.70
608.030	1.35	1.33	1.34	1.74	2.20	2.93	608.030	1.81	1.61	1.47	608.030	−218.37	+1.19
668.333	1.41	1.39	1.39	1.82	2.32	3.05	668.333	1.84	1.66	1.52	668.333	−193.22	+1.30
758.788	1.52	1.49	1.48	1.93	2.42	3.14	758.788	1.85	1.68	1.55	758.788	−214.92	+2.01
819.091	1.62	1.58	1.57	2.01	2.54	3.24	819.091	1.84	1.69	1.57	819.091	−208.84	+2.92
909.546	1.80	1.75	1.73	2.09	2.63	3.40	909.546	1.81	1.65	1.55	909.546	−192.61	+3.72
1000.000	2.03	1.98	1.94	2.03	2.44	3.20	1000.000	1.75	1.59	1.50	1000.000	−198.10	+3.94

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC \ RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	18	9	33	22	34	28	48	32	51
1	–	24	0	33	13	35	22	40	40	48	45	55
2	95	63	46	63	45	67	44	56	54	64	67	70
3	93	64	62	69	61	73	58	74	63	>74	70	75
4	>95	>74	>76	>76	>76	>76	>76	75	>75	74	>75	>74
5	>97	>76	>75	74	74	>75	75	>76	>76	>76	>75	>74
6	>94	>75	>75	>75	>74	>75	>76	>76	>76	>76	>75	74
7	95	>77	>74	>76	73	73	>75	75	75	>76	>76	>76
8	>96	>76	>75	>76	>75	>74	>75	>76	>76	>76	74	74
9	>96	73	74	75	>76	>75	>74	>75	74	>76	>75	>76
10	>96	>75	>75	>76	75	>76	>75	74	>75	>75	>76	>76

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −14.93 DBM
LO IN: 470.01 MHZ; +6.93 DBM
IF OUT: 30.09 MHZ; −20.36 DBM

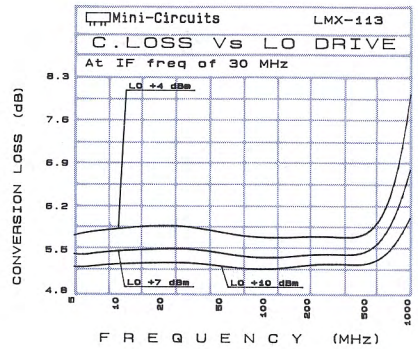
RF ORDER HARMONIC \ RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	13	28	21	39	34	45	41	66	45	62
1	–	25	0	32	13	37	22	42	41	52	51	60
2	79	52	37	55	37	59	36	52	46	63	57	63
3	95	47	53	51	51	57	46	69	60	68	56	64
4	>95	78	64	85	64	75	65	74	59	67	66	69
5	96	82	66	75	60	78	57	71	58	72	58	70
6	94	83	>85	>84	81	78	75	78	70	76	69	73
7	95	85	83	84	83	>84	79	>86	80	85	81	>86
8	95	>85	>86	>86	>84	84	>84	>85	>87	>86	84	>86
9	>96	84	>85	>85	>86	>86	84	>85	>85	>85	85	>85
10	>96	85	>85	>85	85	84	>85	>82	>85	>85	84	>85

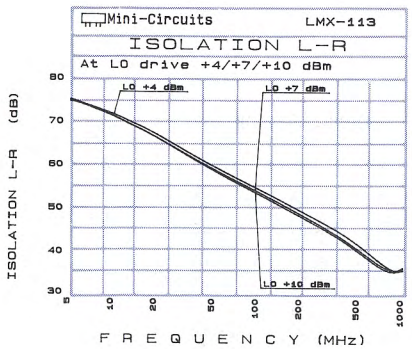
LO Harmonic Order

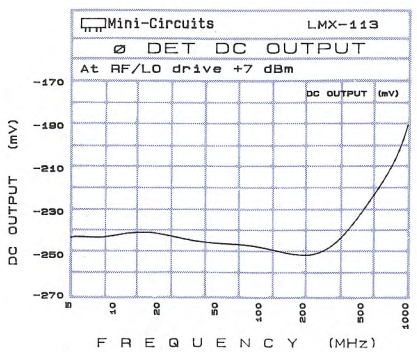
test conditions: RF IN: 500.10 MHZ; −4.99 DBM
LO IN: 470.01 MHZ; +6.93 DBM
IF OUT: 30.09 MHZ; −10.45 DBM

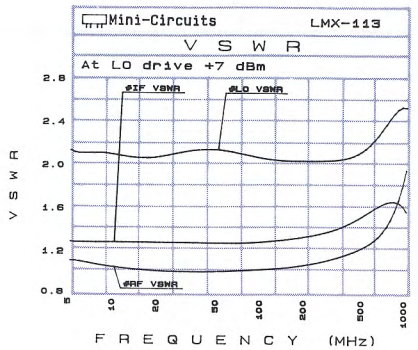
typical performance curves

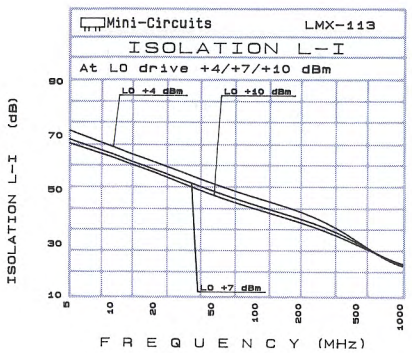
(production unit)

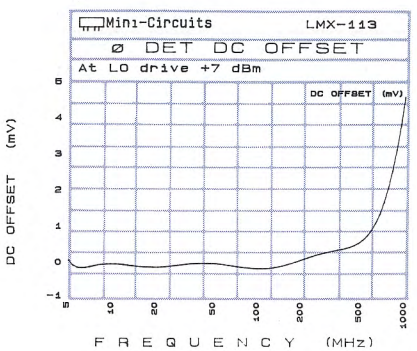












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
LMX-124



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.500	30.50	6.54	6.23	5.94	>64.00	>67.00	>70.00	>64.00	62.90	63.65
2.000	32.00	5.76	5.49	5.26	42.99	41.87	40.94	41.12	40.14	39.23
10.000	40.00	5.58	5.34	5.23	39.95	38.99	38.01	37.90	36.96	36.04
20.000	50.00	5.58	5.34	5.22	39.78	38.83	37.85	37.72	36.80	35.86
32.726	62.73	5.49	5.27	5.17	37.92	36.90	36.00	35.69	34.76	33.91
48.839	78.84	5.40	5.21	5.12	36.21	35.12	34.31	33.75	32.93	32.15
50.000	80.00	5.42	5.22	5.12	34.88	33.77	32.87	32.33	31.58	30.93
97.178	67.18	5.24	5.11	4.98	34.59	33.51	32.71	31.97	31.32	30.63
129.400	99.40	5.26	5.14	5.02	34.10	33.22	32.34	32.08	31.14	30.52
145.520	115.52	5.32	5.16	5.05	33.31	32.33	31.47	30.97	30.11	29.57
161.630	131.63	5.34	5.21	5.09	32.49	31.51	30.65	29.88	29.16	28.69
193.860	163.86	5.46	5.34	5.18	31.89	30.87	29.96	28.98	28.35	27.87
209.970	179.97	5.46	5.30	5.15	31.35	30.33	29.35	28.18	27.72	27.21
226.080	196.08	5.46	5.30	5.11	30.90	29.76	28.77	27.36	26.99	26.46
242.200	212.20	5.41	5.26	5.07	30.57	29.41	28.44	26.66	26.35	25.92
290.530	260.53	5.38	5.25	5.13	29.37	28.19	27.19	25.01	25.01	24.68
322.760	292.76	5.46	5.25	5.15	29.02	27.39	26.01	22.59	22.67	22.38
354.990	324.99	5.70	5.45	5.30	28.98	26.98	25.54	21.01	21.17	20.79
435.550	405.55	5.74	5.46	5.25	26.20	25.58	24.77	20.61	21.09	20.62
500.000	470.00	5.90	5.61	5.39	25.41	25.00	24.33	19.87	20.64	20.39

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.19	1.13	1.12	1.69	2.58	4.03	1.49	1.34	1.20
19.559	1.18	1.09	1.04	1.62	2.43	3.75	1.50	1.34	1.20
34.118	1.18	1.09	1.02	1.67	2.54	3.83	1.49	1.34	1.20
48.676	1.18	1.09	1.02	1.70	2.55	3.78	1.49	1.34	1.20
50.000	1.18	1.09	1.02	1.70	2.52	3.78	1.49	1.34	1.20
63.235	1.18	1.09	1.02	1.64	2.41	3.62	1.49	1.34	1.20
92.353	1.17	1.08	1.01	1.61	2.37	3.42	1.50	1.35	1.21
100.000	1.17	1.08	1.01	1.61	2.30	3.30	1.50	1.35	1.21
106.910	1.17	1.08	1.01	1.59	2.29	3.32	1.50	1.35	1.22
136.030	1.16	1.07	1.02	1.63	2.34	3.35	1.52	1.37	1.23
150.590	1.15	1.07	1.03	1.60	2.27	3.28	1.52	1.37	1.24
165.150	1.15	1.07	1.03	1.61	2.27	3.21	1.52	1.38	1.25
179.710	1.14	1.07	1.04	1.63	2.33	3.26	1.53	1.39	1.26
194.260	1.14	1.07	1.05	1.62	2.32	3.24	1.55	1.40	1.27
208.820	1.14	1.07	1.06	1.62	2.31	3.16	1.56	1.40	1.28
252.500	1.13	1.08	1.08	1.62	2.30	3.12	1.58	1.43	1.31
325.290	1.14	1.13	1.14	1.71	2.37	3.17	1.64	1.48	1.36
398.090	1.21	1.21	1.23	1.77	2.45	3.30	1.72	1.55	1.44
470.880	1.31	1.32	1.33	1.89	2.58	3.38	1.77	1.61	1.51
500.000	1.36	1.37	1.37	1.95	2.62	3.42	1.78	1.63	1.53

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.500	−229.03	+.18
33.194	−234.57	+.25
49.291	−236.63	+.28
50.000	−236.67	+.28
65.388	−236.60	+.31
81.485	−238.53	+.36
97.582	−240.55	+.46
100.000	−239.82	+.48
113.680	−237.49	+.47
129.780	−238.21	+.63
145.870	−237.45	+.61
161.970	−237.09	+.86
178.070	−235.20	+.97
194.160	−235.50	+.84
210.260	−237.19	+.83
258.550	−237.60	+1.46
322.940	−219.78	+2.48
403.430	−212.29	+2.18
467.810	−219.35	+2.68
500.000	−217.66	+2.55

Measurements at RF & LO Power +7 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL											
0	–	–	4	30	16	36	25	41	48	57	53	69
1	–	16	–	30	13	36	32	57	61	58	51	68
2	75	38	32	42	29	45	36	53	45	59	57	68
3	>95	44	42	48	43	60	41	56	63	66	64	67
4	96	72	57	51	48	60	48	53	47	60	70	73
5	>94	73	69	65	59	58	54	59	59	64	69	80
6	>94	79	>83	>86	79	74	59	61	57	64	67	77
7	>96	>84	83	>83	>84	84	>85	80	67	73	67	73
8	>94	>84	>84	>84	>82	>84	80	74	73	78	69	73
9	>94	>83	>83	>84	>83	>83	>84	>84	81	82	78	>85
10	>93	>83	>83	>84	86	>84	>82	>84	>85	>84	82	81
	0	1	2	3	4	5	6	7	8	9	10	

Harmonic LO Order

test conditions: RF.=IN: FREQ.500.1 MHZ DRIVE −4.06 DBM
LO.=IN: FREQ.470.01 MHZ DRIVE 7 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. −10.46 DBM

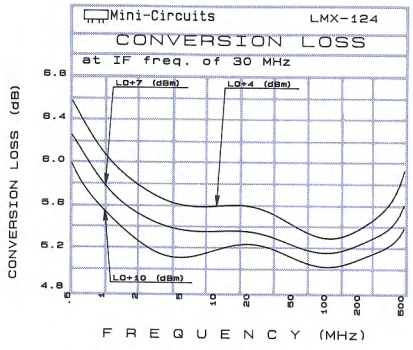
RF ORDER HARMONIC	RF CAL											
0	–	–	+6	20	5	24	13	30	30	41	36	45
1	–	16	–	31	12	32	31	53	51	54	48	61
2	94	48	40	55	37	48	41	61	53	68	60	75
3	>96	68	61	63	58	65	56	76	70	75	>72	>75
4	>95	>74	>75	76	73	>74	73	>76	73	>76	>74	>74
5	>93	75	>75	>76	>75	>75	>76	>75	>77	>75	75	>75
6	>93	>73	>74	>74	>76	>77	>77	>76	>76	>76	>75	>75
7	>95	>74	>73	74	>73	>75	>76	>75	>75	>76	>75	>75
8	>94	>75	>75	>74	>73	>74	>75	>75	>76	>75	>75	>75
9	>93	>73	74	>74	>74	>73	>74	>75	>74	>76	>77	>75
10	>95	>75	>74	74	>73	>73	>72	>74	>75	>75	>75	>75
	0	1	2	3	4	5	6	7	8	9	10	

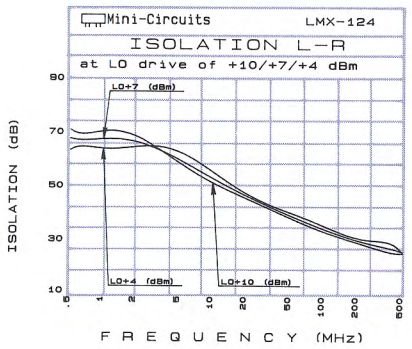
Harmonic LO Order

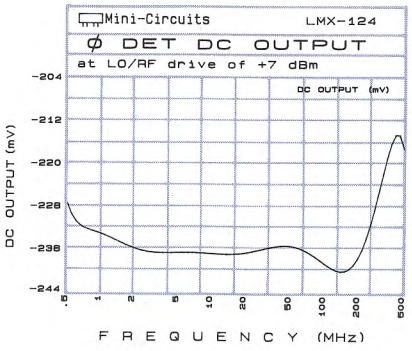
test conditions: RF.=IN: FREQ.500.1 MHZ DRIVE −13.95 DBM
LO.=IN: FREQ.470.01 MHZ DRIVE 7 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. −20.3 DBM

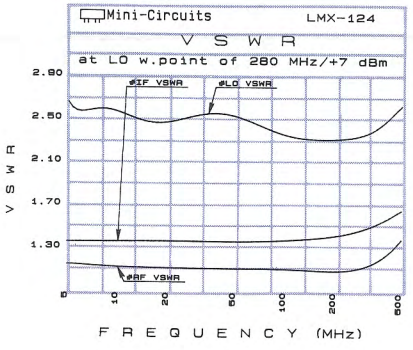
typical performance curves

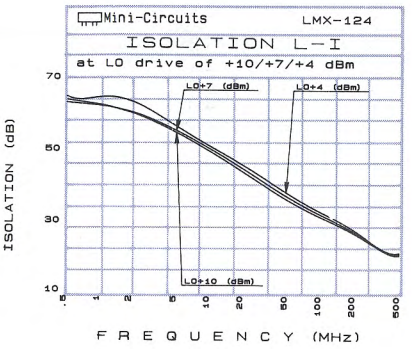
(production unit)

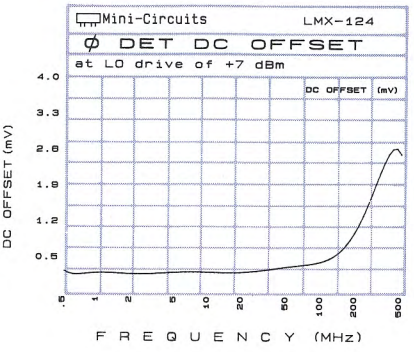












most widely used

Frequency Mixers

Model
LMX-149

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
10.000	40.00	5.89	5.55	5.41	>64.00	>67.00	65.32	>64.00	>67.00	63.75
20.000	50.00	5.95	5.61	5.44	>64.00	61.11	59.59	>64.00	60.03	57.97
145.460	115.46	5.91	5.65	5.54	46.30	45.23	44.11	43.97	43.22	42.55
190.610	160.61	5.96	5.73	5.59	44.52	43.11	42.04	41.83	41.33	40.63
235.760	205.76	6.02	5.77	5.60	43.17	41.70	40.64	40.40	39.99	39.28
326.060	296.06	5.90	5.68	5.53	40.97	39.51	38.56	38.24	37.88	37.22
416.370	386.37	6.16	5.87	5.68	39.24	38.05	37.23	36.16	35.93	35.42
500.000	470.00	6.08	5.77	5.56	38.09	37.27	36.67	34.53	34.64	34.58
551.820	521.82	6.07	5.79	5.59	37.37	36.73	36.21	33.54	33.59	33.31
642.130	612.13	6.19	5.89	5.65	36.82	36.47	36.12	31.91	32.22	32.16
732.430	702.80	6.45	6.08	5.81	36.84	36.95	36.72	30.54	31.31	31.41
822.740	792.70	6.68	6.26	5.93	36.79	37.11	37.31	29.09	30.08	31.12
913.040	883.29	7.15	6.56	6.16	36.95	37.23	37.48	28.48	29.21	29.70
1000.000	970.34	7.56	6.94	6.51	37.46	37.62	37.85	28.37	29.13	29.91
1048.500	1018.60	7.69	7.22	6.77	37.82	37.95	38.16	28.37	29.28	30.01
1138.800	1109.10	**7.70**	**7.23**	**6.81**	**38.26**	**38.76**	**38.91**	28.14	29.11	29.84
1229.100	1199.10	**7.74**	**7.24**	**6.82**	**38.48**	**38.98**	**40.10**	27.99	28.99	29.66
1319.400	1289.50	**7.85**	**7.39**	**7.02**	**38.45**	**38.85**	**38.99**	28.16	28.92	29.66
1409.700	1380.00	**7.99**	**7.38**	**7.05**	**38.49**	**38.89**	**40.01**	27.64	28.88	30.18
1500.000	1469.90	**8.14**	**7.40**	**7.15**	**39.62**	**40.12**	**40.31**	28.87	29.62	30.97

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
10.000	1.25	1.16	1.11	1.83	2.77	3.83	1.81	1.54	1.38
50.000	1.20	1.10	1.03	1.89	2.94	4.19	1.78	1.53	1.38
100.000	1.20	1.10	1.04	1.75	2.68	3.70	1.76	1.52	1.37
145.450	1.20	1.11	1.06	1.77	2.62	3.52	1.73	1.52	1.37
200.000	1.21	1.13	1.09	1.76	2.59	3.54	1.72	1.53	1.38
280.910	1.23	1.17	1.14	1.83	2.54	3.50	1.69	1.52	1.40
371.210	1.27	1.22	1.20	1.88	2.63	3.45	1.67	1.54	1.45
461.520	1.31	1.30	1.28	2.00	2.83	3.56	1.65	1.55	1.50
506.670	1.33	1.34	1.32	2.05	2.74	3.58	1.66	1.58	1.54
596.970	1.39	1.41	1.40	2.21	2.80	3.67	1.65	1.62	1.60
687.270	1.49	1.53	1.52	2.36	3.19	3.98	1.71	1.69	1.70
777.580	1.62	1.66	1.66	2.55	3.30	4.11	1.76	1.76	1.75
867.880	1.77	1.83	1.79	2.76	3.65	4.32	1.82	1.84	1.80
958.180	1.97	2.03	2.00	3.03	3.80	4.46	1.88	1.92	1.87
1003.300	2.08	2.17	2.12	3.11	3.93	4.39	1.91	1.96	1.92
1093.600	2.36	2.41	2.38	3.42	4.20	4.79	1.92	1.98	1.94
1183.900	2.52	2.63	2.58	3.55	4.18	4.72	1.88	1.95	1.92
1274.200	2.68	2.95	2.81	3.65	4.32	4.73	1.82	1.90	1.86
1364.500	2.84	3.22	2.92	3.90	3.99	4.54	1.76	1.82	1.76
1500.000	3.05	3.43	3.09	4.28	3.48	4.32	1.69	1.72	1.64

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
10.000	+229.95	−.08
20.000	+229.43	−.08
48.038	+224.97	−.09
50.000	+224.87	−.09
100.000	+226.50	−.09
162.150	+228.65	−.12
200.190	+226.29	−.16
276.270	+233.99	−.27
390.380	+206.62	−.53
466.460	+210.33	−.51
504.490	+212.98	−.58
580.570	+217.20	−.89
656.650	+205.91	−1.08
770.760	+189.65	−1.47
808.800	+188.14	−1.63
884.870	+193.87	−2.09
960.950	+181.62	−2.31
1000.000	+177.67	−2.13
1250.000	+156.89	−2.29
1500.000	+152.38	−2.17

Measurements at RF & LO Power +7 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	13	31	25	55	34	70	55	66	63	>78
1	–	17	–	41	17	51	50	52	58	63	60	61
2	94	51	44	51	78	58	47	56	47	70	63	73
3	>96	59	38	75	71	80	74	61	65	63	65	67
4	>96	71	79	69	67	63	61	62	67	63	60	77
5	>97	73	74	74	84	59	50	61	53	66	74	78
6	>88	>80	>85	>84	>82	78	71	66	69	69	>84	70
7	>91	>78	>78	>84	>85	83	73	67	66	65	67	73
8	>89	>79	>78	>79	>85	>85	>84	>84	>84	76	80	76
9	>90	>79	>78	>79	>79	>85	>85	>84	>83	77	75	75
10	>89	>79	>79	>78	>79	>78	>84	>85	>85	>83	>84	81
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -3.98 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 7.02 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -11.02 DBM

RF ORDER HARMONIC

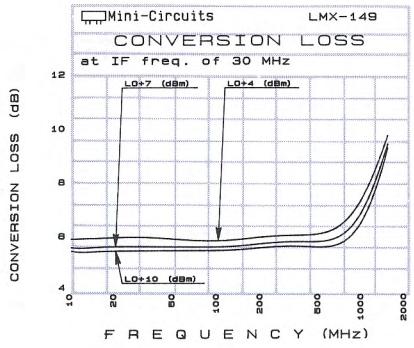
	RF CAL											
0	–	–	2	19	14	53	20	52	40	46	44	61
1	–	17	–	34	15	56	47	44	46	68	46	47
2	>95	59	52	58	50	64	55	62	51	69	63	67
3	>95	>73	58	64	54	70	58	>73	>75	>74	73	>66
4	>95	>75	>75	>73	>73	>74	>74	>74	>73	>74	>73	>74
5	>96	>74	>75	>75	>73	>73	>75	>75	>74	>75	>75	>74
6	>89	>69	>73	>74	>75	>73	>73	>75	>74	>74	>73	>75
7	>88	>67	>69	>75	>74	>75	>74	>73	>74	>74	>74	>73
8	>90	>69	>67	>68	>73	>74	>75	>73	>74	>74	>74	>73
9	>89	>69	>70	>67	>67	>75	>74	>75	>74	>73	>75	>75
10	>88	>69	>67	>68	>68	>67	>76	>74	>76	>73	>75	>74
		0	1	2	3	4	5	6	7	8	9	10

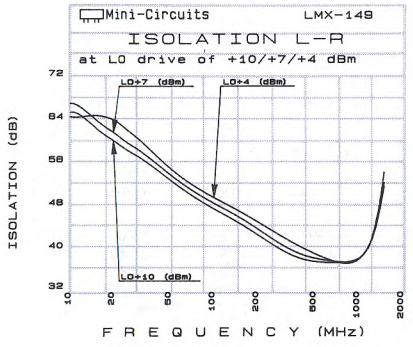
Harmonic LO Order

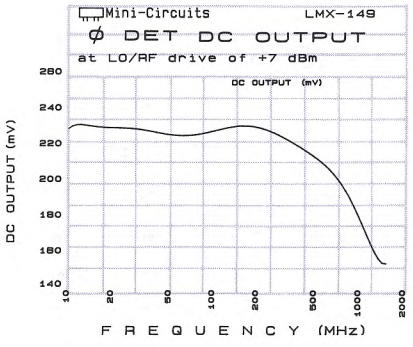
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -14.09 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 7.02 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -21.27 DBM

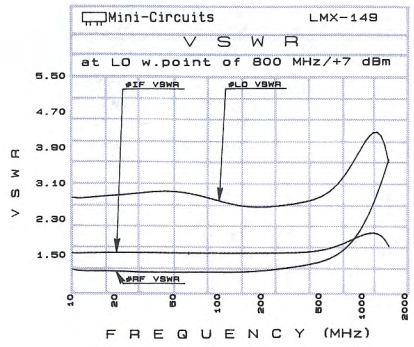
typical performance curves

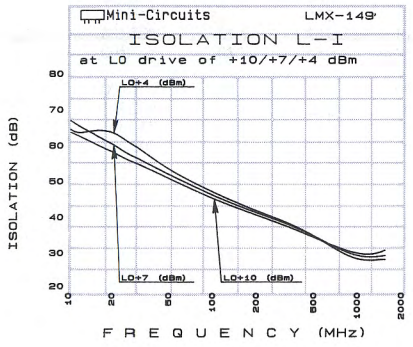
(production unit)

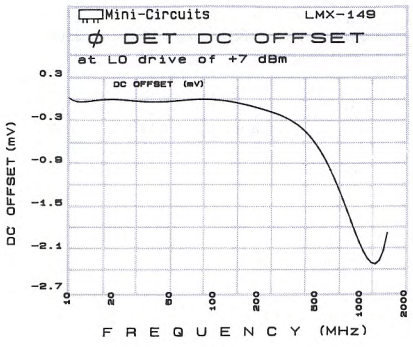












widest variety of connector types

Frequency Mixers

2 to 4.2 GHz

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

ZFM-4212
PAM-42



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
2000.000	2200.000	5.30	5.02	4.83	2000.000	27.78	28.29	28.99	14.41	13.79	13.42
2112.821	2312.821	5.09	4.86	4.73	2125.714	26.91	27.60	28.28	13.45	13.30	12.96
2225.641	2025.641	5.30	5.05	4.90	2251.429	26.66	27.57	28.54	12.82	13.16	13.41
2338.462	2138.462	5.17	4.98	4.90	2377.143	27.35	28.69	29.81	11.99	12.95	13.52
2394.872	2194.872	5.12	4.95	4.89	2440.000	27.61	29.08	30.37	12.22	13.41	14.24
2507.692	2307.692	5.72	5.42	5.25	2502.857	28.36	29.78	31.16	12.94	14.10	15.08
2620.513	2420.513	5.79	5.52	5.35	2628.571	28.76	30.16	31.30	13.20	14.69	15.84
2733.333	2533.333	5.58	5.31	5.16	2754.286	28.81	29.70	30.46	12.65	14.39	15.87
2846.154	2646.154	6.27	5.91	5.68	2880.000	29.99	30.28	30.56	13.60	15.48	17.28
2958.974	2758.974	6.12	5.80	5.60	3000.000	37.18	34.83	34.81	14.73	16.78	18.81
3128.205	2928.205	5.87	5.51	5.41	3131.429	29.76	29.94	29.67	16.33	18.49	20.67
3241.026	3041.026	5.86	5.43	5.19	3257.143	32.28	31.24	30.34	17.76	19.95	22.23
3353.846	3153.846	6.09	5.68	5.52	3382.857	30.35	30.13	29.74	18.56	20.75	22.73
3523.077	3323.077	6.29	5.59	5.23	3508.571	30.81	30.22	29.69	20.40	22.21	23.53
3635.897	3435.897	6.19	5.59	5.36	3634.286	32.38	30.70	29.35	21.89	22.93	23.33
3748.718	3548.718	6.25	5.62	5.30	3760.000	32.60	30.34	29.04	23.90	23.05	22.09
3861.539	3661.539	6.11	5.48	5.20	3885.714	32.58	30.00	28.46	26.07	22.95	20.77
3974.359	3774.359	6.20	5.50	5.16	4000.000	31.57	28.87	27.17	26.30	21.72	19.27
4087.180	3887.180	6.21	5.44	5.10	4074.286	32.77	30.09	28.26	27.33	22.40	19.90
4200.000	4000.000	6.12	5.22	5.12	4200.000	33.54	30.27	28.14	26.28	21.65	19.05

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
2000.000	2.74	2.56	2.43	3.05	3.97	5.22	5.000	1.23	1.09	1.02	2000.000	−208.31	−8.96
2111.392	2.68	2.53	2.42	3.26	4.54	6.19	35.833	1.23	1.08	1.02	2125.714	−219.86	−8.55
2222.785	2.64	2.51	2.40	3.07	4.18	5.66	66.667	1.23	1.09	1.02	2251.429	−226.54	−5.72
2334.177	2.61	2.49	2.39	3.05	4.08	5.58	100.000	1.24	1.09	1.02	2377.143	−224.21	−4.00
2500.000	2.50	2.37	2.28	3.98	5.33	7.17	159.167	1.24	1.10	1.01	2500.000	−227.23	−9.06
2612.658	2.20	2.00	1.86	3.96	5.19	7.11	200.000	1.25	1.10	1.01	2565.714	−223.86	−11.17
2724.051	3.10	2.89	2.70	4.05	5.06	6.73	282.500	1.26	1.12	1.02	2691.429	−204.40	−8.98
2835.443	3.37	3.17	2.99	4.46	5.52	7.25	344.167	1.27	1.14	1.05	2817.143	−210.21	−6.39
2946.835	3.55	3.34	3.17	4.91	5.87	7.70	405.833	1.28	1.15	1.05	2942.857	−205.60	−3.82
3000.000	3.49	3.29	3.15	4.57	5.51	7.38	467.500	1.29	1.17	1.07	3000.000	−215.32	−14.60
3141.772	3.38	3.15	2.99	5.79	6.39	7.80	500.000	1.30	1.18	1.09	3068.571	−220.75	−6.11
3253.165	3.08	2.80	2.58	6.01	6.58	7.90	590.833	1.31	1.20	1.13	3257.143	−206.85	−2.46
3364.557	4.13	3.84	3.60	8.43	9.69	12.44	714.167	1.35	1.25	1.20	3382.857	−211.95	−.86
3500.000	3.97	3.72	3.52	6.42	6.28	7.00	806.667	1.35	1.28	1.27	3500.000	−213.35	−1.40
3643.038	3.73	3.54	3.42	7.63	7.05	7.73	868.333	1.34	1.29	1.30	3571.429	−188.13	−.61
3754.430	3.66	3.50	3.40	8.51	7.70	8.27	899.167	1.34	1.31	1.32	3697.143	−175.24	−1.09
3865.823	3.68	3.52	3.40	10.96	9.90	10.82	1000.000	1.32	1.34	1.39	3822.857	−179.70	−1.53
4000.000	3.90	3.67	3.48	8.20	6.07	5.83	1115.000	1.31	1.40	1.51	4000.000	−184.87	−1.92
4088.608	4.10	3.82	3.61	7.14	5.63	5.28	1207.500	1.32	1.48	1.64	4074.286	−187.94	+.15
4200.000	4.42	4.09	3.79	16.89	10.02	8.72	1300.000	1.36	1.58	1.79	4200.000	−167.29	−2.22

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Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

1.5 to 4.2 GHz

Model
ZAM-42

Mini-Circuits
ULTRA-REL™ MIXERS
5-YR. GUARANTEE *

computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1500.000	1530.000	5.90	5.54	5.32	1500.000	30.03	29.99	29.69	17.82	19.33	20.56
1658.824	1628.824	5.73	5.44	5.28	1658.824	25.88	25.18	24.79	15.24	16.21	16.84
1738.235	1708.235	5.89	5.59	5.42	1738.235	27.94	27.31	26.71	15.33	16.81	18.13
1897.059	1867.059	5.97	5.67	5.46	1897.059	29.66	29.11	28.40	15.23	16.88	18.67
2000.000	1970.000	6.09	5.81	5.60	2000.000	29.99	28.87	27.89	14.80	16.59	18.50
135.294	2105.294	6.35	5.98	5.71	2135.294	30.15	28.59	27.46	14.57	16.39	18.32
2214.706	2184.706	6.27	5.85	5.63	2214.706	30.49	28.86	27.66	14.33	16.25	18.16
2373.529	2343.529	5.85	5.64	5.50	2373.529	30.53	28.81	27.59	15.00	16.59	17.99
2500.000	2470.000	5.89	5.62	5.51	2500.000	29.31	28.07	27.54	17.21	18.04	18.67
2611.765	2581.765	6.03	5.69	5.53	2611.765	29.60	28.44	27.44	17.19	17.91	17.97
2770.588	2740.588	6.00	5.66	5.49	2770.588	30.22	29.10	28.11	18.43	18.41	18.10
3000.000	2970.000	5.64	5.26	5.10	3000.000	29.85	29.15	28.32	20.53	18.81	17.63
3088.235	3058.235	5.55	5.12	4.98	3088.235	30.67	29.59	28.58	21.64	19.37	17.77
3247.059	3217.059	5.35	4.79	4.63	3247.059	30.05	28.63	27.54	20.97	18.40	16.86
3405.882	3375.882	6.42	5.74	5.43	3405.882	31.29	29.33	28.18	20.55	17.66	16.10
3500.000	3470.000	6.41	5.32	4.81	3500.000	29.62	27.61	26.39	18.67	16.55	15.09
3644.118	3614.118	5.81	4.99	4.61	3644.118	29.09	26.82	25.21	17.31	15.37	13.72
3802.941	3772.941	5.91	4.96	4.66	3802.941	28.64	26.47	25.00	16.08	14.66	13.36
4000.000	3970.000	6.01	5.35	5.07	4000.000	30.99	27.26	24.95	16.14	14.78	13.09
4200.000	4170.000	5.76	5.45	5.42	4200.000	28.98	25.73	23.19	13.72	12.88	11.57

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
1500.000	3.06	2.92	2.81	2.89	3.60	4.50	5.000	1.08	1.05	1.17
1568.354	3.33	3.18	3.04	2.67	3.60	4.96	10.000	1.08	1.05	1.17
1773.418	3.99	3.78	3.60	1.83	2.57	3.59	20.000	1.08	1.06	1.17
1841.772	4.14	3.92	3.76	1.77	2.48	3.47	34.118	1.09	1.05	1.16
2000.000	4.38	4.09	3.90	1.73	2.50	3.52	50.000	1.09	1.05	1.16
2183.544	4.55	4.28	4.03	1.80	2.53	3.57	63.235	1.09	1.05	1.16
2320.253	4.60	4.29	4.04	2.06	2.97	4.32	77.794	1.10	1.04	1.15
2500.000	4.56	4.23	3.95	2.35	2.92	3.66	100.000	1.09	1.05	1.16
2593.671	4.54	4.18	3.86	3.68	4.67	6.68	121.471	1.10	1.05	1.16
2730.380	4.47	4.08	3.75	4.26	5.14	6.53	150.588	1.11	1.05	1.15
2901.266	4.48	4.11	3.77	3.68	3.97	4.69	179.706	1.11	1.05	1.14
3000.000	4.15	3.86	3.56	6.07	6.05	7.56	200.000	1.12	1.05	1.15
3243.038	3.13	2.88	2.70	6.51	6.19	6.97	223.382	1.12	1.05	1.14
3379.747	2.54	2.36	2.23	6.76	5.72	5.91	252.500	1.13	1.05	1.13
3500.000	2.11	1.97	1.86	7.47	6.13	6.09	296.176	1.14	1.05	1.12
3721.519	1.59	1.52	1.48	6.83	4.54	4.04	325.294	1.15	1.05	1.12
3858.228	1.53	1.50	1.50	6.76	4.08	3.41	354.412	1.16	1.05	1.10
4000.000	1.79	1.79	1.82	5.27	3.16	2.52	398.088	1.16	1.04	1.09
4131.646	2.47	2.43	2.42	5.44	3.07	2.25	456.324	1.17	1.04	1.06
4200.000	3.01	2.93	2.90	5.28	2.86	1.94	500.000	1.18	1.05	1.04

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
1500.000	+211.46	+3.11
1658.824	+194.76	−.53
1738.235	+194.14	−1.42
1897.059	+156.15	−1.49
2000.000	+161.41	−.69
2135.294	+145.07	−4.98
2214.706	+80.70	−4.17
2373.529	+51.02	+5.86
2500.000	+26.15	+6.36
2611.765	−2.96	+5.46
2770.588	+20.83	+3.06
3000.000	−29.03	+.13
3088.235	+3.02	+.89
3247.059	−48.15	−2.11
3405.882	−53.52	−3.42
3500.000	−29.28	−1.12
3644.118	−13.26	−2.85
3802.941	−9.56	−4.70
4000.000	+25.19	−9.75
4200.000	−87.49	−12.60

In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
TAK-5

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.010	30.01	7.28	7.11	6.93	56.97	58.08	57.43	52.65	53.36	52.26
.200	30.20	4.89	4.71	4.57	58.23	59.34	59.43	51.70	52.17	51.68
1.000	31.00	4.71	4.56	4.42	58.08	59.46	59.35	51.73	51.84	51.63
5.000	35.00	4.87	4.60	4.47	57.90	59.26	59.05	51.61	51.76	51.55
19.240	49.24	4.85	4.71	4.59	56.84	56.47	56.67	51.69	52.25	51.97
28.855	58.86	4.79	4.65	4.53	55.16	54.43	53.81	51.50	52.12	51.71
48.085	78.09	4.76	4.63	4.51	50.43	50.19	50.28	49.40	50.36	50.77
67.315	97.32	4.72	4.60	4.53	47.21	47.74	47.74	46.37	48.07	48.94
86.545	56.55	4.65	4.59	4.50	43.70	44.68	45.60	43.38	45.40	46.91
100.000	70.00	4.72	4.63	4.56	42.85	43.92	44.75	41.42	43.20	44.52
115.390	85.39	4.82	4.75	4.75	41.68	43.05	44.47	40.17	42.22	44.18
134.620	104.62	4.96	4.85	4.75	37.26	38.26	39.58	38.65	40.16	41.69
144.240	114.24	5.10	5.02	4.88	36.69	37.90	39.26	37.73	39.27	40.59
163.470	133.47	5.25	5.14	5.10	36.21	38.05	39.74	36.23	37.81	39.07
182.700	152.70	5.35	5.30	5.26	36.79	38.71	39.42	34.35	34.70	34.66
200.000	170.00	5.52	5.38	5.30	38.74	39.71	39.63	33.89	33.53	33.11
221.160	191.16	5.65	5.36	5.16	41.33	40.42	39.12	33.81	32.38	31.11
230.770	200.77	5.73	5.32	5.04	42.79	40.93	38.79	33.73	31.70	29.71
240.390	210.39	5.96	5.38	5.07	42.40	40.98	38.11	33.46	31.63	28.69
250.000	220.00	6.33	5.61	5.19	41.37	40.47	38.66	32.96	31.55	28.79

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.19	1.07	1.02	1.89	2.97	4.39	1.64	1.43	1.31
10.000	1.20	1.07	1.01	1.86	2.78	4.21	1.65	1.43	1.32
19.412	1.20	1.07	1.00	1.76	2.59	3.92	1.67	1.46	1.34
26.618	1.19	1.07	1.01	1.82	2.67	3.95	1.69	1.48	1.36
48.235	1.17	1.05	1.03	1.87	2.72	3.99	1.78	1.57	1.46
55.441	1.16	1.04	1.04	1.83	2.71	3.88	1.83	1.61	1.50
77.059	1.13	1.03	1.07	1.79	2.56	3.60	2.00	1.78	1.64
84.265	1.12	1.04	1.09	1.78	2.55	3.58	2.05	1.82	1.70
98.676	1.09	1.06	1.12	1.81	2.50	3.47	2.20	1.95	1.80
105.880	1.08	1.07	1.14	1.79	2.51	3.48	2.27	2.01	1.87
113.090	1.08	1.09	1.16	1.81	2.56	3.58	2.37	2.08	1.94
134.710	1.09	1.15	1.22	1.89	2.60	3.51	2.61	2.33	2.16
156.320	1.13	1.21	1.29	1.91	2.62	3.49	2.83	2.55	2.39
177.940	1.18	1.27	1.34	1.94	2.64	3.54	3.04	2.79	2.62
192.350	1.21	1.29	1.35	2.03	2.67	3.51	3.19	2.93	2.74
200.000	1.22	1.30	1.35	2.06	2.72	3.54	3.18	2.96	2.79
213.970	1.22	1.29	1.33	2.16	2.78	3.57	3.22	2.99	2.83
228.380	1.21	1.27	1.29	2.23	2.90	3.72	3.24	2.99	2.82
242.790	1.18	1.22	1.23	2.26	3.00	3.83	3.26	3.00	2.81
250.000	1.17	1.20	1.21	2.26	3.02	3.80	3.27	2.99	2.81

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.010	−235.95	−.02
.050	−230.90	−.13
1.000	−234.34	−.24
9.625	−234.17	−.23
19.240	−234.76	−.23
28.855	−235.42	−.22
48.085	−236.45	−.19
57.700	−236.67	−.17
76.930	−235.16	−.10
96.160	−230.58	−.06
105.780	−231.51	−.09
115.390	−231.91	+.02
134.620	−234.05	+0.00
153.850	−227.02	+.40
173.080	−215.95	+.75
192.310	−209.85	+1.07
200.000	−205.42	+1.15
211.540	−196.29	+1.22
230.770	−181.60	+1.87
250.000	−167.99	+2.55

Measurements at RF & LO Power +7 dBm

Mini-Circuits™
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EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	13	34	19	40	28	41	34	50	35	51
1	–	12	–	36	11	42	31	37	47	38	37	44
2	>96	52	50	53	51	52	53	60	64	>76	64	>75
3	>96	63	51	52	49	50	51	53	66	65	69	66
4	>95	>77	>76	>77	>76	>76	75	>77	74	>77	>77	>75
5	>96	>76	>76	>78	>77	75	>76	73	>77	70	77	78
6	>96	>75	>76	>75	>76	>76	>76	>76	>75	>76	>76	>76
7	>96	>75	>76	>75	>76	>78	>77	>76	77	>75	>77	>76
8	>95	>76	>77	>76	>76	>76	>77	>76	>76	>75	>77	>75
9	>95	>76	>76	>76	>76	>76	>77	>76	>76	>77	>77	>77
10	>95	>76	>74	>76	>75	>76	>75	>76	>76	>77	>76	>76

Harmonic LO Order

test condition: RF. = IN: FREQ. 185.1 MHZ DRIVE —13.99 dBM
LO. IN: FREQ. 155.01 MHZ DRIVE 6.97 dBM
IF = MEASURED: FREQ. 30.091 MHZ AMP —19.69 dBM

RF ORDER HARMONIC

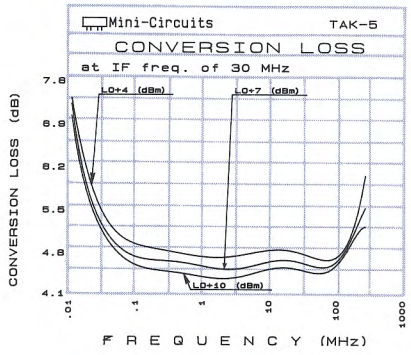
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	22	60	30	51	39	52	44	73	46	69
1	–	13	–	27	12	33	31	42	45	44	44	53
2	81	53	45	60	44	53	47	53	61	68	66	69
3	94	51	38	41	36	47	38	59	59	53	68	56
4	>97	80	67	67	62	76	62	69	62	69	73	78
5	>96	84	65	76	64	50	49	48	50	51	58	71
6	>96	85	84	84	>86	82	75	79	74	74	68	>86
7	>95	72	76	79	78	84	77	63	62	59	61	60
8	>95	>86	>86	>85	>87	>87	>86	>86	84	>87	83	78
9	97	82	85	82	82	>86	>86	>87	83	76	69	68
10	>95	>86	>85	>86	>86	>85	>86	87	>86	>87	>86	>86

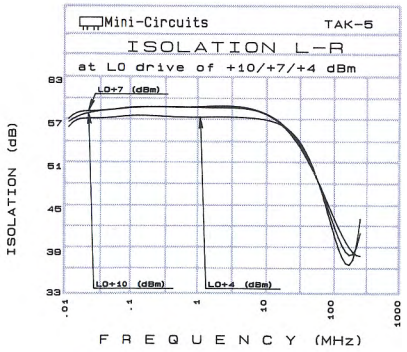
Harmonic LO Order

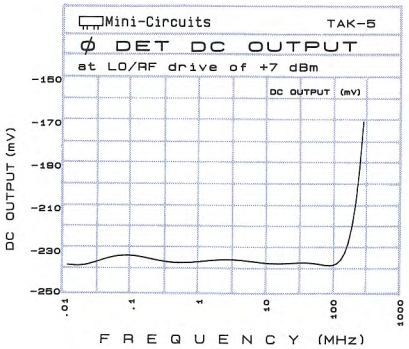
test conditions: RF. = IN: FREQ. 185.1 MHZ DRIVE –3.99 DBM
LO. IN: FREQ. 155.01 MHZ DRIVE 6.97 DBM
IF = MEASURED: FREQ. 30.091 MHZ AMP. –9.69 DBM

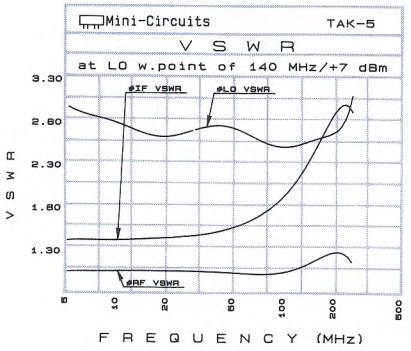
typical performance curves

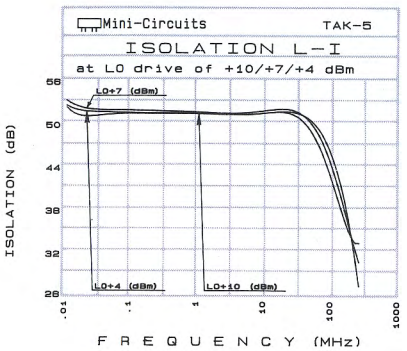
(production unit)

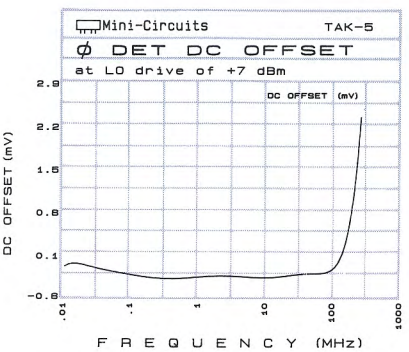












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
TAK-5R

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.050	30.05	5.36	5.17	5.02	58.70	61.25	63.38	59.68	62.86	65.04
.200	30.20	5.02	4.82	4.70	58.78	61.25	63.53	60.25	63.20	65.17
1.000	31.00	4.79	4.62	4.50	58.78	60.99	63.56	60.35	63.40	65.24
5.000	35.00	4.80	4.59	4.52	58.77	61.03	63.40	60.14	63.18	65.16
10.000	40.00	4.95	4.76	4.66	58.84	61.08	63.32	60.27	63.47	65.68
20.000	50.00	5.02	4.82	4.71	58.07	59.80	60.71	58.79	61.27	61.90
27.629	57.63	4.96	4.76	4.65	56.95	57.89	57.17	57.07	58.07	57.51
41.419	71.42	4.97	4.79	4.68	52.50	52.84	53.11	51.56	52.06	52.58
50.000	80.00	4.89	4.74	4.66	50.55	50.73	51.45	49.05	49.96	50.80
62.103	92.10	4.89	4.71	4.61	47.72	48.51	49.45	46.37	47.55	48.71
68.998	99.00	4.94	4.76	4.66	46.00	46.81	47.85	45.15	46.48	47.53
82.788	52.79	4.77	4.66	4.59	44.69	45.80	46.63	43.07	44.56	45.85
96.577	66.58	4.78	4.68	4.61	41.67	42.83	44.07	41.64	43.18	44.30
110.370	80.37	4.90	4.79	4.75	40.55	41.57	42.63	40.40	42.03	43.34
131.050	101.05	4.91	4.80	4.79	39.36	40.59	41.64	38.78	40.54	42.00
144.840	114.84	5.07	4.98	4.90	37.05	38.10	39.29	38.07	39.51	40.84
158.630	128.63	5.20	5.12	5.01	35.56	36.70	37.46	37.78	39.14	39.89
172.420	142.42	5.23	5.14	5.03	34.51	35.89	37.04	36.68	37.99	38.76
186.210	156.21	5.32	5.18	5.10	34.21	35.65	36.61	35.69	36.72	37.03
200.000	170.00	5.46	5.35	5.28	34.69	36.03	36.90	34.87	35.11	34.83

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	1.32	1.21	1.15	1.73	2.61	3.67	1.66	1.53	1.43
10.571	1.33	1.22	1.15	1.69	2.49	3.52	1.67	1.54	1.44
20.000	1.33	1.21	1.15	1.63	2.39	3.36	1.68	1.55	1.45
27.286	1.31	1.20	1.14	1.69	2.46	3.45	1.68	1.56	1.45
38.429	1.30	1.19	1.12	1.76	2.53	3.55	1.70	1.57	1.47
49.571	1.28	1.17	1.10	1.72	2.46	3.45	1.72	1.60	1.50
55.143	1.27	1.16	1.09	1.69	2.43	3.42	1.74	1.62	1.52
71.857	1.22	1.12	1.06	1.70	2.38	3.29	1.80	1.68	1.57
83.000	1.20	1.09	1.04	1.69	2.35	3.19	1.84	1.72	1.61
94.143	1.17	1.07	1.04	1.66	2.33	3.15	1.89	1.77	1.66
99.714	1.15	1.06	1.04	1.70	2.34	3.15	1.93	1.79	1.69
100.000	1.15	1.06	1.05	1.70	2.33	3.14	1.93	1.79	1.69
105.290	1.14	1.05	1.07	1.70	2.36	3.18	1.96	1.82	1.71
116.430	1.11	1.05	1.11	1.71	2.37	3.25	2.02	1.88	1.76
133.140	1.07	1.06	1.13	1.76	2.40	3.19	2.14	2.00	1.88
144.290	1.05	1.08	1.17	1.78	2.41	3.25	2.22	2.08	1.94
161.000	1.03	1.11	1.19	1.83	2.44	3.30	2.35	2.18	2.04
172.140	1.04	1.13	1.22	1.86	2.50	3.31	2.42	2.26	2.10
183.290	1.07	1.16	1.29	1.89	2.51	3.33	2.54	2.36	2.20
200.000	1.14	1.22	3.30	1.92	2.54	3.30	2.67	2.48	2.34

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.050	−233.54	+.16
.200	−238.09	+.30
5.000	−238.75	+.31
10.000	−239.03	+.31
20.000	−238.34	+.31
27.629	−238.37	+.31
34.524	−238.06	+.32
48.314	−238.46	+.32
55.208	−239.95	+.32
68.998	−238.90	+.34
82.788	−237.63	+.32
89.682	−236.52	+.35
100.000	−233.80	+.35
117.260	−231.11	+.32
131.050	−232.02	+.34
144.840	−235.94	+.31
158.630	−234.40	+.21
172.420	−229.13	+.22
186.210	−224.76	+.16
200.000	−220.46	+.17

Measurements at RF & LO Power +7 dBm

Mini-Circuits™
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P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	42	26	48	37	53	47	66	58	63
1	–	17	–	26	12	33	25	41	35	53	48	49
2	81	51	54	55	54	57	50	53	55	69	61	>81
3	94	53	40	52	36	53	37	48	42	50	54	56
4	>95	79	72	66	67	72	69	72	70	65	66	75
5	>96	85	64	67	70	56	56	54	54	57	54	67
6	>95	>86	>86	>87	>85	84	79	>86	85	83	83	79
7	>96	78	84	84	79	>85	74	70	75	66	66	65
8	>97	>87	85	>86	>86	>85	>87	>87	86	>85	>86	>86
9	>95	>85	>85	>85	>84	>86	>86	>87	86	>85	85	84
10	>95	>85	>87	>87	>85	>87	>86	>87	>86	>85	>87	>86

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −4.01 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 6.98 DBM
IF MEASURED: FREQ.30.091 MHZ AMP. −9.59 DBM

RF ORDER HARMONIC

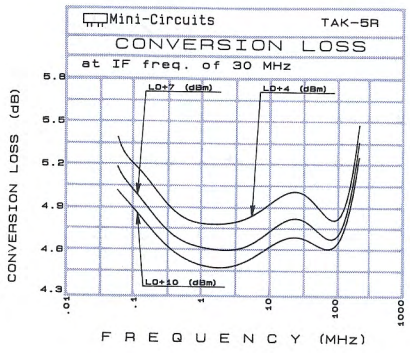
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	18	34	15	38	26	41	34	63	49	53
1	–	16	–	28	11	33	23	39	34	44	48	34
2	>97	57	63	60	63	62	62	60	58	>76	62	>76
3	>96	67	58	66	55	60	56	61	60	68	73	67
4	>94	>77	>76	>76	>76	>77	>76	>75	77	>77	>77	>76
5	>95	>76	>76	>77	>76	>77	>77	>76	>78	>76	>77	>77
6	>95	>76	>76	>76	>76	>76	>78	>77	>76	>77	>77	>77
7	>96	>75	>76	>76	>77	>75	>76	>75	>75	>77	>76	>76
8	>94	>75	>77	>77	>76	>77	>75	>76	>77	>76	>77	>77
9	>95	>74	>76	>76	>76	>77	>77	>76	>76	>77	>76	>76
10	>95	>76	>74	>76	>76	>76	>76	>76	>77	>78	>77	>76

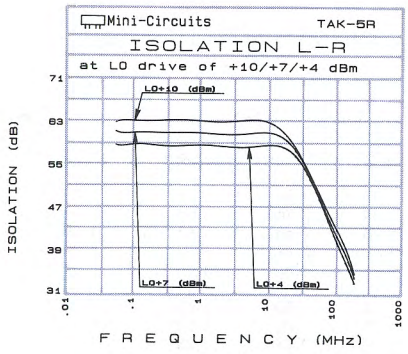
Harmonic LO Order

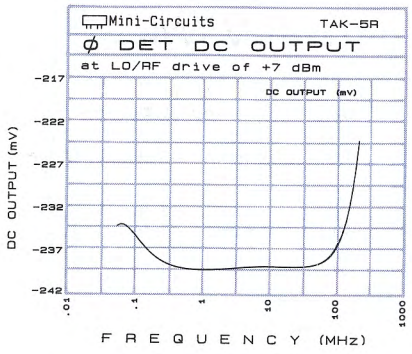
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −14.05 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 6.99 DBM
IF=MEASURED: FREQ.30.091 MHZ AMP. −19.53 DBM

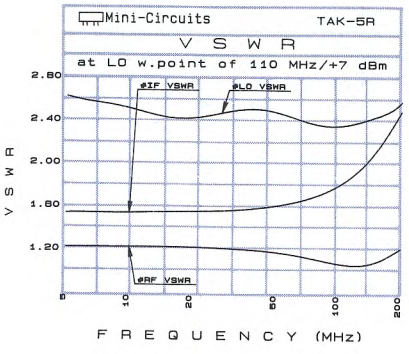
typical performance curves

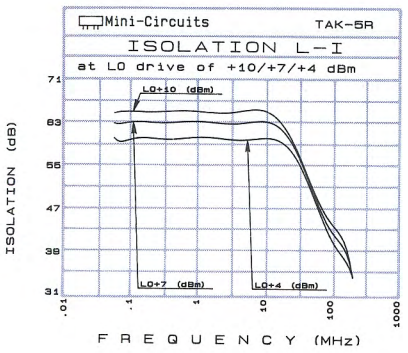
(production unit)

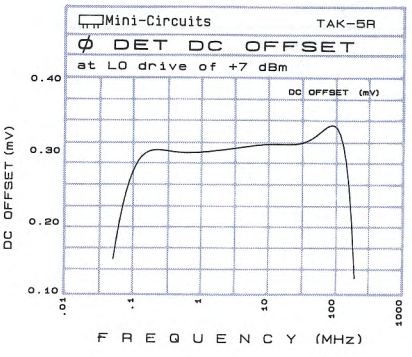












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
TAK-6
TAK-6R

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R* (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.500	30.50	7.80	7.38	7.11	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
1.000	31.00	7.13	6.75	6.47	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
2.000	32.00	6.54	6.13	5.93	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
5.000	35.00	5.88	5.55	5.38	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	> 70.00
10.000	40.00	5.87	5.53	5.32	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	64.95
20.000	50.00	5.94	5.57	5.35	> 64.00	61.27	58.83	> 64.00	58.72	56.92
40.466	70.47	5.89	5.59	5.39	55.07	53.48	52.39	53.40	51.73	50.74
60.449	90.45	5.77	5.51	5.39	51.05	49.77	48.80	49.58	48.51	47.29
100.000	70.00	5.71	5.45	5.32	46.67	45.73	44.75	45.85	44.74	43.77
140.380	110.38	5.66	5.45	5.33	44.05	42.94	42.16	43.49	42.35	41.44
200.000	170.00	5.83	5.64	5.55	41.47	40.43	39.65	40.97	39.87	38.88
240.300	210.30	5.86	5.67	5.55	39.57	38.69	37.99	38.96	38.10	37.46
280.260	250.26	5.78	5.58	5.48	39.59	38.77	37.90	38.36	37.77	36.85
360.190	330.19	6.25	5.95	5.80	36.88	36.13	35.65	35.82	35.08	34.54
400.160	370.16	6.12	5.94	5.87	36.06	36.07	35.61	34.62	34.75	34.34
480.090	450.09	6.72	6.48	6.32	34.66	35.09	35.31	30.47	31.56	32.60
500.080	470.08	6.83	6.59	6.37	34.63	34.94	35.60	29.91	30.74	32.08
540.040	510.04	6.80	6.43	6.19	35.64	35.12	35.58	30.37	30.07	31.01
580.010	550.01	6.93	6.37	6.03	37.16	36.24	35.75	32.15	31.22	30.63
600.000	570.00	7.13	6.51	6.16	37.47	36.75	35.81	33.00	32.22	31.07

*TAK 6R Selected for 40 dB min.

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.19	1.26	1.30	1.88	2.80	4.21	1.49	1.31	1.21
10.000	1.10	1.18	1.24	1.84	2.76	3.86	1.50	1.32	1.21
20.000	1.06	1.16	1.22	1.78	2.60	3.83	1.50	1.32	1.21
41.061	1.07	1.18	1.24	1.89	2.87	3.95	1.49	1.32	1.22
59.091	1.08	1.18	1.24	1.83	2.55	3.65	1.51	1.36	1.25
100.000	1.08	1.18	1.24	1.74	2.50	3.42	1.56	1.39	1.29
149.240	1.09	1.18	1.25	1.76	2.48	3.50	1.66	1.44	1.34
200.000	1.10	1.18	1.24	1.78	2.46	3.33	1.78	1.51	1.41
239.390	1.12	1.19	1.25	1.79	2.48	3.36	1.89	1.60	1.49
257.420	1.13	1.19	1.25	1.79	2.51	3.36	1.95	1.61	1.50
275.450	1.15	1.20	1.27	1.82	2.49	3.35	2.00	1.75	1.63
311.520	1.18	1.23	1.31	1.83	2.50	3.24	1.94	1.94	1.80
347.580	1.23	1.28	1.35	1.89	2.51	3.21	2.25	2.02	1.87
365.610	1.26	1.31	1.38	1.92	2.58	3.26	2.31	2.07	1.92
401.670	1.32	1.36	1.44	1.96	2.63	3.30	2.42	2.18	2.02
455.760	1.41	1.49	1.58	2.03	2.66	3.42	2.61	2.40	2.21
500.000	1.50	1.52	1.61	2.19	2.72	3.45	2.76	2.42	2.25
545.910	1.55	1.61	1.69	2.32	2.90	3.70	2.82	2.51	2.36
581.970	1.58	1.66	1.73	2.45	3.09	3.90	2.87	2.58	2.42
600.000	1.58	1.67	1.73	2.45	3.11	3.91	2.85	2.57	2.41

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
.500	−220.38	−.13
1.000	−221.24	−.14
2.000	−223.15	−.14
5.000	−226.12	−.14
10.000	−228.13	−.13
20.000	−226.19	−.13
40.466	−224.88	−.12
60.449	−225.86	−.11
100.000	−229.17	−.07
140.380	−233.40	+0.00
200.000	−229.89	+.10
240.300	−234.97	+.11
280.260	−236.33	+.34
360.190	−211.20	+.48
400.160	−197.76	+.52
480.090	−211.70	+.79
500.080	−209.44	+1.00
540.040	−192.55	+1.09
580.010	−170.60	+1.36
600.000	−164.18	+1.25

Measurements at RF & LO Power +7 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	45	32	47	41	52	40	53	41	62
1	–	25	–	37	11	44	19	56	24	43	32	49
2	83	76	53	74	53	72	51	70	53	65	57	62
3	95	56	46	59	48	63	51	64	47	58	46	71
4	>97	78	77	79	79	77	77	75	71	75	68	78
5	>96	77	73	76	72	74	63	73	59	74	57	83
6	>96	>87	76	>86	78	>86	82	>85	>87	>87	84	>86
7	>96	85	76	>85	77	>84	82	84	80	85	73	82
8	>95	>85	>85	>87	>85	>86	>85	>86	>85	>85	>85	>87
9	>97	>86	>86	>86	84	>86	82	>85	86	>86	>86	>87
10	>95	>85	>85	>86	>86	>85	>85	>86	>86	>86	>86	88

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −4.03 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 7.03 DBM
IF=MEASURED: FREQ.30.09 AMP.=−10 DBM

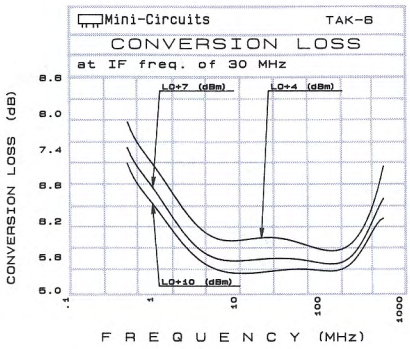
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	18	33	20	34	28	36	27	39	26	49
1	–	24	–	38	11	43	18	49	22	40	30	43
2	>96	>77	63	77	63	72	60	70	59	69	59	75
3	>96	74	64	>75	>75	>77	68	>75	64	>74	61	74
4	>95	>76	>75	76	>76	>76	>76	>76	>75	>75	>75	>77
5	>95	>76	>75	>77	>76	>76	>75	>76	>76	>75	>77	>74
6	>95	>77	>76	>77	>75	>75	>76	>76	>75	>76	>75	>75
7	>96	>76	>75	>74	>75	>75	>76	>75	>76	>75	>75	>74
8	>95	>75	>75	>77	>75	>75	>77	>75	>76	>76	>78	>76
9	>94	>75	>76	>76	>74	>75	>75	>75	>75	>76	>75	>75
10	>95	>76	>75	>76	>75	>75	>75	>76	>76	>75	>76	>74

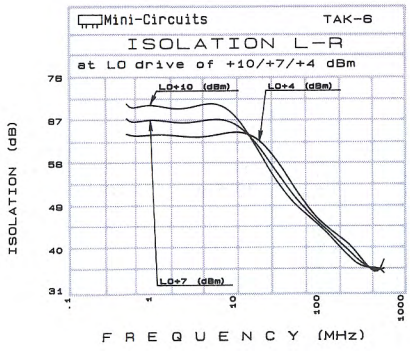
Harmonic LO Order

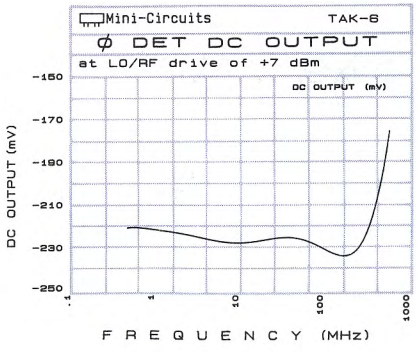
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −14 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 7.02 DBM
IF=MEASURED: FREQ.30.09 AMP.=−19.99 DBM

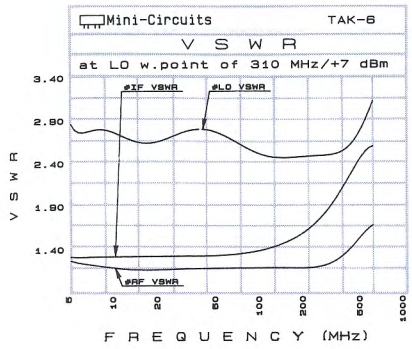
typical performance curves

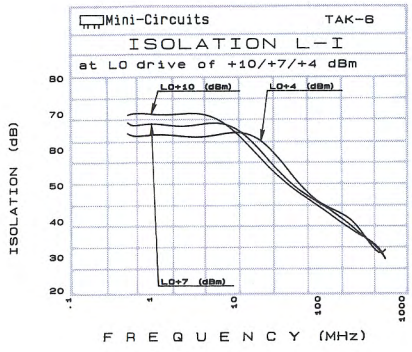
(production unit)

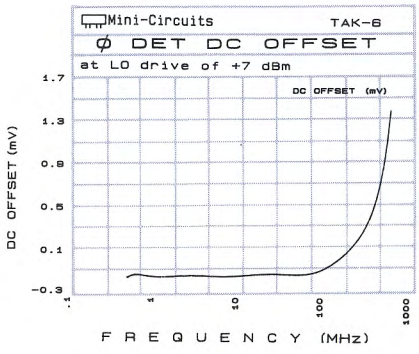












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

GRA-1
SRA-1
SRA-1 TX
ZLW-1
ZAD-1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.500	30.50	7.78	7.29	7.01	>64.00	>67.00	64.94	>64.00	>67.00	56.93
1.000	31.00	7.34	6.89	6.61	>64.00	>67.00	63.22	>64.00	62.73	56.27
2.000	32.00	6.97	6.49	6.20	>64.00	>67.00	61.14	>64.00	61.28	55.71
5.000	35.00	6.39	6.01	5.80	>64.00	>67.00	60.28	>64.00	60.55	55.46
10.000	40.00	6.40	5.99	5.75	>64.00	>67.00	59.63	>64.00	59.37	55.25
20.000	50.00	6.46	6.02	5.75	>64.00	>67.00	58.89	>64.00	59.08	55.09
32.726	62.73	6.37	5.96	5.74	>64.00	59.27	56.91	>64.00	57.92	54.20
50.000	80.00	6.28	5.91	5.71	58.05	56.01	54.48	>64.00	56.08	53.11
64.952	94.95	6.22	5.87	5.64	54.46	53.83	52.86	57.32	54.11	51.72
100.000	70.00	6.13	5.81	5.66	50.35	49.90	48.91	51.33	49.45	47.96
161.630	131.63	6.13	5.84	5.70	45.29	44.60	44.03	44.16	43.60	43.25
200.000	170.00	6.27	5.99	5.82	42.19	41.47	41.29	41.32	40.82	40.93
226.080	196.08	6.26	5.95	5.75	41.04	40.62	40.68	39.98	39.96	40.20
258.310	228.31	6.19	5.89	5.72	39.93	39.44	39.63	38.30	37.84	38.74
306.650	276.65	6.26	5.99	5.84	36.83	37.26	37.70	35.84	36.42	36.87
354.990	324.99	6.57	6.23	6.05	34.24	34.94	35.71	33.81	34.34	35.10
403.330	373.33	6.74	6.32	6.07	33.60	33.70	34.26	33.74	33.77	34.23
451.660	421.66	7.29	6.68	6.25	33.90	33.66	34.10	34.38	33.23	33.15
483.890	453.89	7.77	7.17	6.69	33.99	34.17	34.71	34.99	34.46	34.37
500.000	470.00	7.86	7.25	6.77	34.23	34.51	35.08	34.62	34.41	34.36

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.22	1.21	1.25	1.36	1.98	2.99	1.47	1.28	1.16
17.692	1.12	1.03	1.09	1.29	1.93	2.84	1.48	1.29	1.17
30.384	1.10	1.02	1.09	1.30	1.96	2.82	1.48	1.30	1.18
55.768	1.11	1.06	1.12	1.27	1.86	2.69	1.50	1.32	1.21
81.152	1.12	1.10	1.14	1.25	1.83	2.61	1.53	1.35	1.25
106.540	1.14	1.13	1.17	1.28	1.87	2.68	1.58	1.40	1.30
119.230	1.16	1.15	1.19	1.29	1.88	2.67	1.60	1.43	1.33
144.610	1.19	1.19	1.23	1.31	1.91	2.63	1.69	1.52	1.42
170.000	1.22	1.23	1.26	1.32	1.91	2.59	1.73	1.54	1.43
208.070	1.28	1.29	1.33	1.35	1.92	2.62	1.86	1.66	1.54
233.460	1.33	1.35	1.38	1.39	1.91	2.59	1.96	1.74	1.62
271.530	1.41	1.42	1.46	1.43	1.99	2.65	2.10	1.88	1.73
296.920	1.47	1.49	1.52	1.48	1.99	2.63	2.18	1.97	1.80
322.300	1.53	1.56	1.58	1.52	1.99	2.66	2.29	2.07	1.90
360.380	1.62	1.65	1.68	1.62	2.03	2.64	2.45	2.19	2.03
398.450	1.73	1.74	1.77	1.73	2.16	2.72	2.59	2.33	2.13
423.840	1.80	1.81	1.83	1.77	2.20	2.83	2.65	2.40	2.20
461.910	1.92	1.93	1.94	1.80	2.27	2.90	2.76	2.49	2.29
487.300	1.99	2.00	2.00	1.82	2.25	2.87	2.81	2.53	2.32
500.000	2.03	2.03	2.02	1.83	2.26	2.86	2.79	2.55	2.33

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
10.000	−270.82	−.24
20.000	−267.82	−.23
24.000	−264.99	−.21
50.000	−261.17	−.19
80.000	−263.77	−.16
100.000	−264.35	−.15
122.000	−267.69	−.12
150.000	−263.45	−.11
178.000	−262.10	−.07
200.000	−261.22	−.13
248.000	−265.76	−.10
276.000	−270.40	−.18
304.000	−266.94	−.26
332.000	−249.96	−.23
360.000	−231.15	−.47
388.000	−211.89	−.18
430.000	−189.53	−.45
458.000	−184.41	−.03
486.000	−184.46	−.13
500.000	−181.27	−.33

Measurements at RF & LO Power +7 dBm

Mini-Circuits™
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800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>94	–	36	51	42	61	42	60	58	62	54	72
1	>94	23	–	39	12	46	22	51	35	56	48	72
2	74	68	54	71	55	73	55	74	55	64	50	77
3	81	47	41	49	40	53	42	55	42	56	44	64
4	>94	73	75	76	71	77	67	76	66	76	62	75
5	>94	70	66	67	52	71	49	66	49	71	52	65
6	>94	84	77	>86	>86	>86	81	>86	82	84	82	83
7	>94	83	65	79	65	78	75	76	60	77	55	73
8	>94	86	85	>88	81	>86	>86	>86	>86	>86	84	>86
9	93	87	84	86	80	82	73	85	75	86	84	78
10	>93	>87	>87	86	>87	>88	>88	>86	>86	>86	>86	>86

Harmonic LO Order

test conditions: RF = 185.100 MHZ INPUT P. = +0.00DBM
LO = 155.010 MHZ INPUT P. = +6.92DBM
IF = 30.090 MHZ IF AMPLIT. = −6.18 DBM

RF ORDER HARMONIC

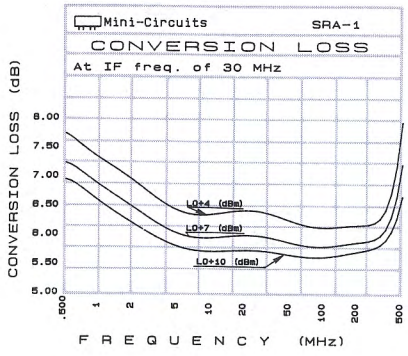
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>84	–	28	42	28	52	27	43	30	48	35	48
1	>84	22	–	36	13	40	21	47	30	44	36	49
2	82	75	60	76	60	73	59	73	58	69	49	69
3	>84	65	62	67	66	69	56	73	55	69	53	68
4	>84	>76	>76	>76	>76	>76	>76	>76	>76	>76	>76	>76
5	>84	>76	>76	>76	>76	>76	>76	>76	>76	>76	>76	>76
6	>84	>78	>76	>76	>76	>76	>76	>76	>76	>76	>76	>76
7	84	>78	>78	>76	>76	>76	>76	>76	>76	>76	>76	>76
8	>84	>78	>78	78	>78	>76	>76	>76	>76	>76	>76	>76
9	82	77	>78	>78	>78	>78	>76	>76	>76	>76	>76	>76
10	>82	>76	78	78	>78	78	>78	>76	>76	>76	>76	>76

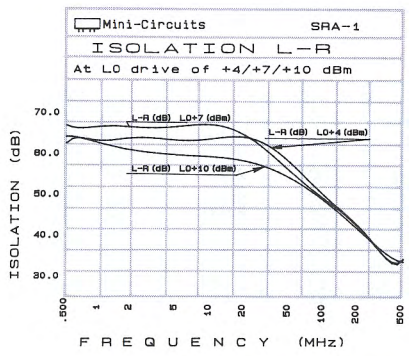
Harmonic LO Order

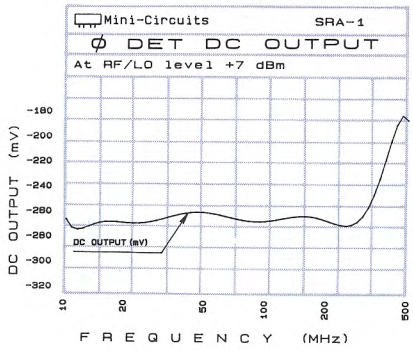
test conditions: RF = 185.100 MHZ INPUT P. = −9.96DBM
LO = 155.010 MHZ INPUT P. = +6.92DBM
IF = 30.090 MHZ IF AMPLIT. = −15.97 DBM

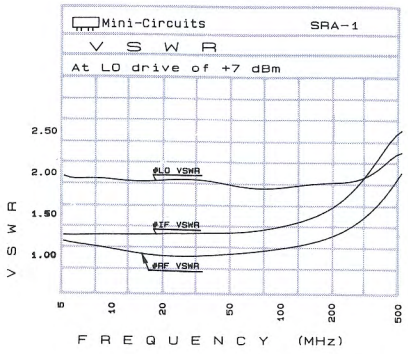
typical performance curves

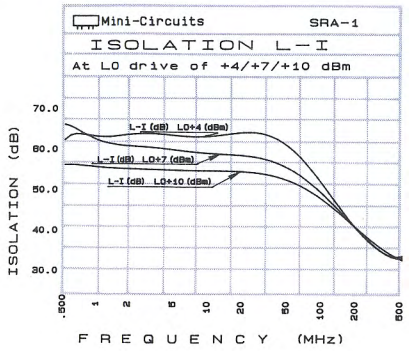
(production unit)

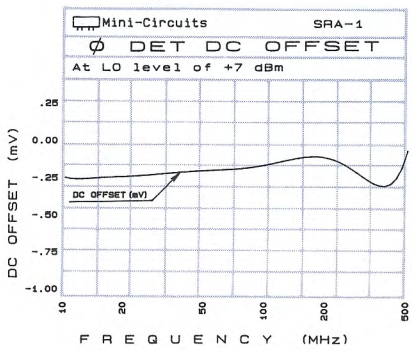












broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
TFM-42MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
10.000	40.00	8.64	7.94	7.54	18.19	20.28	22.57	19.61	21.61	23.35
20.000	50.00	8.30	7.65	7.31	25.45	27.98	30.94	25.92	29.30	32.49
200.000	170.00	7.88	7.32	6.98	29.33	31.88	34.29	28.39	32.33	35.67
295.000	265.00	8.19	7.53	7.19	30.92	32.40	33.59	30.16	33.77	35.29
500.000	470.00	8.43	7.77	7.34	31.53	31.96	32.27	32.61	33.79	32.15
722.500	692.50	8.33	7.70	7.30	32.12	32.05	31.65	35.16	32.52	29.62
1000.000	970.00	8.38	7.67	7.30	33.21	32.59	32.12	33.86	29.95	27.43
1150.000	1120.00	8.23	7.63	7.22	34.18	32.84	31.97	32.53	29.21	27.20
1435.000	1405.00	7.47	6.82	6.74	36.72	35.06	33.31	29.77	28.00	26.61
1577.500	1547.50	8.16	7.65	7.33	36.83	34.54	33.27	28.80	27.23	26.18
1862.500	1832.50	8.40	7.75	7.26	36.46	36.03	34.57	27.76	27.46	27.11
2005.000	1975.00	9.29	8.44	7.82	33.40	34.15	33.90	28.29	27.88	27.48
2290.000	2260.00	9.55	8.70	8.09	30.39	30.53	29.93	30.46	30.66	30.60
2500.000	2470.00	9.46	8.40	7.70	30.63	31.06	31.31	30.79	30.74	30.57
2717.500	2687.50	9.39	8.50	8.04	28.65	29.50	30.35	31.68	31.68	31.79
3000.000	2970.00	8.82	8.07	7.70	31.97	33.65	35.18	33.28	32.53	30.30
3145.000	3115.00	8.32	7.62	7.29	33.92	33.58	32.04	31.80	31.08	28.62
3500.000	3470.00	8.17	7.57	7.22	30.85	32.49	33.79	25.95	26.48	26.09
3857.500	3827.50	8.39	7.73	7.28	27.55	28.41	29.15	23.47	24.34	24.47
4200.000	4170.00	9.47	8.84	8.30	26.82	29.31	31.59	23.38	25.00	26.18

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
10.000	2.38	2.29	2.17	2.27	2.30	2.86	1.42	1.62	1.69
50.000	1.53	1.39	1.34	1.27	1.76	2.55	1.20	1.21	1.27
152.500	1.57	1.38	1.32	1.08	1.54	2.26	1.21	1.11	1.18
295.000	1.68	1.48	1.41	1.07	1.47	2.10	1.18	1.11	1.20
500.000	1.86	1.65	1.57	1.14	1.42	1.97	1.09	1.17	1.27
722.500	2.09	1.88	1.79	1.23	1.42	1.91	1.01	1.26	1.35
1000.000	2.33	2.09	1.99	1.18	1.45	1.87	1.14	1.37	1.47
1150.000	2.42	2.18	2.13	1.24	1.37	1.81	1.22	1.43	1.55
1435.000	2.41	2.18	2.10	1.29	1.47	1.92	1.35	1.53	1.65
1577.500	2.31	2.08	2.05	1.30	1.58	2.02	1.38	1.53	1.65
1862.500	2.15	1.96	1.88	1.47	1.73	2.11	1.42	1.50	1.56
2005.000	2.17	2.05	2.03	1.59	1.95	2.30	1.61	1.78	1.89
2290.000	2.72	2.44	2.34	1.92	2.32	2.42	1.74	1.59	1.59
2500.000	3.07	2.78	2.75	2.17	2.05	2.17	2.13	1.84	1.84
2717.500	3.50	3.21	3.04	2.45	2.02	1.99	2.53	2.28	2.11
3000.000	3.60	3.16	3.18	2.21	1.58	1.53	2.44	2.20	2.20
3145.000	3.55	3.37	3.06	1.92	1.34	1.27	2.35	2.13	2.06
3500.000	3.90	3.33	2.98	1.34	1.23	1.36	2.33	2.37	2.37
3857.500	2.25	2.13	1.89	1.62	1.96	2.09	2.78	2.60	2.52
4200.000	1.27	1.19	1.11	1.99	2.35	2.96	3.26	3.86	4.12

ϕ detection

max. output/DC offset vs. freq. freq. (MHz)	max. DC output mV	DC offset mv
10.000	+255.94	−5.40
50.000	+278.74	−.68
148.000	+279.98	−.89
286.000	+294.67	−1.09
500.000	+215.17	+.07
700.000	+278.98	+1.05
1000.000	+229.74	+2.23
1187.500	+202.77	+3.42
1500.000	+257.06	+3.60
1675.000	+203.10	+6.74
1837.500	+210.00	+6.38
2000.000	+206.74	+7.15
2333.300	+214.80	+6.57
2500.000	+208.74	+5.99
2666.700	+233.75	+5.29
3000.000	+227.73	12.42
3166.700	+233.01	+7.84
3500.000	+216.25	+1.65
3833.300	+154.35	+2.91
4200.000	+123.50	+4.20

Measurements at RF & LO Power +13 dBm

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Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	11	24	23	27	41	37	44	38	43	47
1	–	21	–	31	16	40	30	37	40	52	33	58
2	63	53	44	48	46	47	49	44	48	54	50	44
3	>94	55	45	54	47	50	46	52	48	59	58	58
4	>95	66	65	63	64	61	61	60	60	71	62	64
5	>94	77	73	82	71	78	71	74	69	73	72	68
6	>90	>81	>84	>86	>83	>88	79	>88	77	81	76	>87
7	>88	>80	>82	>88	>87	>87	>86	>87	>88	>86	>87	>82
8	>88	>81	>81	>81	>87	>86	>86	>86	>87	>88	>88	>86
9	>89	>81	>81	>80	>81	>86	>88	>86	>86	>87	>88	>88
10	>89	>80	>81	>81	>80	>82	>87	>88	>86	>86	>88	>87

Harmonic LO Order

test conditions: RF. IN: FREQ.990.1006 MHZ DRIVE .06 DBM
LO. IN: FREQ.960.0069 MHZ DRIVE 12.91 DBM
IF MEASURED: FREQ.30.0941 MHZ AMP. −8.01 DBM

RF ORDER HARMONIC

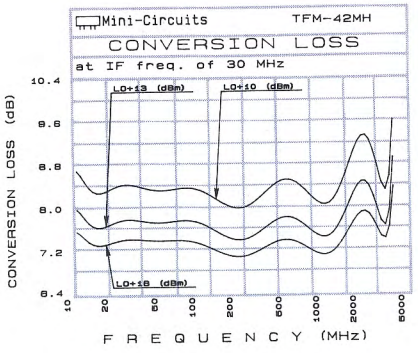
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	1	17	12	16	32	23	33	21	28	31
1	–	22	–	31	20	37	24	36	34	50	30	49
2	83	72	56	53	61	53	57	51	55	54	53	49
3	>93	73	69	74	60	73	61	74	64	74	71	>69
4	>95	>75	>75	>77	>78	>77	>76	>77	>74	>76	>75	>76
5	>95	>76	>76	>74	>77	>76	>76	>77	>76	>75	>75	>76
6	>90	>71	>74	>76	>77	>75	>77	>78	>77	>78	>74	>76
7	89	>68	71	>76	>75	>76	>76	>76	>77	>77	>77	>75
8	>89	>69	>69	>72	>76	>76	>76	>76	>77	>78	>77	>77
9	>89	>70	>69	>70	>71	>76	>76	>76	>74	>77	>77	>77
10	88	>72	>70	>70	>70	>71	>76	>75	>77	>76	>77	>78

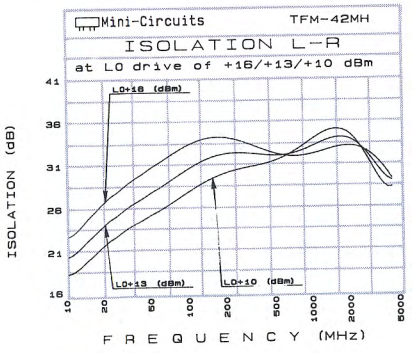
Harmonic LO Order

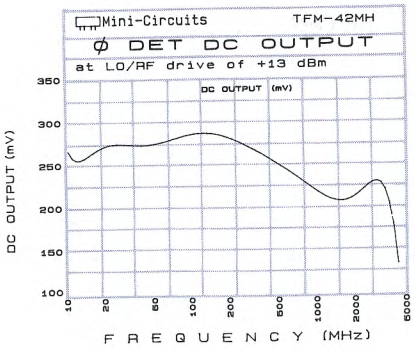
test conditions: RF. IN: FREQ.990.1007 MHZ DRIVE −10.01 DBM
LO. IN: FREQ.960.0069 MHZ DRIVE 12.91 DBM
IF MEASURED: FREQ.30.0939 MHZ AMP. −18.71 DBM

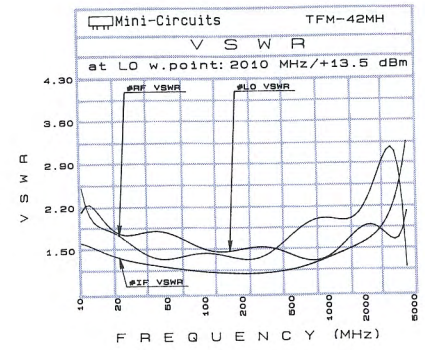
typical performance curves

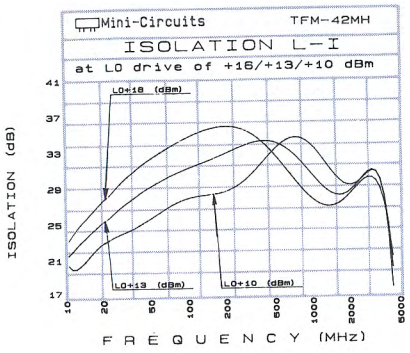
(production unit)

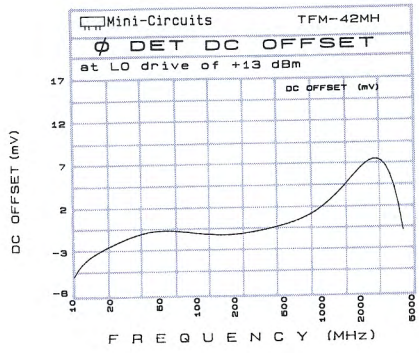












most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model SRA-2CM

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	7.75	7.36	7.16	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
38.133	68.13	5.84	5.59	5.49	56.05	54.82	54.04	54.35	53.34	52.98
71.266	41.27	5.54	5.30	5.22	50.40	49.15	48.69	49.20	48.13	47.93
137.530	107.53	5.50	5.33	5.28	46.96	46.10	45.62	45.97	45.22	45.20
200.000	170.00	5.52	5.35	5.27	43.52	42.68	42.28	42.30	41.91	41.97
236.930	206.93	5.46	5.27	5.21	41.88	41.09	40.58	40.59	40.29	40.32
303.200	273.20	5.46	5.28	5.20	39.83	39.42	39.20	38.94	38.94	39.35
336.330	306.33	5.57	5.42	5.31	40.07	39.72	39.32	36.53	36.88	37.57
402.600	372.60	5.88	5.63	5.54	38.76	38.13	37.74	35.41	35.49	36.02
468.860	438.86	5.87	5.62	5.54	36.36	37.15	37.25	34.20	35.09	36.00
535.130	505.13	6.19	5.87	5.72	34.59	35.49	36.19	31.24	32.57	34.19
568.260	538.26	6.56	6.01	5.77	34.55	35.26	36.09	30.16	31.27	32.93
634.530	604.53	7.22	6.17	5.57	36.21	36.03	36.59	29.26	29.46	30.74
700.790	670.79	7.51	6.68	5.99	37.17	38.00	38.67	29.58	30.29	31.32
767.060	737.06	7.37	6.49	5.85	36.88	38.00	39.61	28.98	29.92	31.27
800.190	770.19	6.81	6.11	5.78	37.47	39.26	41.53	28.01	28.34	29.27
833.330	803.33	6.88	6.37	6.22	37.91	39.87	41.80	27.20	27.52	28.51
899.590	869.59	7.04	6.80	6.81	38.42	40.23	41.59	26.73	26.99	27.39
965.860	935.86	7.10	6.86	6.82	40.37	42.61	43.57	26.04	25.65	25.38
1000.000	969.00	7.31	7.10	7.06	43.89	44.90	42.74	24.72	24.17	23.59

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	5.30	5.03	4.68	3.65	4.09	5.51	1.83	1.48	1.30
36.063	1.33	1.40	1.48	2.11	3.04	4.34	1.83	1.50	1.31
67.126	1.23	1.31	1.39	2.01	2.99	4.22	1.84	1.51	1.33
100.000	1.20	1.27	1.35	1.94	2.83	3.86	1.88	1.55	1.37
160.320	1.19	1.24	1.31	1.95	2.82	3.82	1.96	1.64	1.46
200.000	1.20	1.24	1.29	1.94	2.72	3.62	2.04	1.74	1.54
253.500	1.23	1.24	1.27	1.99	2.76	3.57	2.17	1.82	1.65
315.630	1.28	1.26	1.26	2.03	2.77	3.54	2.29	1.94	1.75
377.760	1.35	1.30	1.27	2.15	2.85	3.65	2.39	2.03	1.84
439.880	1.44	1.37	1.31	2.18	2.84	3.56	2.41	2.07	1.88
500.000	1.54	1.45	1.37	2.35	2.97	3.69	2.40	2.04	1.84
533.070	1.61	1.50	1.42	2.41	2.96	3.66	2.38	2.02	1.81
595.200	1.72	1.61	1.52	2.54	3.10	3.84	2.18	1.90	1.76
657.320	1.83	1.70	1.63	2.58	3.21	3.86	2.15	1.86	1.67
719.450	1.99	1.85	1.78	2.58	3.09	3.86	2.06	1.82	1.66
781.580	2.17	2.01	1.93	2.54	3.03	3.86	1.87	1.69	1.55
812.640	2.25	2.08	2.02	2.59	3.08	3.86	1.75	1.59	1.47
874.760	2.46	2.32	2.22	2.85	3.39	3.95	1.57	1.44	1.38
936.890	2.73	2.53	2.43	3.17	3.58	4.10	1.49	1.44	1.47
1000.000	2.93	2.76	2.64	3.48	3.76	4.27	1.58	1.63	1.73

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
5.000	−223.58	+.09
36.094	−231.75	+.08
67.188	−233.00	+.07
100.000	−236.12	+.10
160.470	−238.09	+.21
200.000	−236.09	+.29
253.750	−239.55	+.26
315.940	−224.28	+.60
378.130	−205.13	+.77
440.320	−196.55	+.48
500.000	−212.68	+1.14
533.600	−200.87	+1.45
595.790	−160.67	+1.44
657.970	−154.37	+1.02
720.160	−144.12	+.56
782.350	−133.92	+1.88
813.440	−142.24	+2.68
875.630	−155.17	+3.99
937.820	−142.49	+3.65
1000.000	−133.44	+4.19

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS
5-YR. GUARANTEE ✱

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90°	–	17	30	25	48	31	66	65	66	58	78
1	>90°	14	–	35	11	40	35	41	47	59	66	66
2	81°	51	46	53	48	59	53	58	46	72	77	77
3	86°	52	44	48	36	56	38	53	51	50	56	66
4	83°	73	70	70	57	60	52	64	65	76	63	79
5	84°	68	57	79	57	53	54	59	49	63	66	64
6	85°	79	78	78	76	74	63	75	66	78	76	79
7	86°	79	79	76	66	79	71	74	65	67	65	76
8	86°	80	79	80	76	78	>83	>84	75	82	>82	>82
9	85°	80	79	79	79	77	74	>83	79	76	75	80
10	86°	80	79	78	78	78	78	79	>83	>84	>82	>82

Harmonic LO Order

test conditions: RF 550.100 MHZ INPUT P. −4.01DBM
LO 520.010 MHZ INPUT P. +6.83DBM
IF= 30.090MHZ IF AMPLIT. −10.22 DBM

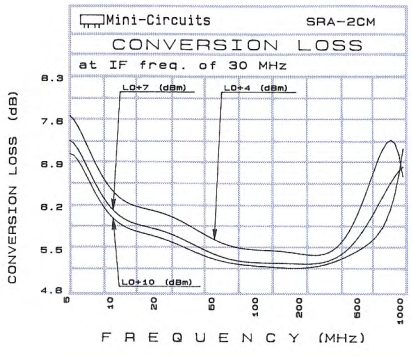
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>81	–	7	20	15	40	20	50	51	52	44	62
1	>81	14	–	34	10	36	31	35	40	52	60	57
2	>81	61	67	59	55	66	60	64	55	69	70	69
3	>81	70	68	64	62	63	57	70	>73	66	68	70
4	81	68	>74	>74	>73	>73	>72	>72	>74	>73	68	69
5	>81	69	68	>74	>74	>73	>73	>72	>72	>74	>73	68
6	>81	68	69	68	>74	73	>73	>73	>72	>72	74	>73
7	>81	68	69	68	68	>73	>74	>73	>73	>72	>72	>74
8	>81	69	69	70	69	68	>73	74	>72	>73	>72	>72
9	>81	69	69	69	70	69	68	>73	>74	>72	>72	>73
10	>80	70	70	68	70	70	68	69	>73	>74	>72	>72

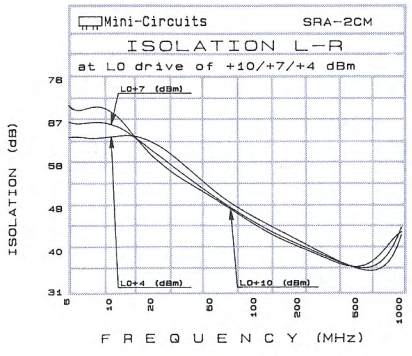
Harmonic LO Order

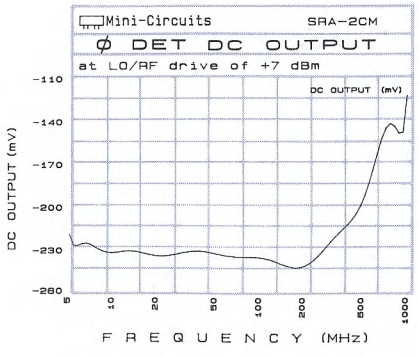
test conditions: RF 550.100 MHZ INPUT P. −14.04DBM
LO 520.010 MHZ INPUT P. +6.83DBM
IF= 30.090MHZ IF AMPLIT. −20.08 DBM

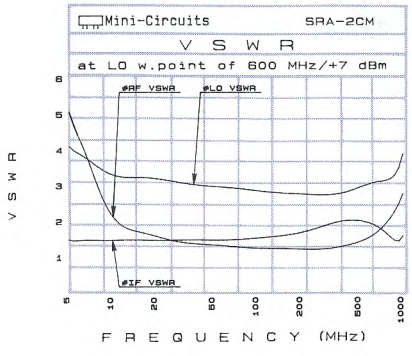
typical performance curves

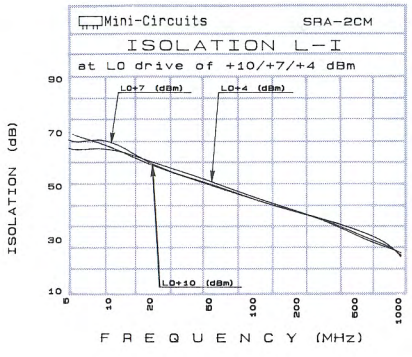
(production unit)

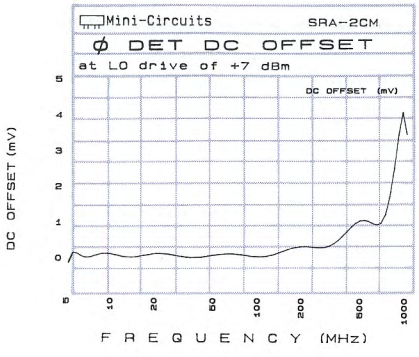












In Stock...Immediate Delivery

broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
SRA-2010MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
10.000	40.00	6.31	6.24	6.17	61.07	61.45	62.30	58.79	59.82	60.28
20.000	50.00	6.39	6.20	6.07	55.33	55.00	54.83	54.26	54.21	54.34
138.390	108.39	6.75	6.51	6.39	50.42	49.69	49.22	50.45	49.89	49.44
266.770	236.77	7.19	6.85	6.62	44.67	44.01	43.31	44.96	44.00	43.58
330.970	300.97	7.83	7.32	6.76	42.52	41.56	40.90	41.60	40.89	40.34
395.160	365.16	8.10	7.23	6.67	39.75	38.14	37.51	38.45	37.11	36.32
523.550	493.55	8.63	7.43	6.88	38.00	36.37	36.04	37.78	35.38	34.72
651.940	621.94	8.81	7.64	7.04	35.41	35.08	34.87	35.15	33.80	33.30
716.130	686.13	8.71	7.86	7.25	32.94	32.75	32.61	32.38	31.76	31.27
908.710	878.71	7.87	7.61	7.49	31.39	31.68	31.95	26.02	26.34	26.42
1000.000	970.00	7.20	6.95	6.81	36.08	35.00	33.84	27.79	28.22	28.37
1101.300	1071.30	7.10	6.76	6.65	34.58	34.66	33.60	28.94	29.26	29.12
1200.000	1170.00	7.30	6.90	6.74	31.34	31.53	31.53	27.34	27.67	27.34
1293.900	1263.90	7.83	7.26	6.96	29.22	29.55	30.14	26.28	26.63	26.48
1422.300	1392.30	8.39	7.65	7.07	26.99	27.31	27.59	23.72	24.03	23.75
1500.000	1470.00	8.44	7.45	7.11	27.94	28.63	29.48	32.24	32.27	32.18
1614.800	1584.80	8.66	7.77	7.34	30.41	31.09	31.26	40.71	40.59	39.77
1743.200	1713.20	8.27	7.62	7.23	32.17	32.79	32.98	32.86	33.64	34.77
1871.600	1841.60	8.05	7.54	7.10	30.21	30.56	30.25	28.32	29.04	29.30
2000.000	1970.00	7.75	7.25	7.04	26.62	27.05	27.53	22.69	23.55	24.27

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
10.000	3.18	2.94	2.75	1.48	2.22	3.37	1.81	1.85	1.87
50.000	4.25	3.81	3.59	1.32	2.10	3.54	1.28	1.38	1.44
100.000	4.57	4.09	3.84	1.31	2.11	3.27	1.24	1.33	1.38
200.000	4.66	4.33	4.23	1.32	1.93	2.70	1.21	1.27	1.33
266.770	4.86	4.45	4.37	1.37	1.96	2.62	1.24	1.28	1.32
395.160	4.47	4.45	4.43	1.44	1.88	2.50	1.35	1.35	1.37
500.000	4.16	4.13	4.06	1.46	1.82	2.37	1.47	1.46	1.48
587.740	3.50	3.56	3.63	1.45	1.74	2.29	1.60	1.62	1.68
716.130	3.07	3.11	3.17	1.50	1.67	2.14	1.88	2.09	2.18
844.520	2.82	2.84	2.78	1.70	1.69	2.15	2.45	2.80	2.87
972.900	2.45	2.37	2.35	1.87	1.63	1.98	3.35	3.66	3.90
1037.100	2.60	2.48	2.39	1.84	1.62	1.93	3.93	4.34	4.15
1165.500	2.19	1.97	1.86	1.95	1.55	1.82	4.75	5.14	4.98
1229.700	2.12	1.89	1.76	1.97	1.49	1.70	4.77	5.33	5.17
1358.100	2.16	1.90	1.75	2.01	1.40	1.62	3.46	3.75	3.69
1486.500	2.53	2.39	2.29	1.85	1.31	1.65	14.74	17.39	17.39
1550.600	2.71	2.58	2.44	1.77	1.26	1.57	15.67	17.39	17.39
1679.000	2.93	2.78	2.73	1.62	1.18	1.57	16.26	13.60	13.81
1807.400	3.10	2.99	2.98	1.53	1.11	1.62	15.00	14.87	14.38
2000.000	3.59	3.30	3.21	1.28	1.20	1.70	13.60	13.19	12.44

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EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	34	20	37	37	50	42	64	54	54
1	–	13	–	32	22	41	37	34	47	37	48	39
2	63	>58	47	>65	46	>68	43	>61	>60	>61	55	>66
3	>95	57	47	55	45	55	49	55	61	54	65	55
4	>96	83	63	73	64	70	59	78	60	75	77	74
5	>94	79	>85	70	76	72	58	67	66	68	70	72
6	>89	>82	>86	>86	72	79	76	76	70	>86	75	>88
7	>88	>81	>81	>86	>87	>87	>88	>89	70	>88	>82	>86
8	>87	>82	>80	>82	>87	>88	>84	>87	>87	>87	80	>87
9	90	>82	>81	>80	>83	>86	>88	>87	>88	>89	81	>87
10	>89	>81	>82	>81	>80	>81	>86	>87	>86	>87	>88	>89

Harmonic LO Order

test conditions: RF. IN: FREQ.990.1006 MHZ DRIVE −.06 DBM
LO. IN: FREQ.960.0066 MHZ DRIVE 12.98 DBM
IF MEASURED: FREQ.30.094 MHZ AMP. −7.7 DBM

RF ORDER HARMONIC

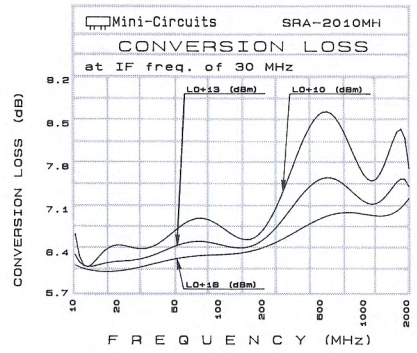
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	23	9	27	25	40	30	50	44	38
1	–	14	–	35	23	46	38	32	46	35	42	35
2	83	63	51	62	49	68	48	68	67	68	61	>70
3	>94	70	65	69	62	70	64	70	74	70	75	70
4	>95	>77	>75	>78	>76	>79	76	78	>77	>78	>77	>78
5	>94	>77	>76	>76	>77	>77	>78	>77	>78	>76	>77	>77
6	>91	>72	>77	>75	>77	>77	>78	>79	>77	>77	>76	>78
7	>88	>70	>72	>76	>75	>77	>76	>78	>78	>78	>79	>76
8	90	>72	>70	>71	>76	>77	>77	>76	>78	>79	>79	>78
9	>89	>72	>70	>70	>70	>76	>77	>77	>77	>78	>79	>77
10	>88	>70	>70	>71	>71	>71	>77	>76	>77	>77	>78	>80

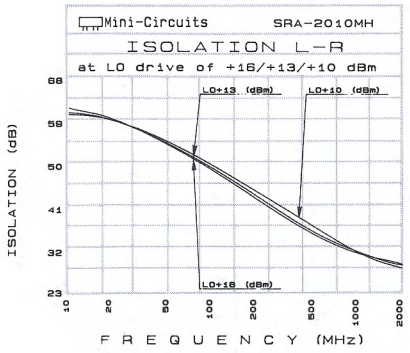
Harmonic LO Order

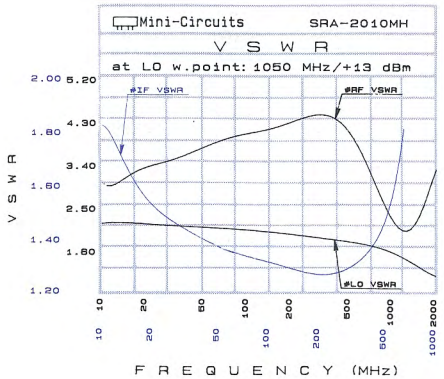
test conditions: RF. IN: FREQ.990.1006 MHZ DRIVE −9.97 DBM TESTED ON :13.5.85
LO. IN: FREQ.960.0066 MHZ DRIVE 12.98 DBM TESTED BY :B.O.
IF MEASURED: FREQ.30.0942 MHZ AMP. −17.61 DBM

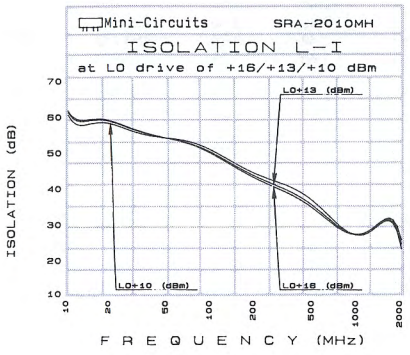
typical performance curves

(production unit)









most widely-used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
ROSE-1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.000	5.67	5.45	5.34	1.000	32.33	34.92	37.55	66.11	67.77	68.84
2.000	32.000	5.46	5.27	5.16	2.000	34.96	37.59	40.14	64.35	65.02	65.10
5.000	35.000	5.26	5.04	4.94	5.000	38.52	41.17	43.73	59.81	59.48	58.85
10.000	40.000	5.31	5.04	4.91	10.000	40.39	42.84	45.20	55.48	54.45	53.88
20.000	50.000	5.29	5.06	4.93	20.000	40.87	42.95	44.78	49.26	48.34	47.81
40.933	70.933	5.60	5.28	5.07	40.933	39.08	40.34	41.16	42.55	41.63	41.28
50.000	80.000	5.38	5.12	5.00	50.000	38.39	39.28	39.86	40.52	39.65	39.38
60.900	90.900	5.45	5.19	5.01	60.900	37.74	38.51	38.94	39.18	38.46	38.21
100.000	70.000	5.43	5.14	4.99	100.000	36.80	36.62	36.21	36.49	35.64	35.20
120.800	90.800	5.38	5.13	4.98	120.800	36.55	36.20	35.67	36.06	35.30	34.77
160.733	130.733	5.28	5.09	4.97	160.733	35.52	34.21	33.38	34.05	33.10	32.47
200.000	170.000	5.27	5.08	4.99	200.000	34.90	32.97	31.92	32.96	31.83	31.06
240.600	210.600	5.37	5.17	5.07	240.600	33.33	31.27	30.28	30.19	29.54	29.23
300.000	270.000	5.46	5.23	5.10	300.000	31.41	29.42	28.34	27.50	27.31	27.24
340.433	310.433	5.48	5.25	5.17	340.433	29.84	27.80	26.75	25.53	25.44	25.47
400.333	370.333	5.46	5.21	5.03	400.333	27.80	26.14	25.34	23.06	23.22	23.44
460.233	430.233	5.66	5.44	5.28	460.233	26.92	25.11	24.08	21.43	21.77	21.89
500.000	470.000	5.74	5.46	5.24	500.000	26.88	25.19	24.13	20.62	21.08	21.38
540.100	510.100	5.90	5.65	5.48	540.100	25.79	24.29	23.34	19.27	19.74	20.07
600.000	570.000	6.34	5.89	5.61	600.000	25.17	24.10	23.51	18.29	19.03	19.67

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. MHz	max. DC output mV	DC offset mV
5.000	1.21	1.14	1.12	1.68	2.49	3.45	5.000	1.47	1.32	1.22	1.000	−242.57	+.16
10.000	1.20	1.11	1.06	1.64	2.42	3.34	10.000	1.48	1.33	1.23	2.000	−243.96	+.17
20.000	1.19	1.09	1.03	1.73	2.55	3.48	20.000	1.48	1.33	1.23	5.000	−247.52	+.18
42.188	1.18	1.08	1.02	1.65	2.46	3.42	42.188	1.48	1.33	1.23	10.000	−246.63	+.19
50.000	1.18	1.08	1.02	1.65	2.46	3.41	50.000	1.48	1.33	1.23	20.000	−244.39	+.24
79.375	1.18	1.08	1.03	1.66	2.44	3.39	79.375	1.50	1.35	1.25	40.933	−242.09	+.35
100.000	1.17	1.08	1.03	1.64	2.41	3.33	100.000	1.51	1.36	1.26	50.000	−242.56	+.32
135.156	1.17	1.08	1.04	1.66	2.42	3.36	135.156	1.55	1.40	1.29	60.900	−241.95	+.23
153.750	1.17	1.08	1.04	1.67	2.43	3.34	153.750	1.57	1.41	1.31	100.000	−244.81	−.31
172.344	1.17	1.08	1.05	1.66	2.40	3.28	172.344	1.59	1.43	1.33	120.800	−244.13	−.63
200.000	1.17	1.08	1.06	1.65	2.36	3.24	200.000	1.62	1.46	1.36	160.733	−244.76	−.48
246.719	1.16	1.08	1.07	1.68	2.40	3.25	246.719	1.68	1.53	1.41	200.000	−240.52	+2.28
265.313	1.16	1.09	1.08	1.65	2.36	3.18	265.313	1.71	1.55	1.44	240.600	−243.88	+3.47
300.000	1.16	1.09	1.09	1.68	2.34	3.14	300.000	1.78	1.61	1.49	300.000	−251.35	+12.43
339.688	1.16	1.11	1.11	1.69	2.37	3.15	339.688	1.83	1.64	1.52	340.433	−241.84	+16.64
395.469	1.17	1.14	1.15	1.74	2.36	3.05	395.469	1.91	1.73	1.59	400.333	−213.57	+15.89
451.250	1.19	1.18	1.20	1.73	2.29	2.93	451.250	1.98	1.79	1.66	460.233	−207.08	+14.31
500.000	1.22	1.22	1.25	1.84	2.40	3.11	500.000	2.04	1.85	1.72	500.000	−205.21	+18.70
544.219	1.26	1.27	1.29	1.90	2.43	3.16	544.219	2.07	1.90	1.77	540.100	−201.66	+29.21
600.000	1.31	1.33	1.36	2.01	2.63	3.41	600.000	2.08	1.93	1.81	600.000	−210.10	+36.97

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	6	9	13	23	12	20	17	30	25	35
1	–	18	+0	32	11	36	18	39	23	36	28	41
2	93	56	47	57	47	53	48	53	46	52	45	56
3	94	72	70	75	69	74	64	>76	62	72	60	71
4	>97	>76	75	>76	>76	75	>76	>76	>76	75	>76	>76
5	95	>76	74	>76	75	>77	>76	>75	>76	>76	>76	75
6	>96	>77	>76	>76	75	>77	>76	>76	75	>76	>76	>76
7	>96	>76	>76	>76	>76	>76	>76	>76	75	>76	>76	>77
8	>96	>76	>76	75	>76	>76	>76	>77	74	>76	>76	75
9	95	>75	>75	75	73	>75	>76	>76	>76	>76	>76	>76
10	>95	>75	75	>76	>75	75	>76	72	>75	>77	>76	>76
		0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −15.04 DBM
LO IN: 155.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −20.23 DBM

RF ORDER HARMONIC

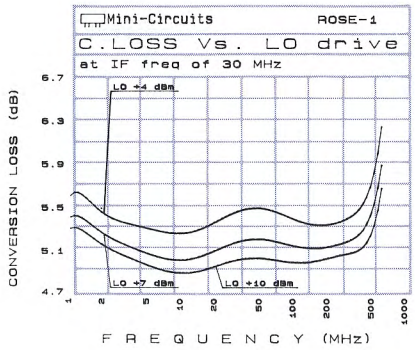
	RF CAL											
0	–	–	15	19	26	35	25	34	33	42	45	50
1	–	18	+0	32	11	37	18	42	24	39	29	44
2	82	49	41	52	42	52	42	51	40	47	42	53
3	>96	53	50	57	58	61	64	63	50	56	48	56
4	>97	79	63	64	60	62	60	58	59	56	56	55
5	>97	67	71	65	62	68	60	67	57	68	55	78
6	>96	84	72	81	72	84	75	80	78	75	80	71
7	>96	80	81	82	82	81	>86	81	80	80	74	82
8	>96	84	82	78	82	79	80	81	85	82	>86	81
9	>96	>85	>86	>86	81	>86	83	>86	>86	83	82	84
10	95	>85	85	>86	85	>85	>85	>86	>86	>86	>86	>86
		0	1	2	3	4	5	6	7	8	9	10

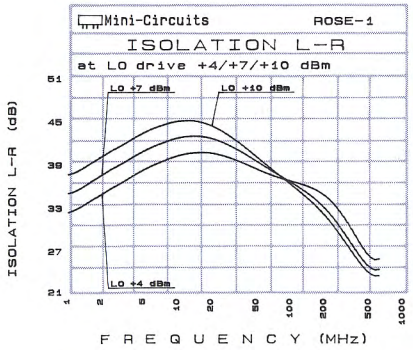
LO Harmonic Order

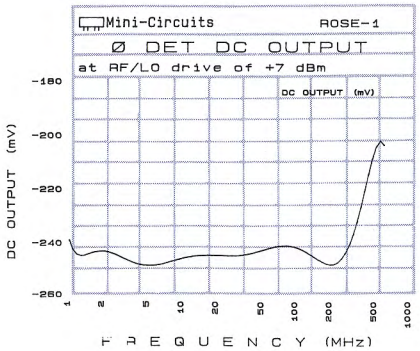
test conditions: RF IN: 185.10 MHZ; −5.02 DBM
LO IN: 155.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −10.14 DBM

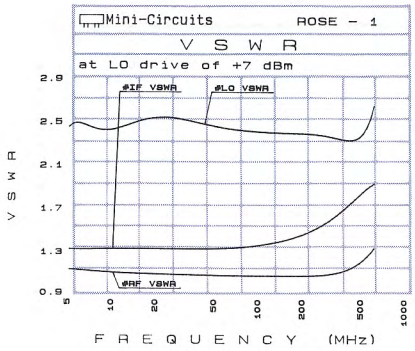
typical performance curves

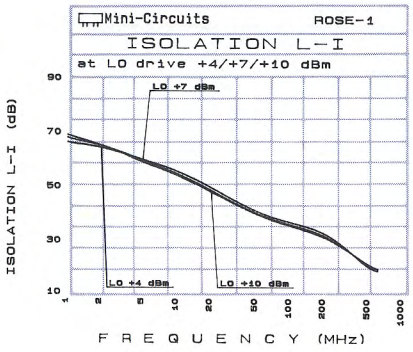
(production unit)

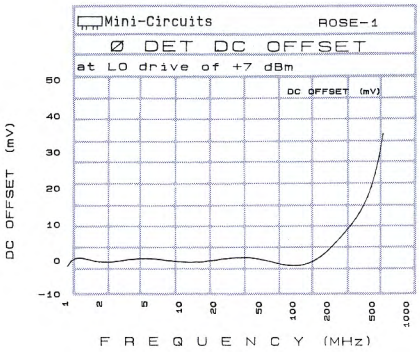












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SAM-1
TSM-1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.00	7.31	7.00	6.81	>64.00	>67.00	>70.00	>64.00	>67.00	67.13
5.000	35.00	6.05	5.81	5.66	>64.00	>67.00	>70.00	>64.00	>67.00	66.56
20.000	50.00	6.07	5.82	5.64	>64.00	>67.00	66.62	>64.00	63.03	61.96
39.646	69.65	6.07	5.79	5.62	60.97	60.82	59.98	57.56	57.34	57.16
58.969	88.97	5.98	5.75	5.61	56.54	56.81	56.53	53.47	53.89	53.57
97.615	67.62	5.96	5.72	5.60	52.03	52.49	52.27	48.48	49.40	49.96
136.260	106.26	5.89	5.69	5.59	49.25	49.36	49.21	45.55	46.66	47.34
174.910	144.91	5.94	5.77	5.66	46.93	47.07	46.75	43.44	44.47	44.96
200.000	170.00	6.07	5.87	5.76	45.75	45.71	45.58	42.49	43.53	43.81
232.880	202.88	6.02	5.82	5.70	44.60	44.45	44.37	41.04	41.92	42.15
271.520	241.52	5.83	5.63	5.53	42.79	42.63	42.54	39.79	40.43	40.58
310.170	280.17	5.87	5.69	5.61	41.77	41.76	41.87	38.52	39.12	39.29
348.810	318.81	6.00	5.81	5.69	41.09	40.89	40.94	36.88	37.24	38.02
387.460	357.46	5.91	5.71	5.60	40.89	40.87	40.96	36.05	36.52	36.78
426.110	396.11	6.18	5.99	5.85	38.94	38.89	39.15	34.63	35.09	35.82
464.750	434.75	6.16	5.95	5.81	37.11	37.39	37.70	34.34	34.88	36.03
500.000	470.00	6.16	5.94	5.83	36.74	37.14	37.86	33.99	34.65	35.23
522.720	492.72	6.26	6.05	5.92	36.70	37.11	37.56	33.29	33.82	34.12
561.370	531.37	6.53	6.32	6.16	36.72	37.22	37.70	31.85	32.34	32.73
600.000	570.00	6.87	6.59	6.30	35.24	35.63	36.68	30.17	30.55	31.20

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	1.24	1.34	1.30	1.91	2.92	4.23	1.37	1.22	1.13
10.000	1.11	1.23	1.19	1.85	2.84	4.07	1.37	1.22	1.13
20.000	1.04	1.20	1.15	1.79	2.70	3.92	1.38	1.22	1.14
41.061	1.04	1.21	1.17	1.90	2.87	4.10	1.37	1.22	1.14
59.091	1.05	1.21	1.18	1.84	2.73	3.94	1.38	1.23	1.15
100.000	1.07	1.20	1.19	1.75	2.53	3.54	1.40	1.26	1.18
149.240	1.09	1.18	1.20	1.74	2.46	3.35	1.46	1.31	1.23
185.300	1.10	1.16	1.22	1.74	2.46	3.34	1.51	1.36	1.27
203.330	1.11	1.15	1.22	1.72	2.42	3.26	1.54	1.39	1.30
239.390	1.12	1.11	1.23	1.72	2.40	3.17	1.60	1.44	1.35
275.450	1.13	1.21	1.25	1.73	2.40	3.12	1.69	1.54	1.44
311.520	1.14	1.29	1.25	1.73	2.37	3.08	1.75	1.58	1.47
347.580	1.15	1.27	1.26	1.75	2.37	3.02	1.82	1.65	1.53
383.640	1.17	1.27	1.27	1.80	2.39	3.01	1.91	1.72	1.60
437.730	1.19	1.29	1.28	1.84	2.40	2.99	2.05	1.84	1.72
473.790	1.21	1.30	1.29	1.88	2.37	2.96	2.10	1.90	1.76
500.000	1.23	1.31	1.31	1.88	2.41	2.98	2.17	1.97	1.81
527.880	1.25	1.32	1.32	1.91	2.41	2.94	2.20	1.98	1.84
563.940	1.28	1.33	1.34	1.92	2.42	2.96	2.27	2.05	1.91
600.000	1.30	1.34	1.35	1.93	2.37	2.91	2.28	2.06	1.94

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
1.000	−219.74	−.14
5.000	−228.96	−.13
20.000	−229.16	−.13
39.646	−226.03	−.13
58.969	−226.83	−.14
100.000	−229.55	−.13
136.260	−233.59	−.11
174.910	−231.58	−.12
200.000	−231.48	−.14
232.880	−233.79	−.23
271.520	−237.93	−.29
310.170	−230.08	−.36
348.810	−220.21	−.33
387.460	−210.92	−.43
426.110	−211.73	−.34
464.750	−213.09	−.36
500.000	−217.98	−.98
522.720	−218.31	−.95
561.370	−210.89	−.87
600.000	−201.93	−.50

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	20	38	33	46	33	39	28	44	46	66
1	–	22	–	33	11	37	33	49	37	44	55	57
2	75	57	58	56	50	56	48	67	52	>73	43	58
3	>95	52	48	57	45	58	42	65	56	62	57	55
4	>95	>84	81	74	68	68	66	65	64	80	72	76
5	>94	82	84	78	62	64	61	64	59	64	73	80
6	>95	>83	>83	>85	>85	>84	80	83	80	76	78	>85
7	>94	>84	>83	>82	>83	>85	83	84	81	82	76	79
8	>94	>85	>83	>85	>83	>85	>85	>84	>84	>85	>84	>83
9	>95	>83	>84	>83	>85	>84	>83	>85	>84	>85	>85	>84
10	>95	85	>83	>83	>83	>82	>82	>84	>84	>84	>85	>82
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF. IN: FREQ.500.1 MHZ DRIVE −4 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 7.05 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. −10.58 DBM

RF ORDER HARMONIC

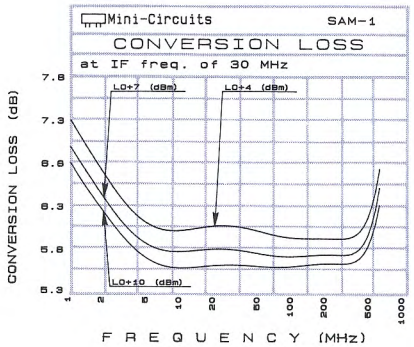
	RF CAL											
0	–	–	11	27	20	32	11	28	17	31	34	52
1	–	21	–	35	11	37	31	50	33	36	43	55
2	94	63	73	63	60	60	57	>74	59	68	52	63
3	>96	72	68	69	67	69	60	70	74	76	>73	70
4	>95	>74	>75	>75	>74	>75	>77	>76	>74	>75	>73	>73
5	>94	>74	>75	>73	>75	>75	>77	>76	>75	>75	>74	>76
6	>94	>73	>73	>75	>75	>76	>74	>75	>77	>76	>76	>75
7	>94	>74	>72	>73	>74	>75	>76	>74	>75	>75	>76	>75
8	>95	>74	>75	>75	>72	>74	>75	>75	>76	>76	>77	>75
9	>94	>73	>73	>75	>75	>74	>74	>75	>75	>76	>77	>75
10	>95	>74	>73	>74	>74	>75	>74	>75	>76	>76	76	>76
		0	1	2	3	4	5	6	7	8	9	10

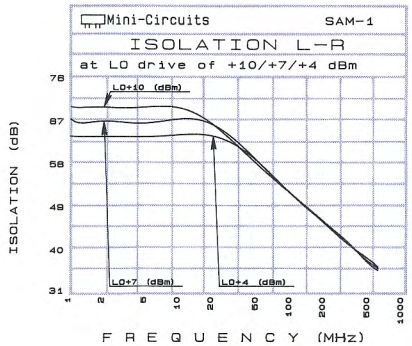
Harmonic LO Order

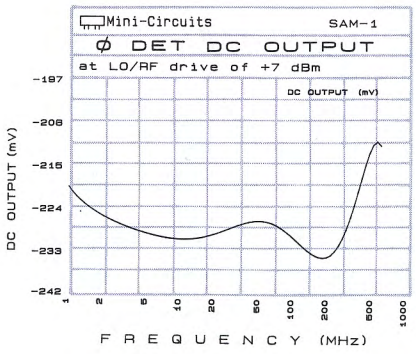
test conditions: RF. =IN: FREQ.500.1 MHZ DRIVE −13.95 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 6.99 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. −20.5 DBM

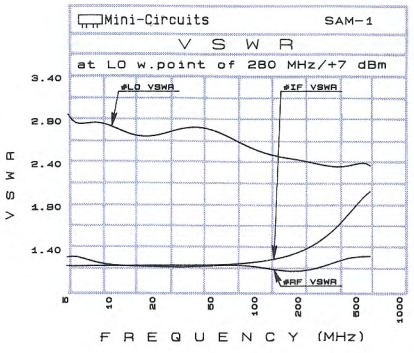
typical performance curves

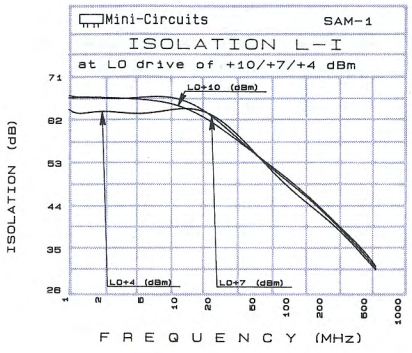
(production unit)

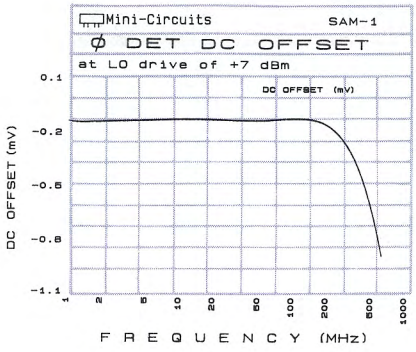












In Stock...Immediate Delivery

broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
TFM-12MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
.500	30.50	5.85	5.54	5.35	63.00	61.48	59.90	63.52	64.69	59.50
5.000	35.00	5.93	5.64	5.45	63.62	61.51	59.85	63.91	64.42	59.69
20.000	50.00	5.86	5.60	5.45	63.18	61.26	59.82	62.25	63.51	59.44
50.000	80.00	6.17	5.85	5.67	58.36	58.01	57.90	55.12	56.01	55.59
100.000	70.00	6.17	5.85	5.69	55.18	55.76	55.75	51.62	52.77	52.44
222.670	192.67	6.96	6.55	6.24	46.66	47.09	47.81	42.86	43.57	44.57
370.780	340.78	8.11	7.22	6.68	42.33	43.20	43.91	39.04	40.28	40.42
500.000	470.00	8.69	7.60	6.93	38.78	39.53	40.41	35.94	35.85	35.78
592.940	562.94	8.74	7.49	6.88	37.80	38.74	39.89	34.30	33.96	33.98
741.060	711.06	8.57	7.43	6.76	36.30	37.61	38.75	33.00	32.39	32.02
889.170	859.17	7.39	6.76	6.46	33.12	33.34	34.02	29.52	29.78	30.03
1037.300	1007.30	6.40	6.12	5.99	33.46	34.59	35.34	30.14	30.40	30.09
1111.300	1081.30	6.31	6.07	5.96	34.15	35.77	36.33	32.12	31.30	30.32
1259.400	1229.40	6.89	6.35	6.20	34.81	37.02	37.87	33.86	32.22	31.04
1333.500	1303.50	7.20	6.58	6.36	34.21	36.62	37.75	32.92	31.95	31.07
1481.600	1451.60	7.92	7.15	6.83	33.20	35.23	37.05	34.03	34.09	34.32
1555.700	1525.70	8.10	7.34	7.00	31.91	34.20	35.89	38.52	39.23	40.02
1703.800	1673.80	8.40	7.82	7.59	32.83	35.34	37.63	39.07	39.62	39.16
1851.900	1821.90	8.69	8.07	7.86	35.67	38.03	39.61	35.44	35.98	34.70
2000.000	1970.00	9.24	8.50	8.30	33.40	32.12	30.71	38.85	36.12	31.03

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.000	4.80	4.43	4.04	1.19	1.96	3.06	1.11	1.13	1.22
10.000	4.86	4.51	4.05	1.14	1.88	2.85	1.09	1.10	1.19
20.000	4.92	4.59	4.06	1.25	2.04	2.95	1.08	1.09	1.19
50.000	4.78	4.43	3.96	1.16	1.91	2.90	1.09	1.11	1.20
71.500	4.84	4.31	3.87	1.18	1.86	2.69	1.11	1.13	1.21
200.000	4.88	4.70	4.24	1.30	1.78	2.40	1.26	1.27	1.32
337.500	4.93	4.92	4.41	1.39	1.67	2.19	1.43	1.43	1.47
470.500	4.75	4.52	4.33	1.46	1.58	2.07	1.60	1.64	1.69
537.000	4.62	4.48	4.20	1.50	1.56	2.06	1.70	1.75	1.81
670.000	3.58	3.42	3.33	1.56	1.43	1.86	1.93	2.07	2.14
869.500	2.52	2.40	2.39	1.47	1.27	1.61	2.61	2.81	2.95
1000.000	1.98	1.85	1.75	1.45	1.19	1.57	3.28	3.49	3.57
1069.000	1.75	1.61	1.50	1.46	1.18	1.56	3.76	3.93	4.05
1200.000	1.48	1.35	1.22	1.40	1.24	1.64	4.80	5.22	5.13
1335.000	1.37	1.25	1.11	1.36	1.31	1.72	4.93	5.06	5.13
1468.000	1.41	1.32	1.14	1.34	1.42	1.88	6.53	7.41	7.50
1534.500	1.53	1.43	1.22	1.37	1.43	1.83	10.96	10.37	10.89
1667.500	1.90	1.79	1.53	1.52	1.53	1.86	11.85	10.31	9.69
1867.000	2.74	2.62	2.35	1.84	1.59	1.72	9.08	8.81	8.43
2000.000	3.46	3.22	3.16	1.99	1.58	1.54	6.39	6.58	6.68

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ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	13	40	15	44	36	45	41	51	58	61
1	–	19	–	46	24	33	32	46	43	44	50	52
2	63	>60	44	52	44	>64	39	>69	55	>70	>59	>64
3	>94	59	48	67	39	69	52	56	51	66	53	60
4	>95	78	63	78	66	69	62	77	57	75	69	77
5	>94	80	75	79	69	78	58	75	71	70	65	84
6	>90	>82	>88	>87	76	>86	79	78	74	>89	71	82
7	>88	>82	>82	>87	>85	>88	82	>87	71	>84	>86	>82
8	>88	>82	>82	>83	>88	>87	>85	>89	>90	>86	82	>90
9	>89	>83	>82	>82	>84	>88	>89	>88	>87	>89	82	>89
10	>89	>83	>82	>83	>83	>83	>88	>88	>87	>88	>90	>90

Harmonic LO Order

test conditions: RF. IN: FREQ.990.1006 MHZ DRIVE .06 DBM
LO. IN: FREQ.960.0069 MHZ DRIVE 12.91 DBM
IF MEASURED: FREQ.30.094 MHZ AMP. −6.27 DBM

RF CAL

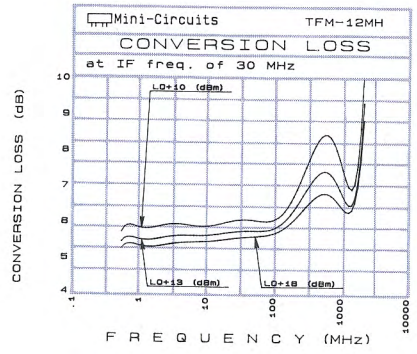
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	29	4	35	24	34	28	41	41	47
1	–	19	–	50	24	31	31	42	38	41	43	45
2	82	65	51	57	50	67	46	66	61	72	60	67
3	>93	75	64	75	56	74	69	68	67	76	68	72
4	>95	>79	76	>79	>80	80	>79	>78	74	>77	>80	79
5	>94	>78	>80	78	>78	>80	>79	>80	>81	>78	>78	>78
6	>88	>73	>78	>79	>79	>79	>81	>79	>79	>79	>77	>78
7	>88	>72	>72	>77	>79	>79	>78	81	>80	>81	>79	>77
8	>89	>73	>72	>73	>78	>78	>78	>77	>80	>80	>80	>79
9	>91	>73	>73	73	>73	>78	>77	>79	>79	>79	>79	>79
10	>89	>72	>72	>73	>72	>73	>79	>78	>78	>79	>79	>80

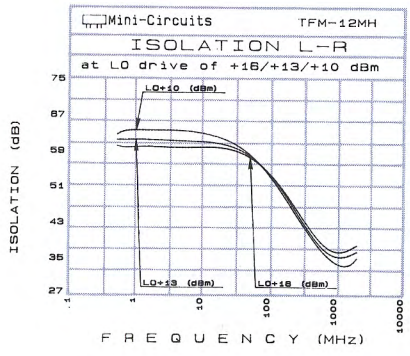
Harmonic LO Order

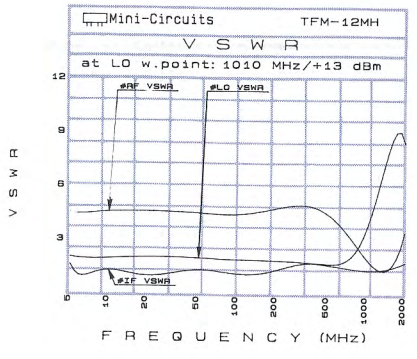
test conditions: RF. IN: FREQ.990.1007 MHZ DRIVE −9.96 DBM TESTED ON :16.5.85
LO. IN: FREQ.960.0071 MHZ DRIVE 12.91 DBM TESTED BY :B.O.
IF MEASURED: FREQ.30.0938 MHZ AMP. −16.16 DBM

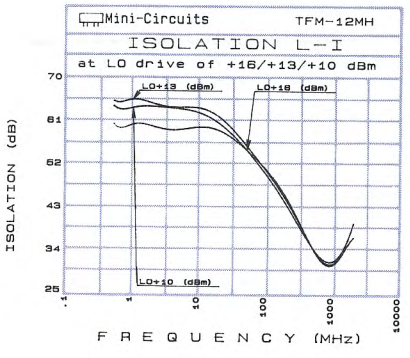
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SAM-3
TSM-3

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.100	30.10	6.00	5.74	5.57	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	66.23
.200	30.20	5.45	5.22	5.09	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	65.77
.500	30.50	5.20	4.98	4.85	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	65.50
1.000	31.00	5.12	4.89	4.76	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	65.49
2.000	32.00	5.08	4.86	4.74	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	65.24
5.000	35.00	5.03	4.82	4.72	> 64.00	> 67.00	> 70.00	> 64.00	> 67.00	64.20
10.000	40.00	5.09	4.86	4.72	> 64.00	> 67.00	64.53	> 64.00	> 67.00	60.90
20.000	50.00	5.14	4.94	4.79	> 64.00	58.85	57.49	> 64.00	58.01	56.70
41.470	71.47	5.07	4.85	4.78	52.92	51.90	51.32	52.89	51.69	50.98
55.260	85.26	5.06	4.89	4.78	50.20	49.48	48.87	50.06	49.53	48.71
100.000	70.00	4.95	4.79	4.73	45.42	44.78	44.29	45.39	44.91	44.39
151.790	121.79	4.99	4.81	4.78	42.39	41.85	41.22	41.97	41.77	41.34
200.000	170.00	5.16	5.01	4.91	40.15	39.70	39.49	39.45	39.48	39.58
220.740	190.74	5.19	5.05	4.95	40.31	39.83	39.25	38.69	38.88	38.68
248.320	218.32	5.15	5.02	4.93	39.82	39.44	38.87	37.84	38.41	38.66
303.480	273.48	5.23	5.11	5.14	36.90	36.66	36.33	36.10	36.25	36.28
331.060	301.06	5.40	5.25	5.29	36.17	36.60	36.55	35.34	36.25	36.67
358.640	328.64	5.66	5.48	5.47	35.52	36.34	36.77	33.90	35.29	36.31
386.220	356.22	5.67	5.50	5.48	35.15	36.21	37.07	31.88	33.15	34.38
400.000	370.00	5.78	5.52	5.39	35.10	36.19	36.99	31.08	32.27	33.43

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.20	1.11	1.05	1.72	2.55	3.62	.58	1.44	1.33
10.000	1.20	1.11	1.05	1.74	2.49	3.53	.59	1.45	1.33
20.000	1.20	1.11	1.04	1.68	2.41	3.35	.60	1.46	1.34
39.853	1.18	1.09	1.03	1.81	2.51	3.56	.60	1.46	1.34
50.000	1.18	1.09	1.03	1.81	2.51	3.47	.61	1.47	1.35
74.706	1.18	1.09	1.03	1.70	2.40	3.23	.64	1.50	1.38
100.000	1.17	1.08	1.03	1.66	2.27	3.10	.69	1.55	1.42
132.790	1.16	1.07	1.02	1.67	2.30	3.09	.76	1.63	1.51
167.650	1.14	1.06	1.01	1.67	2.31	2.98	.85	1.73	1.60
190.880	1.13	1.05	1.00	1.69	2.30	3.00	.94	1.80	1.67
200.000	1.12	1.05	1.01	1.68	2.30	3.00	.96	1.83	1.71
225.740	1.11	1.04	1.03	1.72	2.30	2.95	.04	1.91	1.77
248.970	1.09	1.04	1.04	1.75	2.30	3.00	.15	2.01	1.86
272.210	1.08	1.05	1.07	1.80	2.36	2.98	.24	2.11	1.95
295.440	1.07	1.06	1.09	1.80	2.38	3.00	.34	2.19	2.04
307.060	1.07	1.08	1.11	1.78	2.40	3.00	.38	2.24	2.08
330.290	1.07	1.11	1.14	1.83	2.46	3.06	.48	2.36	2.18
353.530	1.09	1.14	1.18	1.84	2.47	3.06	.58	2.45	2.26
376.760	1.11	1.17	1.21	1.90	2.52	3.09	.66	2.57	2.37
400.000	1.13	1.20	1.24	1.98	2.58	3.13	.72	2.65	2.45

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
.100	−236.30	+.13
.200	−237.64	+.12
.500	−239.63	+.12
1.000	−239.96	+.12
2.000	−240.28	+.12
5.000	−241.56	+.12
10.000	−241.74	+.12
20.000	−240.48	+.12
41.470	−239.23	+.12
55.260	−240.62	+.14
100.000	−241.67	+.20
151.790	−239.61	+.30
200.000	−242.22	+.31
220.740	−242.19	+.32
248.320	−239.84	+.40
303.480	−220.69	+.36
331.060	−213.10	+.48
358.640	−214.55	+.75
386.220	−208.18	+1.12
400.000	−206.78	+1.26

Measurements at RF & LO Power +7 dBm

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Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	28	48	33	52	39	49	40	64	38	64
1	–	23	–	34	11	44	18	39	24	44	44	59
2	83	58	48	63	49	64	50	67	54	65	55	70
3	94	51	43	51	45	61	46	59	41	65	40	52
4	>96	71	67	72	62	73	61	71	59	73	59	80
5	>95	75	67	69	59	75	55	70	54	74	54	69
6	>96	>86	77	80	74	84	77	85	77	>86	76	81
7	>96	>86	80	>86	72	82	82	77	70	79	66	77
8	>95	>85	>85	>87	>85	>87	82	>86	85	87	>87	>86
9	>94	>85	>87	>86	>86	>86	77	>86	78	>87	82	>86
10	>96	>84	>85	>86	>86	>87	>85	>86	>88	>87	>87	>86

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −4.01 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 7 DBM
IF=MEASURED: FREQ.30.09 AMP.=−9.33 DBM

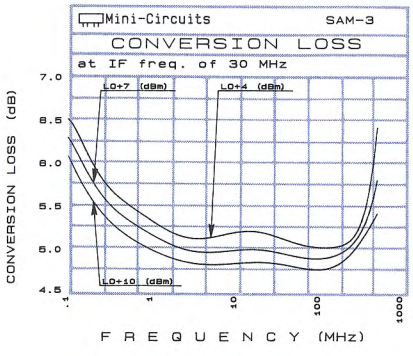
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	19	36	21	38	29	37	28	50	24	54
1	–	22	–	35	11	46	17	37	21	39	41	50
2	>95	74	52	>76	52	71	52	>76	52	70	58	>77
3	>96	74	62	72	63	74	62	>77	60	74	61	>76
4	>96	>76	>77	>77	>78	>77	>76	>77	>76	>77	>77	>76
5	>97	>77	>77	>77	>77	>76	>76	>76	76	>76	>76	>75
6	>96	>76	>77	>77	>77	>76	>76	>77	>77	>76	>78	>77
7	>95	>75	>77	>77	>78	>77	>79	>75	>78	>77	>76	>78
8	>97	>77	>76	>77	>77	>75	>77	>76	>77	>76	>76	>76
9	>95	77	>76	>77	>76	>76	>78	>76	>77	>76	>77	>78
10	>96	>77	>76	>77	>76	>78	>77	>77	>76	>77	>76	>76

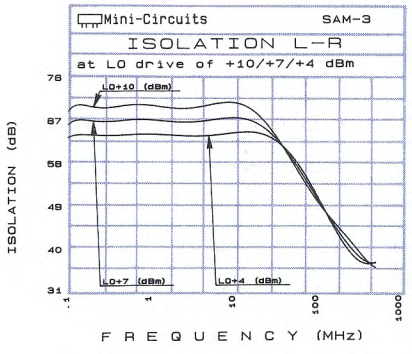
Harmonic LO Order

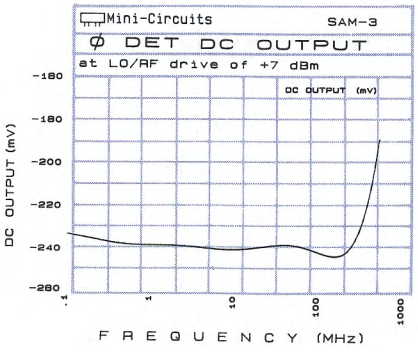
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE −14 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 7.03 DBM
IF=MEASURED: FREQ.30.09 AMP.=−19.34 DBM

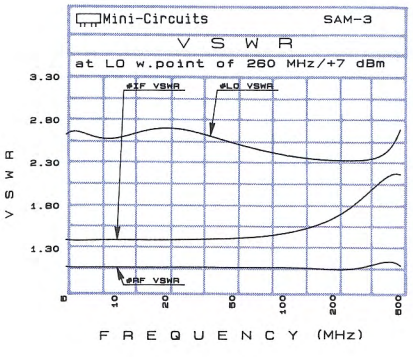
typical performance curves

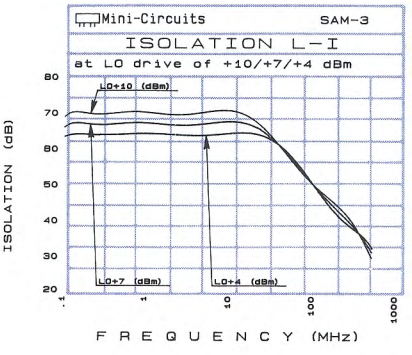
(production unit)

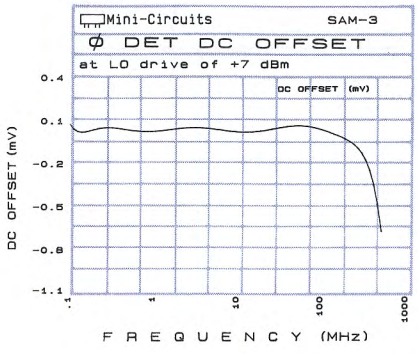












most widely used

Frequency Mixers

Model SAM-4

LEVEL 7 (+7dBm LO, up to +1dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	6.26	5.94	5.69	59.83	59.43	57.96	>64.00	61.56	59.99
20.000	50.00	6.35	6.01	5.75	58.99	57.85	57.24	61.19	60.18	58.72
43.906	73.91	6.35	6.01	5.76	56.19	55.63	54.65	57.82	56.61	55.69
121.720	91.72	6.27	5.97	5.72	48.39	48.05	47.50	49.68	49.15	48.47
199.530	169.53	6.52	6.14	5.87	43.81	44.14	44.62	45.64	45.36	44.99
238.440	208.44	6.52	6.15	5.88	42.30	43.00	43.56	44.33	43.97	43.62
316.250	286.25	6.41	6.08	5.84	40.10	41.40	42.11	42.50	42.08	41.70
394.060	364.06	6.49	6.14	5.92	38.29	39.59	40.33	40.89	40.42	39.98
471.870	441.87	6.74	6.42	6.12	36.72	38.20	39.11	41.19	40.40	39.92
549.680	519.68	6.71	6.44	6.17	36.02	37.71	38.46	39.78	39.04	38.23
588.590	558.59	6.86	6.59	6.28	35.62	37.59	37.96	38.53	38.26	37.96
666.400	636.40	7.07	6.81	6.48	33.97	35.77	35.88	36.80	36.89	36.81
744.210	714.21	6.88	6.56	6.23	32.09	33.69	33.73	36.44	36.91	37.23
822.030	792.03	6.67	6.31	5.97	30.51	32.17	32.64	35.91	36.54	37.05
899.840	869.84	6.74	6.35	6.00	29.07	30.79	31.49	35.74	36.37	37.04
977.650	947.65	6.50	6.12	5.77	27.98	29.61	30.39	35.75	36.61	37.16
1016.600	986.60	6.44	6.07	5.77	27.58	29.23	29.91	35.83	36.74	37.35
1094.400	1064.40	6.34	5.99	5.68	26.93	28.64	29.40	36.01	36.86	37.72
1172.200	1142.20	6.40	6.09	5.84	26.39	28.41	29.20	34.94	35.96	36.47
1250.000	1220.00	6.54	6.33	6.13	26.25	28.31	29.37	35.21	35.12	35.29

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	1.73	1.47	1.27	2.04	3.00	4.04	1.20	1.28	1.38
10.000	1.73	1.47	1.27	1.95	2.89	3.94	1.12	1.22	1.32
20.000	1.73	1.47	1.28	1.90	2.85	3.86	1.10	1.21	1.30
50.000	1.72	1.47	1.28	2.00	2.93	4.00	1.11	1.23	1.32
100.000	1.75	1.52	1.32	1.87	2.63	3.62	1.12	1.23	1.32
160.630	1.84	1.60	1.41	1.82	2.58	3.42	1.12	1.22	1.31
200.000	1.90	1.67	1.49	1.81	2.55	3.35	1.11	1.22	1.31
277.340	2.01	1.81	1.64	1.77	2.40	3.16	1.11	1.21	1.30
355.160	2.18	1.96	1.79	1.77	2.36	3.06	1.12	1.21	1.29
432.970	2.39	2.11	1.96	1.79	2.35	3.01	1.13	1.21	1.27
500.000	2.42	2.20	2.06	1.76	2.31	2.92	1.13	1.21	1.24
549.690	2.47	2.24	2.11	1.80	2.28	2.87	1.13	1.19	1.22
627.500	2.56	2.30	2.17	1.80	2.25	2.81	1.13	1.17	1.17
783.130	2.44	2.23	2.07	1.81	2.26	2.72	1.07	1.04	1.03
860.940	2.41	2.17	2.00	1.84	2.22	2.69	1.11	1.06	1.08
938.750	2.33	2.03	1.86	1.88	2.19	2.66	1.23	1.20	1.22
1000.000	2.24	1.95	1.77	1.91	2.22	2.65	1.38	1.36	1.38
1055.500	2.12	1.86	1.68	1.92	2.21	2.61	1.54	1.52	1.53
1133.300	1.98	1.74	1.59	1.94	2.26	2.66	1.83	1.81	1.80
1250.000	1.80	1.65	1.59	1.96	2.20	2.64	2.32	2.19	2.17

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL		0	1	2	3	4	5	6	7	8	9	10
0	-	-	25	28	46	37	58	58	51	60	46	64	
1	-	21	-	33	14	35	26	46	50	45	45	56	
2	75	51	54	55	57	49	57	52	62	68	58	64	
3	>96	54	35	51	43	56	38	52	44	51	61	53	
4	>95	>83	76	63	71	58	67	56	74	63	70	>83	
5	>95	76	68	69	54	62	51	60	49	62	56	65	
6	>93	>84	>84	79	>84	68	85	68	78	66	>84	72	
7	>93	84	>83	>84	77	82	64	76	64	71	61	77	
8	>94	>84	>86	>84	>83	>84	>84	80	>86	82	>86	75	
9	>94	>84	>84	>83	>85	>83	>84	>85	81	81	77	84	
10	>95	>83	>84	>85	>85	>83	>83	>84	>86	>84	>86	81	

Harmonic LO Order

test conditions: RF.=IN: FREQ.500.1 MHZ DRIVE -3.96 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 7.02 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. -10.52 DBM

RF ORDER HARMONIC

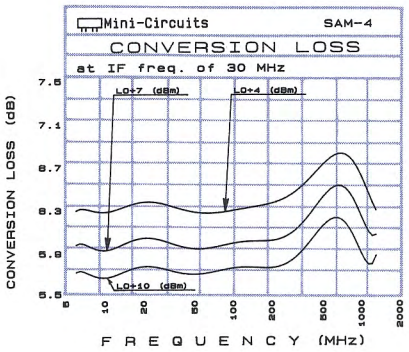
	RF CAL		0	1	2	3	4	5	6	7	8	9	10
0	-	-	15	19	32	24	44	42	33	55	28	42	
1	-	21	-	34	14	32	24	37	43	36	34	41	
2	93	51	63	52	62	48	71	58	66	74	70	58	
3	>94	67	52	66	55	66	51	69	60	66	>73	67	
4	>95	>74	>75	>75	76	75	>75	72	>75	>74	>75	>72	
5	>94	>73	76	>75	>75	>76	>76	>76	>75	>74	>75	>74	
6	>93	>74	>74	>74	>74	>76	>76	>76	>75	>76	>76	>75	
7	>95	>74	>72	>72	>73	>75	>75	>75	>75	>75	>75	>76	
8	>96	>73	>74	>75	>73	>74	>75	>74	>75	>76	>76	>75	
9	>95	>73	>73	>75	>75	>74	>74	>76	>75	>76	>75	>74	
10	>96	>73	>74	>76	>73	>73	>73	>74	>74	>75	>75	>75	

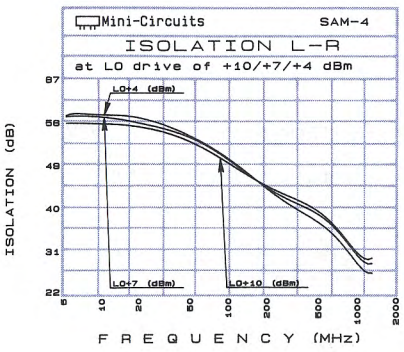
Harmonic LO Order

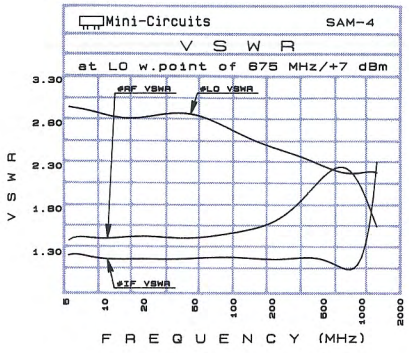
test conditions: RF.=IN: FREQ.500.1 MHZ DRIVE −13.98 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 7.05 DBM
IF=MEASURED: FREQ.30.09 MHZ AMP. −20.57 DBM

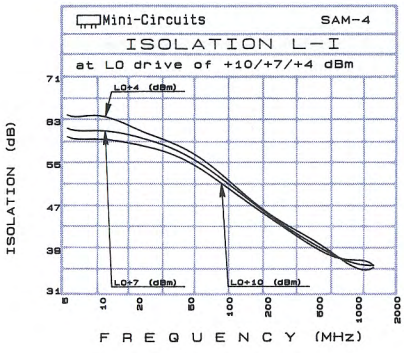
typical performance curves

(production unit)









most widely used

Frequency Mixers

Model SAM-5

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	5.86	5.58	5.34	>64.00	61.45	60.51	>64.00	>67.00	>70.00
20.000	50.00	6.13	5.81	5.51	59.93	58.66	58.81	>64.00	>67.00	>70.00
100.000	70.00	5.99	5.73	5.47	50.27	50.13	50.06	52.31	51.69	51.44
145.160	115.16	6.15	5.90	5.61	46.83	47.16	47.51	48.76	48.88	48.59
238.600	208.60	6.21	5.85	5.61	41.63	42.72	43.77	44.44	44.36	44.24
332.030	302.03	6.26	5.93	5.68	38.60	40.12	41.18	41.62	41.77	41.68
425.470	395.47	6.54	6.14	5.84	35.60	37.03	38.42	40.36	40.50	40.38
500.000	470.00	6.45	6.14	5.89	34.59	36.19	36.97	39.59	39.52	39.04
565.630	535.63	6.50	6.18	5.93	33.44	34.87	35.84	37.74	38.30	38.26
612.350	582.35	6.76	6.39	6.08	32.05	33.19	34.23	36.63	37.13	37.48
705.790	675.86	6.43	6.14	5.86	30.03	31.05	31.51	36.26	37.14	37.65
799.220	769.48	6.02	5.71	5.48	28.25	29.41	30.44	35.93	37.01	37.45
892.660	862.67	6.12	5.64	5.38	26.86	27.93	28.82	34.92	35.99	36.61
986.100	956.07	6.11	5.72	5.40	25.19	26.32	27.19	34.47	35.42	36.07
1032.800	1002.80	6.01	5.68	5.40	24.40	25.45	26.49	33.74	34.44	35.42
1126.300	1096.50	5.98	5.72	5.45	23.25	24.03	25.24	32.13	32.06	33.24
1219.700	1189.70	6.06	5.83	5.64	22.69	23.54	23.67	34.44	34.42	33.22
1313.100	1283.10	6.42	6.22	6.09	22.73	23.61	24.30	35.68	36.18	36.05
1406.600	1376.80	6.80	6.67	6.57	23.69	24.24	24.56	35.83	36.02	36.15
1500.000	1469.90	7.49	7.43	7.35	24.18	24.41	24.62	35.50	35.83	35.74

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.003	1.86	1.61	1.48	1.98	2.93	4.03	1.37	1.45	1.55
20.000	1.87	1.62	1.49	1.79	2.80	3.96	1.22	1.32	1.44
50.000	1.87	1.62	1.49	1.90	2.89	4.05	1.22	1.33	1.44
100.000	1.86	1.67	1.52	1.79	2.68	3.62	1.21	1.33	1.42
200.000	2.07	1.83	1.72	1.72	2.50	3.42	1.21	1.32	1.40
285.310	2.25	2.05	1.90	1.69	2.48	3.17	1.20	1.32	1.37
378.750	2.34	2.25	2.03	1.66	2.37	3.02	1.17	1.29	1.31
472.190	2.50	2.39	2.18	1.68	2.39	3.01	1.12	1.22	1.24
500.000	2.49	2.40	2.17	1.66	2.39	2.97	1.10	1.20	1.20
565.630	2.46	2.39	2.12	1.65	2.37	2.89	1.05	1.12	1.12
659.060	2.42	2.20	2.03	1.64	2.39	2.85	1.10	1.02	1.09
752.500	2.31	2.16	1.89	1.62	2.33	2.84	1.28	1.23	1.28
845.940	2.14	1.99	1.68	1.75	2.47	2.84	1.55	1.55	1.58
939.380	2.01	1.86	1.52	1.81	2.60	2.82	1.93	1.97	1.97
1000.000	1.95	1.77	1.46	1.82	2.65	2.80	2.23	2.27	2.28
1079.500	1.83	1.67	1.40	1.82	2.59	2.82	2.70	2.77	2.74
1173.000	1.58	1.48	1.31	1.80	2.59	2.80	3.26	3.24	3.26
1266.400	1.33	1.30	1.25	1.84	2.57	2.79	3.62	3.41	3.63
1359.800	1.23	1.33	1.38	1.89	2.69	2.91	3.91	3.48	4.15
1500.000	1.70	2.05	1.97	2.22	3.14	3.12	4.32	4.37	4.57

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	24	31	41	41	48	56	39	48	56	66
1	–	22	–	39	14	33	30	45	53	47	48	52
2	75	49	59	51	65	49	58	59	67	>71	49	56
3	96	47	37	59	41	66	38	49	51	53	68	56
4	>96	>86	78	63	68	60	65	60	71	72	82	>81
5	>94	81	71	75	54	64	50	63	49	67	60	69
6	>94	>84	>85	>84	>85	79	76	79	73	74	74	80
7	>95	79	>84	>83	>84	>83	71	78	67	74	62	83
8	>94	>84	84	>85	>83	>84	>86	83	84	79	84	78
9	>94	>83	>83	84	>85	>82	85	>84	79	83	73	81
10	>95	>84	>82	>84	>83	>84	>83	>84	>85	>84	86	>85

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE -3.96 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 7.01 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -10.57 DBM

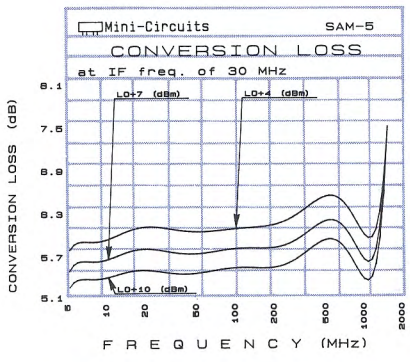
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	23	29	29	36	41	23	32	39	49
1	–	23	–	37	15	30	29	37	47	38	36	39
2	94	54	59	53	58	51	68	69	>74	68	51	67
3	>97	64	52	69	52	68	50	68	64	68	73	66
4	>97	>75	>76	>76	>76	76	>77	75	>76	>76	74	>74
5	>95	>75	>75	>76	>76	>76	>77	>76	74	>75	>76	>76
6	>94	>74	>75	>75	>77	>76	>77	>76	>76	>77	>76	>75
7	>96	>76	>74	>73	>75	>75	>77	>76	>76	>76	>76	>76
8	96	>75	>76	>74	>74	>75	>75	>77	>76	>76	>76	>77
9	>96	>75	>76	>75	>75	>75	>75	>76	>75	>76	>77	>77
10	>95	>74	>76	>75	>76	>75	>75	>75	>76	>76	>76	>76

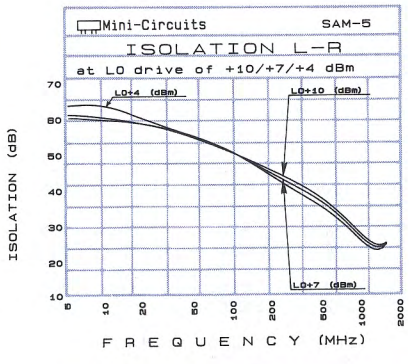
Harmonic LO Order

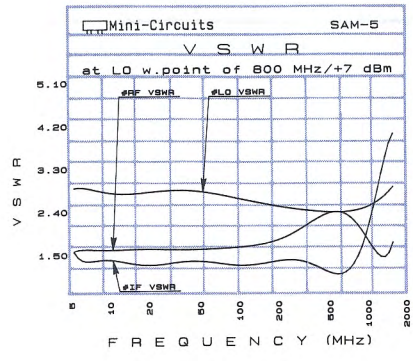
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE -13.97 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 7.05 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -20.47 DBM

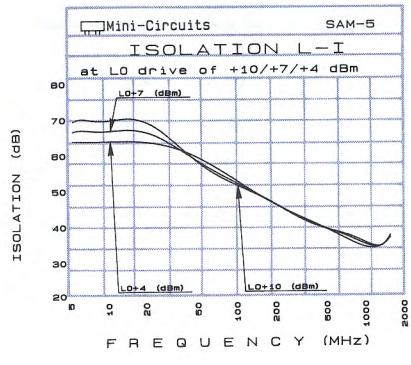
typical performance curves

(production unit)









broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
ROK-186MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
2.000	102.000	7.20	6.50	6.10	2.000	28.60	31.80	35.20	35.20	37.80	40.20
5.000	105.000	7.10	6.40	6.10	5.000	31.00	34.00	37.20	40.02	43.60	46.40
10.000	110.000	7.00	6.30	6.00	10.000	31.10	34.00	36.90	41.80	45.60	49.00
50.000	150.000	6.60	5.80	5.50	50.000	30.70	33.80	36.80	41.10	45.20	48.70
100.000	200.000	6.50	6.30	5.80	100.000	30.90	34.10	37.00	40.90	45.20	48.90
251.800	351.800	7.40	6.60	6.20	251.800	31.60	34.70	36.80	42.10	47.20	50.90
584.870	484.870	7.50	6.60	6.10	584.870	33.20	36.10	36.90	48.80	63.40	56.10
668.130	568.130	7.60	6.70	6.20	668.130	33.80	36.90	37.10	49.50	65.10	50.90
834.670	734.670	7.27	6.48	6.13	834.670	36.70	41.70	38.20	50.20	55.50	45.70
1001.200	901.200	7.42	6.66	6.26	1001.200	39.10	48.40	38.60	43.10	45.30	41.50
1167.700	1067.700	7.30	6.51	6.20	1167.700	40.20	51.90	39.10	38.90	41.00	39.60
1334.300	1234.300	7.42	6.63	6.28	1334.300	38.70	44.20	38.40	35.70	37.90	38.80
1500.800	1400.800	6.99	6.34	6.04	1500.800	37.80	41.30	37.60	32.90	34.50	35.60
1667.300	1567.300	6.93	6.27	6.01	1667.300	37.80	39.90	37.30	31.60	32.90	34.00
1833.900	1733.900	7.11	6.40	6.11	1833.900	35.40	37.90	38.30	29.80	31.10	32.50
2000.400	1900.400	7.83	6.92	6.48	2000.400	33.50	35.70	37.40	28.50	29.80	31.20
2083.700	1983.700	8.20	7.03	6.45	2083.700	33.40	35.20	36.70	28.00	29.20	30.90
2250.200	2150.200	7.65	6.65	6.15	2250.200	34.00	35.80	37.00	26.70	28.40	30.30
2416.700	2316.700	7.22	6.50	6.15	2416.700	36.00	39.90	41.30	26.30	28.20	30.00
2500.000	2400.000	7.20	6.65	6.33	2500.000	37.90	46.80	44.60	26.00	28.10	29.80

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.001	1.84	1.68	1.57	1.11	1.48	2.18	5.001	1.59	1.36	1.21
10.000	1.84	1.68	1.56	1.12	1.46	2.18	10.000	1.60	1.36	1.21
50.000	1.82	1.67	1.56	1.11	1.44	2.16	50.000	1.60	1.36	1.21
100.000	1.87	1.70	1.58	1.12	1.43	2.14	100.000	1.61	1.36	1.22
200.000	1.88	1.73	1.60	1.17	1.38	2.12	200.000	1.57	1.33	1.20
337.670	1.92	1.76	1.64	1.17	1.38	2.04	337.670	1.48	1.28	1.19
500.000	1.96	1.81	1.68	1.25	1.34	2.06	500.000	1.37	1.23	1.23
587.170	1.97	1.82	1.70	1.25	1.33	2.01	587.170	1.30	1.23	1.28
753.500	2.01	1.87	1.76	1.32	1.34	2.14	753.500	1.24	1.29	1.40
919.830	2.04	1.89	1.80	1.34	1.30	2.03	919.830	1.19	1.32	1.45
1068.200	2.03	1.88	1.77	1.34	1.28	1.91	1068.200	1.10	1.27	1.41
1252.500	2.06	1.88	1.76	1.25	1.27	1.91	1252.500	1.16	1.26	1.39
1418.800	2.12	1.89	1.76	1.27	1.21	1.80	1418.800	1.46	1.47	1.54
1585.200	2.08	1.87	1.71	1.23	1.20	1.68	1585.200	1.74	1.69	1.71
1751.500	2.10	1.87	1.71	1.20	1.24	1.58	1751.500	1.92	1.84	1.81
1917.800	2.06	1.84	1.68	1.12	1.34	1.54	1917.800	2.08	1.97	1.96
2000.000	2.03	1.81	1.66	1.10	1.38	1.51	2000.000	2.16	2.04	2.01
2167.300	1.91	1.73	1.59	1.17	1.51	1.52	2167.300	2.23	2.12	2.08
2333.700	1.75	1.59	1.49	1.34	1.71	1.65	2333.700	2.32	2.25	2.18
2500.000	1.46	1.36	1.31	1.52	1.88	1.80	2500.000	2.40	2.32	2.27

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF Order Harmonic	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	17	12	17	19	16	29	30	51	61	49
1	–	37	+0	44	16	58	33	48	48	48	46	51
2	94	61	60	60	62	61	61	71	56	70	4	73
3	>95	77	63	>80	63	9	63	77	65	78	71	74
4	>94	79	>81	>81	79	>79	>80	>81	>80	80	>80	>81
5	>89	>80	>81	>81	>80	>80	>79	>80	>79	77	>81	>81
6	>87	>75	>81	>80	>81	>80	79	78	>80	>80	80	>80
7	>87	73	>75	>80	>81	>82	>80	>81	>79	79	>80	>80
8	>84	>75	>76	>75	>81	>81	>82	>80	>80	>79	>80	79
9	>89	>75	>76	74	75	>80	>80	>81	>80	>81	>80	79
10	>88	73	>75	72	>75	>75	>81	>81	>81	>81	79	>80

LO Harmonic Order

test condition RF IN: 1000.20 MHZ; −10.01 DBM
LO IN: 900.01 MHZ; +12.92 DBM
IF OUT: 100.19 MHZ; −15.97 DBM

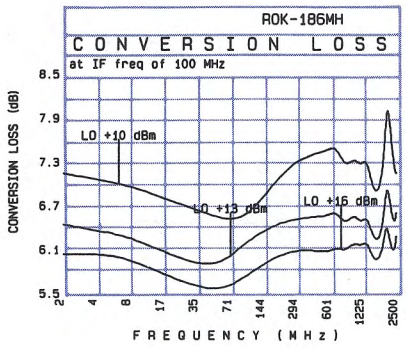
RF Order Harmonic	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	22	27	28	27	38	43	62	64	58
1	–	36	+0	44	15	56	30	50	46	49	51	52
2	>88	53	53	52	55	55	56	61	49	61	65	73
3	>85	67	48	77	46	73	46	67	48	66	56	72
4	>89	81	73	76	67	77	65	75	68	75	62	83
5	>90	82	71	84	70	83	64	84	66	87	71	71
6	>89	>85	87	>80	86	>88	79	80	78	82	81	>88
7	>91	>85	>84	>80	89	>89	>87	86	81	>85	80	84
8	>88	>86	84	82	>81	87	>80	>87	>88	>85	>86	84
9	>89	85	>85	84	>86	>81	89	89	>89	>87	>85	>74
10	>87	>85	85	>85	>85	>85	>91	>90	>90	>91	85	>88

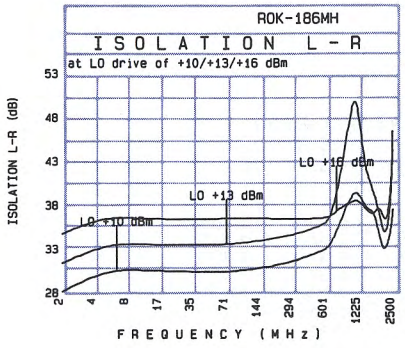
LO Harmonic Order

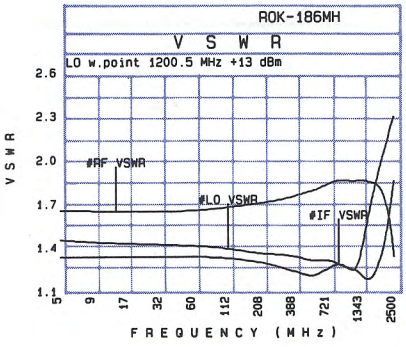
test condition RF IN: 1000.20 MHZ; +.03 DBM
LO IN: 900.01 MHZ; +13.00 DBM
IF OUT: 100.19 MHZ; −5.73 DBM

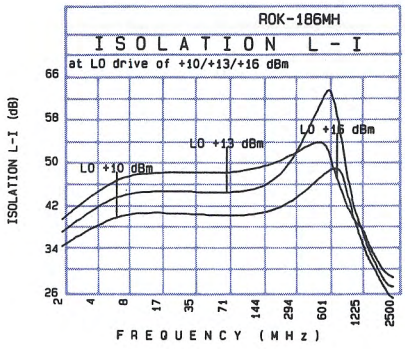
typical performance curves

(production unit)









In Stock...Immediate Delivery

most economical

Frequency Mixers

Model SBL-1Z

LEVEL 7 (+7dBm LO, up to +1dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
10.000	40.00	7.43	6.98	6.75	>64.00	64.02	62.91	51.31	52.18	52.52
39.088	69.09	7.12	6.66	6.51	54.89	52.99	51.43	40.88	41.66	42.39
68.176	98.18	7.26	6.76	6.68	49.27	47.28	46.36	36.71	37.96	38.83
100.000	70.00	7.14	6.63	6.45	44.65	43.53	43.70	34.34	35.77	36.27
184.530	154.53	6.67	6.42	6.34	40.00	40.41	40.88	31.81	32.64	33.03
242.710	212.71	6.62	6.33	6.20	38.06	39.05	39.32	29.92	30.64	31.21
271.790	241.79	6.80	6.52	6.43	37.93	38.77	38.72	27.98	28.77	29.53
329.970	299.97	6.74	6.49	6.40	36.58	36.87	36.75	25.83	26.53	27.30
388.150	358.15	6.84	6.51	6.37	35.74	35.36	34.79	24.14	24.66	25.55
446.320	416.32	7.14	6.80	6.60	36.22	34.53	33.10	22.77	23.26	23.83
504.500	474.50	7.53	7.15	6.96	35.59	32.41	30.74	21.54	21.71	22.00
533.590	503.59	7.26	6.88	6.77	34.94	31.87	30.11	20.94	21.16	21.64
591.760	561.76	7.55	6.96	6.73	33.66	31.63	29.09	20.30	21.41	22.05
649.940	619.94	8.43	7.46	6.77	30.26	29.54	28.38	20.96	22.56	24.29
708.120	678.12	8.70	7.80	7.10	29.51	28.43	27.92	20.92	22.26	23.75
766.290	736.29	8.95	7.88	7.23	29.14	28.16	27.74	20.62	21.92	22.99
824.470	794.47	8.94	7.92	7.21	28.69	27.76	26.91	19.91	21.01	21.60
882.650	852.65	8.85	7.81	7.19	28.27	27.27	26.65	18.66	19.21	19.15
940.820	910.82	8.86	7.88	7.44	28.13	26.94	26.12	17.19	17.55	17.37
1000.000	969.00	8.87	8.07	7.65	29.82	28.45	27.36	14.38	14.47	14.04

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
10.000	1.38	1.45	1.52	1.63	2.51	3.83	2.00	1.72	1.53
39.088	1.25	1.34	1.42	1.71	2.57	3.87	1.99	1.71	1.52
68.176	1.25	1.34	1.42	1.58	2.42	3.54	2.00	1.72	1.53
100.000	1.26	1.35	1.43	1.55	2.37	3.45	2.02	1.74	1.55
155.440	1.27	1.37	1.44	1.58	2.36	3.42	2.06	1.79	1.60
200.000	1.29	1.39	1.45	1.60	2.33	3.34	2.11	1.83	1.64
242.710	1.30	1.40	1.47	1.63	2.32	3.24	2.14	1.88	1.69
300.880	1.33	1.43	1.50	1.69	2.36	3.27	2.22	1.94	1.76
359.060	1.35	1.45	1.52	1.78	2.44	3.25	2.30	2.01	1.85
417.240	1.37	1.46	1.53	1.87	2.53	3.37	2.37	2.09	1.90
475.410	1.38	1.46	1.52	1.95	2.59	3.40	2.41	2.13	1.94
504.500	1.37	1.45	1.50	2.01	2.61	3.37	2.42	2.13	1.97
562.680	1.36	1.42	1.46	2.16	2.74	3.45	2.34	2.06	1.88
620.850	1.34	1.40	1.45	2.32	2.86	3.52	2.30	2.02	1.83
679.030	1.38	1.42	1.46	2.41	3.00	3.70	2.25	1.97	1.77
737.210	1.49	1.53	1.57	2.52	3.04	3.73	2.14	1.88	1.69
795.380	1.71	1.73	1.77	2.61	3.14	3.79	2.05	1.80	1.62
853.560	2.04	2.04	2.07	2.67	3.16	3.81	1.94	1.72	1.58
911.740	2.46	2.44	2.44	2.75	3.20	3.82	1.83	1.63	1.52
1000.000	3.20	3.10	3.03	3.06	3.37	3.71	1.64	1.47	1.39

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
10.000	−236.03	+.11
39.088	−235.42	+.13
68.176	−235.70	+.12
100.000	−239.09	+.11
155.440	−243.47	+.21
200.000	−242.64	+.32
242.710	−247.61	+.33
300.880	−243.91	+.47
359.060	−221.38	+.71
417.240	−205.96	+.68
475.410	−209.28	+1.42
504.500	−212.10	+.83
562.680	−205.18	+.13
620.850	−178.98	+.16
679.030	−165.25	−.20
737.210	−159.75	−.87
795.380	−160.74	−1.60
853.560	−159.34	−2.37
911.740	−167.51	−3.31
1000.000	−145.30	−3.69

Measurements at RF & LO Power +7 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	38	17	58	14	54	48	58	58	67
1	-	33	-	39	11	41	33	49	35	51	50	76
2	75	62	40	67	44	59	39	61	35	66	54	63
3	>95	59	40	55	43	58	38	58	55	71	56	67
4	>96	82	>85	78	58	79	60	73	55	73	62	76
5	>95	>83	78	73	61	65	57	67	54	67	64	>84
6	>94	>81	81	>84	82	>84	73	>82	73	82	67	83
7	>94	>83	>82	>83	>83	>83	84	79	78	79	70	78
8	94	>83	>83	>85	>82	>83	>84	>83	83	>82	83	>83
9	>94	>83	>82	>83	>83	>82	>84	>83	>85	>85	>82	>83
10	>93	>82	>82	>84	84	>83	>82	>83	>85	>84	>85	82

Harmonic LO Order

test conditions: RF. IN: FREQ.500.1004 MHZ DRIVE −3.91 DBM
LO. IN: FREQ.470.0085 MHZ DRIVE 6.91 DBM
IF MEASURED: FREQ.30.0922 MHZ AMP. −11.39 DBM

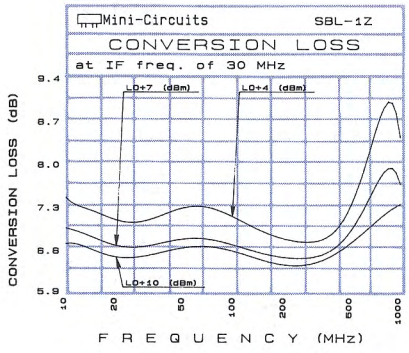
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	26	6	41	2	41	31	44	54	54
1	-	32	-	43	11	36	33	47	34	48	46	72
2	94	71	52	>74	56	68	50	68	43	68	61	73
3	>95	73	59	71	61	71	56	70	67	>73	>72	>73
4	>95	>73	>75	>73	>75	>76	>74	>75	>74	75	>73	>73
5	>95	>72	>73	>74	>75	>75	>74	>73	>74	>74	>74	>73
6	>95	>71	>74	>74	>73	>74	>74	>76	>75	>75	>74	>74
7	>94	>72	>71	>72	>73	>74	>74	>74	>74	>73	>74	>73
8	>95	>74	74	>73	>72	>73	>75	>75	>74	>75	>74	>75
9	>94	>72	>72	>74	>73	73	>72	>73	>73	>75	>74	>75
10	>95	>72	>73	>72	>73	>72	>72	>73	>75	>75	>74	75

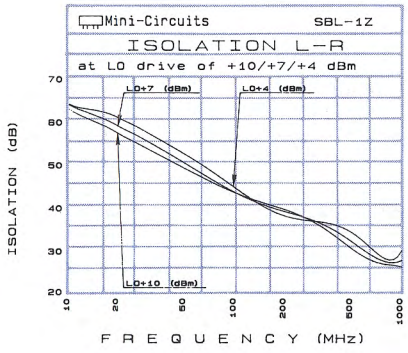
Harmonic LO Order

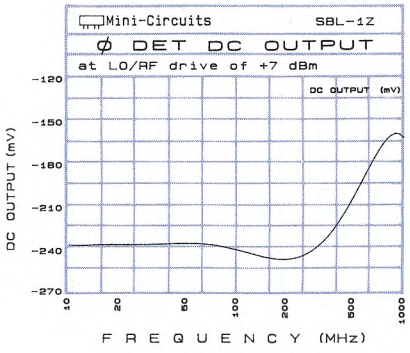
test conditions: RF. IN: FREQ.500.1005 MHZ DRIVE −14.06 DBM
LO. IN: FREQ.470.0085 MHZ DRIVE 6.91 DBM
IF MEASURED: FREQ.30.0922 MHZ AMP. −21.61 DBM

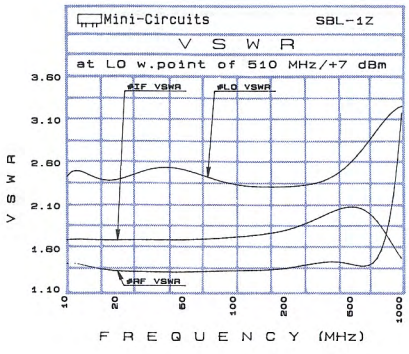
typical performance curves

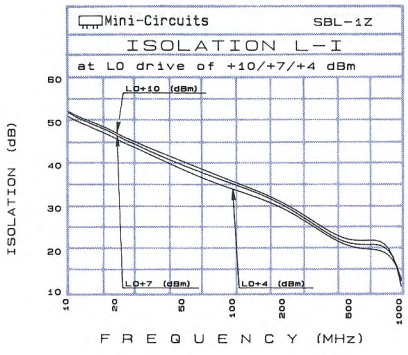
(production unit)

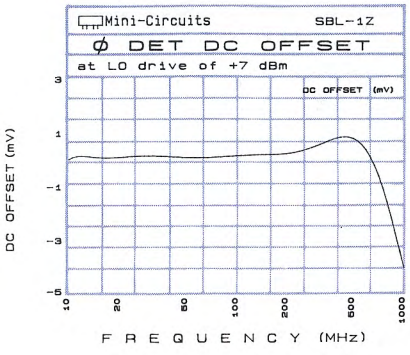












most economical

Frequency Mixers

Model SBL-1-1

LEVEL 7 (+7dBm LO, up to +1dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.100	30.10	6.29	5.97	5.79	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.200	30.20	5.79	5.50	5.33	>64.00	>67.00	>70.00	>64.00	>67.00	>70.00
.500	30.50	5.39	5.10	4.97	>64.00	>67.00	>70.00	>64.00	60.77	58.85
1.000	31.00	5.26	5.03	4.88	>64.00	>67.00	>70.00	>64.00	61.39	59.31
2.000	32.00	5.17	4.95	4.83	>64.00	>67.00	>70.00	>64.00	61.65	59.31
5.000	35.00	5.09	4.94	4.79	>64.00	>67.00	>70.00	>64.00	62.29	59.84
10.000	40.00	5.11	4.92	4.82	>64.00	>67.00	60.40	>64.00	61.63	57.18
20.000	50.00	5.23	5.01	4.91	>64.00	>67.00	59.96	>64.00	61.41	57.08
50.000	80.00	5.11	4.95	4.85	>64.00	57.89	55.46	>64.00	55.93	53.10
69.828	99.83	5.07	4.92	4.82	57.45	53.82	52.57	54.47	51.57	50.50
100.000	70.00	4.98	4.82	4.77	53.52	51.38	50.35	51.19	49.30	48.15
121.450	91.45	5.00	4.86	4.82	52.86	50.92	50.33	50.39	48.83	47.91
155.860	125.86	5.02	4.95	4.87	49.47	48.48	47.39	46.94	46.32	45.35
200.000	170.00	5.19	5.08	4.99	42.69	42.54	43.78	40.65	40.81	42.06
224.690	194.69	5.33	5.23	5.09	42.78	42.61	43.16	40.33	40.35	40.99
241.900	211.90	5.32	5.21	5.10	42.94	43.39	44.16	40.17	40.85	41.71
293.520	263.52	5.41	5.32	5.28	38.29	38.74	39.32	36.72	36.85	37.59
327.930	297.93	5.64	5.57	5.50	36.69	37.88	39.26	35.47	36.40	37.52
379.550	349.55	5.89	5.70	5.54	35.04	36.54	37.94	32.97	33.55	34.49
413.970	383.97	6.34	5.75	5.31	36.38	37.59	38.39	34.55	34.68	33.66

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.38	1.27	1.20	1.50	2.30	3.45	2.13	1.92	1.78
10.000	1.38	1.27	1.20	1.42	2.24	3.20	2.12	1.91	1.77
20.000	1.37	1.27	1.20	1.51	2.26	3.25	2.12	1.90	1.76
34.118	1.35	1.25	1.18	1.47	2.20	3.09	2.13	1.91	1.77
50.000	1.33	1.23	1.16	1.43	2.16	3.02	2.15	1.92	1.78
77.795	1.28	1.18	1.12	1.41	2.11	2.89	2.16	1.93	1.80
100.000	1.25	1.15	1.09	1.40	2.08	2.88	2.21	1.96	1.85
121.470	1.21	1.12	1.07	1.47	2.09	2.94	2.24	2.00	1.87
150.590	1.16	1.09	1.07	1.50	2.12	2.86	2.34	2.05	1.93
179.710	1.13	1.10	1.10	1.51	2.18	2.87	2.42	2.13	1.99
200.000	1.12	1.11	1.14	1.53	2.22	2.96	2.44	2.19	2.04
223.390	1.12	1.15	1.19	1.58	2.23	2.93	2.51	2.24	2.08
252.500	1.14	1.19	1.24	1.64	2.35	3.02	2.55	2.30	2.14
267.060	1.16	1.22	1.27	1.69	2.38	3.05	2.60	2.32	2.17
296.180	1.20	1.27	1.33	1.71	2.43	3.15	2.66	2.37	2.24
325.300	1.24	1.31	1.38	1.80	2.44	3.20	2.68	2.41	2.25
354.420	1.27	1.34	1.41	1.93	2.56	3.26	2.66	2.37	2.25
368.980	1.29	1.35	1.42	2.00	2.65	3.37	2.68	2.42	2.27
383.530	1.29	1.36	1.41	2.09	2.75	3.42	2.65	2.37	2.23
398.090	1.29	1.35	1.41	2.14	2.83	3.52	2.65	2.38	2.23

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.100	−252.07	+.02
.200	−255.06	+.03
.500	−256.56	+.02
1.000	−257.44	+.02
2.000	−256.78	+.02
5.000	−258.91	+.02
10.000	−257.73	+.02
20.000	−259.14	+.03
50.000	−256.04	+.02
73.912	−260.65	+.03
100.000	−261.64	+.05
137.820	−258.93	+.04
159.130	−256.39	+.09
200.000	−257.48	+.15
223.040	−261.16	+.20
244.340	−258.10	+.14
300.000	−236.58	+.14
350.860	−220.32	+.07
372.170	−208.88	−.07
400.000	−197.61	−.18

Measurements at RF & LO Power +7 dBm

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Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>89	-	41	48	40	59	33	49	33	52	41	72
1	>89	20	-	31	11	39	18	39	27	43	43	52
2	76	56	69	61	64	63	65	64	52	56	48	64
3	85	51	44	50	45	58	45	52	41	55	45	53
4	85	73	64	74	66	72	66	76	67	72	66	67
5	85	>83	59	67	63	69	57	66	54	66	53	73
6	85	80	82	79	77	>83	74	>84	75	>84	74	>83
7	84	80	76	82	69	79	72	77	74	76	70	74
8	86	80	79	80	80	>83	>83	>83	83	>84	>84	>84
9	86	79	80	80	80	80	81	>83	77	82	>83	81
10	85	80	80	80	80	80	81	>83	>83	>83	>83	>83

Harmonic LO Order

test conditions: RF = 185.100 MHZ INPUT P. −3.91DBM
LO = 155.010 MHZ INPUT P. +6.83DBM
IF = 30.090 MHZ IF = AMPLIT. −9.36 DBM

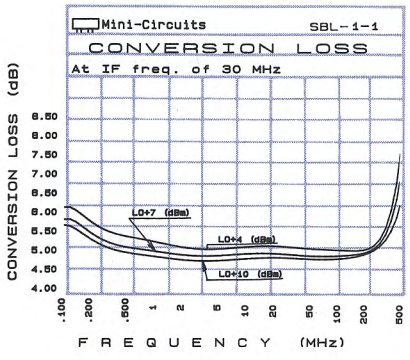
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>80	-	34	37	29	47	21	34	20	43	26	60
1	>80	20	-	32	12	36	17	40	26	40	42	48
2	>80	62	61	64	59	67	60	63	54	58	52	68
3	>80	72	59	67	63	67	57	>73	57	66	58	>73
4	>80	>73	>73	>73	>73	>74	>74	>74	>73	>73	>73	>73
5	>80	>73	>73	>73	>73	>73	>74	>74	>74	>73	>73	>73
6	>80	69	>73	>73	>73	>73	>73	>74	>74	>74	>73	>73
7	>80	70	70	>73	>73	>73	>73	>73	>74	>74	>74	>73
8	>80	69	70	69	68	>73	>73	>73	>73	>74	>74	>74
9	>80	69	69	70	71	70	>73	>73	>73	>73	>73	>74
10	>79	70	70	70	70	70	70	>73	>73	>73	>73	>73

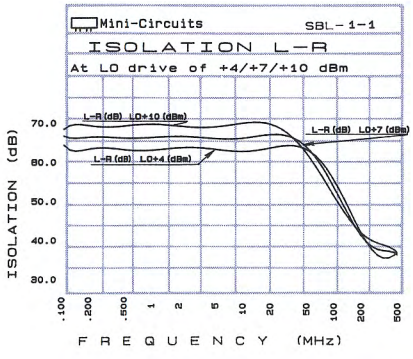
HARMONIC LO ORDER

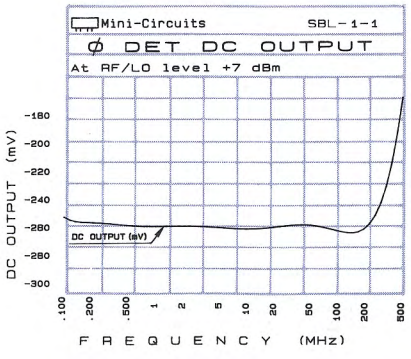
test conditions: RF 185.100 MHZ INPUT P. −13.96DBM
LO 155.010 MHZ INPUT P. +6.83DBM
IF = 30.090MHZ IF = AMPLIT. −19.44 DBM

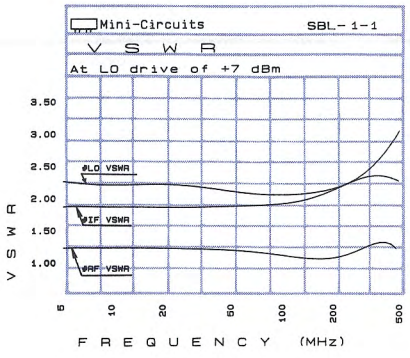
typical performance curves

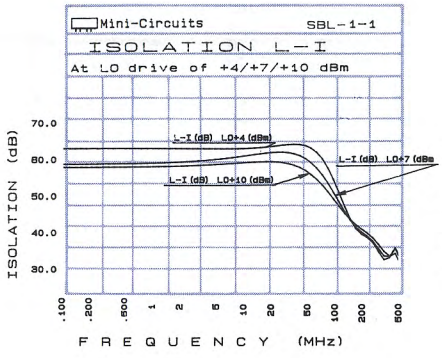
(production unit)

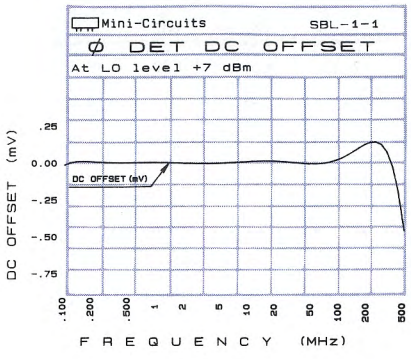












most widely-used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model SBL-3

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.025	30.025	9.03	8.41	8.05	.025	68.38	70.32	73.64	71.48	73.42	79.24
.040	30.040	7.34	6.80	6.48	.040	64.91	68.24	72.87	70.01	73.04	81.87
.050	30.050	6.79	6.31	6.01	.050	64.32	68.06	72.79	69.72	73.56	83.69
.100	30.100	5.94	5.51	5.27	.100	63.53	67.57	72.70	69.83	74.37	88.60
.200	30.200	5.67	5.27	5.02	.200	63.80	67.72	72.52	69.80	74.82	91.52
.500	30.500	5.53	5.15	4.92	.500	63.65	67.66	72.44	70.15	75.16	95.14
1.000	31.000	5.38	4.98	4.80	1.000	63.35	67.06	71.74	69.95	74.46	89.64
2.000	32.000	5.27	4.89	4.71	2.000	63.09	66.83	71.61	69.19	74.03	87.61
5.000	35.000	5.26	4.86	4.70	5.000	63.12	66.56	70.96	68.22	72.56	82.86
10.000	40.000	5.34	4.93	4.75	10.000	62.81	66.04	69.84	65.21	69.54	77.34
20.000	50.000	5.48	5.06	4.81	20.000	61.82	64.65	67.17	59.82	63.95	70.07
30.790	60.790	5.54	5.13	4.90	30.790	60.76	63.14	65.62	56.36	60.24	64.82
38.482	68.482	5.56	5.16	4.92	38.482	60.50	62.80	64.66	54.22	57.90	61.76
50.000	80.000	5.47	5.09	4.88	50.000	59.30	61.63	62.89	51.24	53.78	57.85
76.938	46.938	5.45	4.97	4.80	76.938	57.86	58.56	59.12	45.53	48.75	53.79
100.000	70.000	5.16	4.81	4.70	100.000	57.01	58.22	58.59	42.87	46.67	51.18
123.087	93.087	5.13	4.85	4.77	123.087	53.35	52.38	52.58	40.55	44.01	47.17
146.161	116.161	5.21	4.94	4.84	146.161	61.41	58.82	56.52	41.29	46.22	49.60
176.926	146.926	5.43	5.26	5.18	176.926	51.71	51.25	50.35	37.12	39.55	42.10
200.000	170.000	5.53	5.36	5.29	200.000	44.42	44.86	46.05	36.79	38.02	37.46

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.67	1.44	1.28	1.25	1.33	2.01	5.000	1.78	1.61	1.51	.025	−233.99	−.30
10.000	1.68	1.45	1.29	1.25	1.32	1.99	10.000	1.79	1.63	1.52	.030	−261.03	−.32
16.143	1.69	1.45	1.29	1.28	1.29	1.96	16.143	1.80	1.63	1.53	.050	−293.94	−.29
20.000	1.68	1.44	1.28	1.29	1.28	1.94	20.000	1.80	1.63	1.53	.100	−309.10	−.25
27.286	1.68	1.43	1.28	1.22	1.34	1.99	27.286	1.80	1.64	1.53	.500	−318.60	−.24
32.857	1.68	1.43	1.27	1.19	1.35	2.04	32.857	1.81	1.64	1.54	1.000	−320.60	−.24
38.429	1.67	1.43	1.27	1.19	1.37	2.02	38.429	1.82	1.65	1.54	2.000	−317.20	−.23
50.000	1.67	1.42	1.25	1.19	1.37	2.01	50.000	1.85	1.68	1.57	10.000	−318.80	−.22
60.714	1.67	1.40	1.24	1.21	1.36	2.00	60.714	1.88	1.70	1.59	20.000	−312.40	−.23
71.857	1.66	1.39	1.22	1.22	1.36	1.98	71.857	1.93	1.74	1.63	30.790	−316.60	−.24
83.000	1.64	1.37	1.20	1.23	1.35	1.98	83.000	1.97	1.78	1.66	46.173	−314.90	−.26
94.143	1.62	1.35	1.17	1.24	1.36	1.99	94.143	2.02	1.82	1.70	53.864	−314.80	−.25
100.000	1.60	1.33	1.16	1.25	1.36	1.98	100.000	2.04	1.85	1.72	69.247	−309.50	−.22
116.429	1.56	1.29	1.12	1.25	1.39	2.01	116.429	2.12	1.91	1.78	92.321	−317.30	−.07
127.571	1.53	1.26	1.10	1.28	1.41	2.01	127.571	2.19	1.98	1.84	100.013	−318.90	−.08
133.143	1.53	1.26	1.10	1.29	1.45	2.00	133.143	2.27	2.04	1.90	107.704	−313.80	−.09
149.857	1.47	1.22	1.07	1.29	1.49	2.03	149.857	2.37	2.13	1.98	130.778	−313.30	−.07
166.571	1.43	1.19	1.07	1.29	1.51	2.07	166.571	2.50	2.25	2.09	153.852	−318.70	+.45
183.286	1.38	1.17	1.09	1.36	1.55	2.10	183.286	2.67	2.38	2.20	176.926	−319.90	+.26
200.000	1.34	1.18	1.14	1.44	1.60	2.10	200.000	2.82	2.52	2.31	200.000	−312.20	−.13

Measurements at RF & LO Power +7 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	30	42	28	52	33	45	42	45	45	52
1	–	32	0	36	12	38	25	34	51	33	36	39
2	93	76	61	77	62	>77	63	>77	63	76	69	76
3	>97	73	70	73	62	75	55	68	55	66	55	70
4	>97	>77	>76	>77	>77	76	73	>77	77	76	75	>78
5	>97	>78	77	>78	77	>77	75	>77	75	76	76	>78
6	>97	>78	76	>77	76	>77	76	>77	>77	77	>78	>78
7	>97	>77	>78	>78	>77	>77	76	76	>77	>78	>77	>77
8	>97	75	>77	76	>77	77	74	>77	76	>77	74	>78
9	>97	>77	>77	>77	75	>77	>78	>78	>77	>78	>77	>77
10	>96	>78	>78	>78	>78	>78	>77	>78	>77	>78	76	>77

LO Harmonic Order

test conditions: RF IN: 10.10 MHZ; −14.06 DBM
LO IN: 40.01 MHZ; +6.97 DBM
IF OUT: 29.91 MHZ; −18.97 DBM

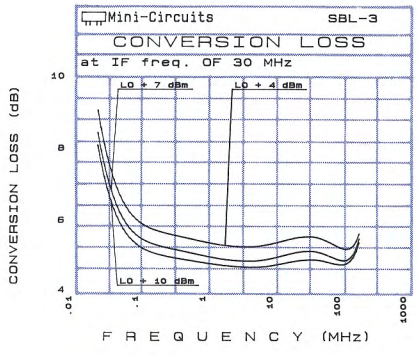
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	41	52	40	65	45	57	56	59	57	65
1	–	33	0	38	12	41	23	37	37	38	48	45
2	81	86	62	84	60	82	60	72	63	68	68	70
3	86	57	55	58	63	58	50	53	49	51	47	54
4	>97	>87	71	>87	71	>88	72	86	72	85	75	86
5	>97	81	70	84	64	80	60	72	58	70	57	70
6	>96	>87	79	>87	81	>87	82	84	82	>87	82	85
7	>97	84	82	86	72	>87	69	86	68	84	68	86
8	>97	>87	86	>86	>87	>88	>87	>88	>88	86	>87	>87
9	>97	>87	86	>87	80	>87	77	>88	76	>87	76	>87
10	>96	>87	>88	87	>87	>88	86	>88	>88	>87	>87	>87

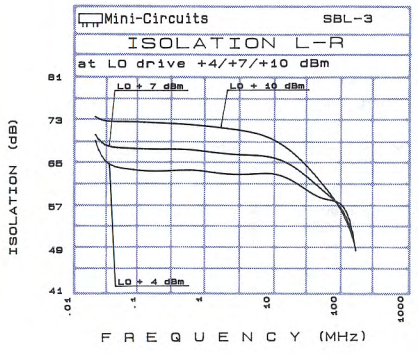
LO Harmonic Order

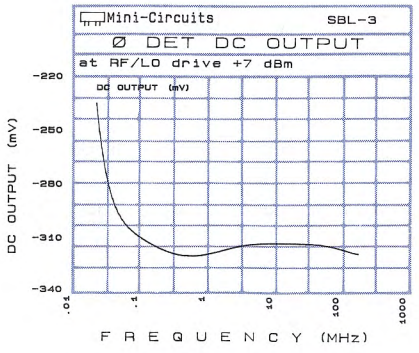
test conditions: RF IN: 10.10 MHZ; −4.06 DBM
LO IN: 40.01 MHZ; +6.97 DBM
IF OUT: 29.91 MHZ; −9.00 DBM

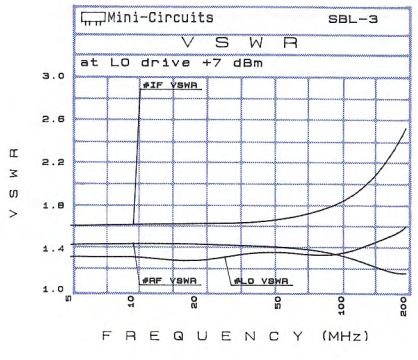
typical performance curves

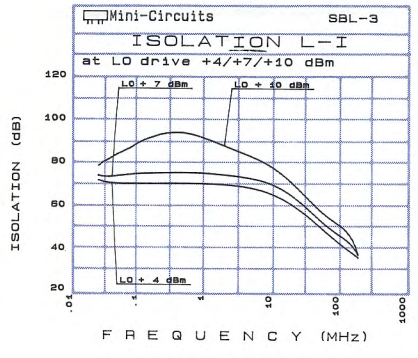
(production unit)

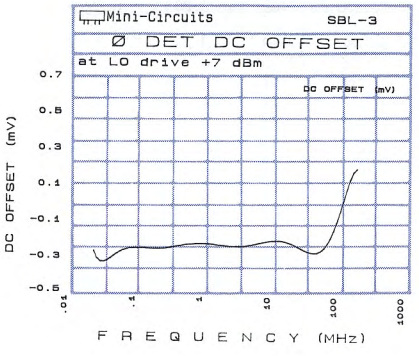












In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-5
ZLW-5

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	5.26	5.19	5.23	46.45	47.86	48.59	48.34	49.36	49.99
20.000	50.00	6.29	6.09	5.99	46.85	48.24	48.94	48.18	49.31	50.03
51.719	81.72	6.53	6.29	6.17	46.29	47.39	47.85	47.82	48.80	49.03
145.160	115.16	6.65	6.43	6.31	43.70	43.93	43.85	43.97	44.02	43.97
238.600	208.60	6.98	6.60	6.33	40.89	40.69	40.39	40.01	39.98	39.94
332.030	302.03	7.18	6.70	6.41	38.95	38.28	37.72	37.38	37.11	36.86
425.470	395.47	7.78	7.15	6.76	37.52	36.61	36.03	34.44	34.20	33.94
500.000	470.00	7.62	7.01	6.68	36.23	35.64	35.02	35.68	34.86	33.97
565.630	535.63	7.85	7.33	6.97	35.19	34.43	33.73	35.23	34.15	32.88
659.070	629.07	8.32	7.84	7.51	34.06	33.47	32.87	33.96	32.77	31.70
752.500	722.38	7.85	7.61	7.43	33.77	33.21	32.96	32.65	31.65	30.92
845.940	816.02	7.55	7.30	7.14	33.17	32.60	31.98	32.17	31.29	30.04
939.380	909.31	7.42	7.20	7.07	31.66	31.12	30.52	33.22	31.57	30.00
1000.000	969.82	7.31	7.11	6.99	31.06	30.45	30.03	33.33	31.53	30.18
1079.500	1049.30	7.28	7.08	6.94	31.01	30.12	29.69	32.96	31.21	29.64
1173.000	1143.00	7.34	7.05	6.97	31.12	30.51	29.72	33.13	30.75	28.48
1266.400	1236.40	7.83	7.40	7.15	32.81	32.04	31.40	33.08	29.64	26.95
1359.900	1329.80	7.95	7.48	7.21	35.41	35.34	35.27	32.11	27.77	25.26
1453.300	1423.30	8.31	7.81	7.56	39.62	36.11	33.37	37.02	32.82	30.65
1500.000	1469.90	8.24	7.78	7.55	38.41	36.51	34.92	40.65	37.91	36.13

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	2.87	2.75	2.71	2.31	3.11	4.50	3.79	3.85	3.69
10.000	2.32	2.18	2.10	1.89	2.80	4.01	1.87	1.92	1.93
50.000	2.22	2.05	1.95	1.90	2.89	4.29	1.24	1.36	1.41
100.000	2.29	2.13	2.03	1.78	2.58	3.54	1.14	1.26	1.33
200.000	2.76	2.53	2.38	1.78	2.57	3.54	1.15	1.25	1.37
285.310	3.11	2.88	2.68	1.78	2.43	3.26	1.18	1.28	1.41
378.750	3.64	3.26	3.08	1.75	2.30	3.07	1.24	1.33	1.47
472.190	3.57	3.35	3.26	1.71	2.18	2.82	1.34	1.42	1.56
518.910	3.68	3.49	3.40	1.68	2.13	2.75	1.40	1.51	1.63
612.340	3.40	3.28	3.19	1.66	1.99	2.56	1.55	1.65	1.75
705.780	3.19	3.24	3.12	1.68	1.93	2.48	1.83	1.98	2.05
799.220	3.25	3.37	3.40	1.69	1.84	2.31	2.46	2.76	2.86
892.660	2.67	2.65	2.55	1.69	1.76	2.20	2.57	2.87	2.90
986.090	2.58	2.54	2.46	1.67	1.67	2.00	3.22	3.49	3.48
1032.800	2.49	2.46	2.36	1.68	1.60	1.91	3.44	3.77	3.72
1126.300	2.37	2.33	2.24	1.63	1.50	1.78	4.47	4.66	4.59
1219.700	2.23	2.20	2.08	1.56	1.39	1.67	4.74	4.93	4.80
1313.100	2.17	2.11	2.00	1.44	1.32	1.66	4.78	5.06	4.78
1406.600	2.04	2.08	1.88	1.37	1.25	1.62	3.90	4.40	3.86
1500.000	2.22	2.32	2.11	1.25	1.24	1.65	8.43	12.01	8.31

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	34	26	45	44	52	40	58	70	67
1	–	16	–	69	23	38	34	39	47	58	50	55
2	>94	58	52	53	43	72	51	65	55	60	53	63
3	>95	65	45	65	69	52	52	80	52	81	58	70
4	>96	79	78	74	67	73	59	78	63	77	67	68
5	>96	80	83	>83	65	>84	56	69	71	79	64	64
6	>90	>79	>85	>85	77	82	76	82	68	>83	70	>85
7	>89	>78	>78	>83	>85	>84	79	>84	70	80	>84	>83
8	>91	>79	>78	>78	>84	>85	>85	>85	>85	>84	77	>84
9	>89	>78	>78	>78	>78	>84	>84	>84	>84	>85	81	>84
10	>90	>78	>79	>79	>77	>78	>85	>84	>84	>84	>85	>84

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE –3.99 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 6.94 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. –11.24 DBM

RF ORDER HARMONIC

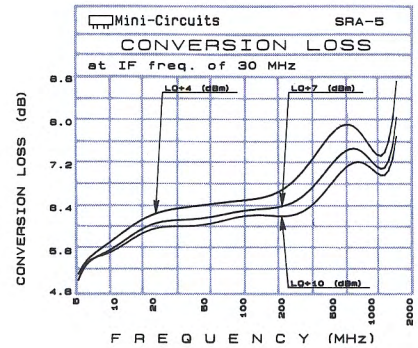
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	24	15	34	32	38	26	40	54	49
1	–	16	–	29	23	38	72	35	43	52	42	45
2	>95	63	63	60	52	72	56	72	61	64	55	64
3	>96	>73	65	>74	57	70	71	>75	69	67	73	>68
4	>96	>74	>74	>74	>74	>75	>74	>74	>73	>75	>75	>75
5	>95	>74	>75	>74	>73	>75	>74	>74	>74	>74	>74	>75
6	>89	>68	>74	>75	>75	>75	>75	>74	>74	>74	>72	>75
7	>89	>67	>68	>75	>74	>75	>74	>75	>75	>74	>73	>74
8	>90	>69	>68	>68	>74	>76	>74	74	>73	>74	>75	>74
9	>91	69	>69	>69	69	>74	>73	>74	>74	>74	>74	>74
10	>90	>68	>69	>68	>69	>67	>74	>75	>74	>73	>74	>73

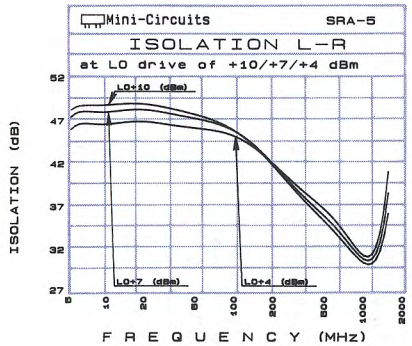
Harmonic LO Order

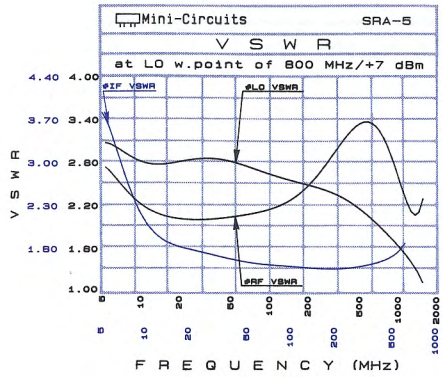
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE –14.04 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 7 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. –21.25 DBM

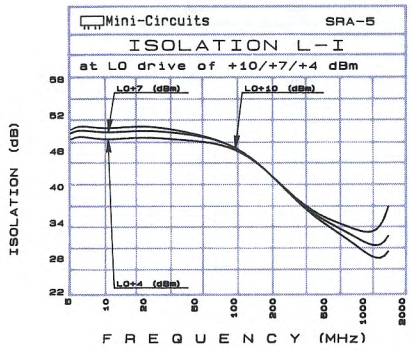
typical performance curves

(production unit)









In Stock...Immediate Delivery

most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
SRA-4
ZAD-4



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.00	6.20	5.79	5.59	>64.00	>67.00	67.93	>64.00	>67.00	>70.00
10.000	40.00	6.26	5.84	5.60	>64.00	65.29	64.57	>64.00	>67.00	66.23
20.000	50.00	6.29	5.86	5.61	61.44	60.94	59.26	62.27	62.65	60.88
50.000	80.00	6.21	5.81	5.59	54.39	53.43	51.96	56.06	54.72	53.49
121.720	91.72	6.23	5.83	5.65	47.32	46.46	45.38	48.15	47.50	46.41
199.530	169.53	6.51	6.05	5.80	43.86	43.59	42.89	44.96	44.16	43.05
238.440	208.44	6.54	6.06	5.82	42.86	42.83	42.10	44.17	43.15	42.01
316.250	286.25	6.53	6.13	5.88	40.35	40.50	40.30	41.79	40.40	39.25
394.060	364.06	6.68	6.22	5.98	38.40	38.94	38.73	40.33	38.72	37.59
471.870	441.87	7.07	6.61	6.43	37.52	37.04	37.76	39.42	38.51	38.50
549.680	519.68	6.92	6.55	6.33	34.62	35.20	34.82	36.71	36.00	35.34
588.590	558.59	6.75	6.42	6.22	34.10	35.15	35.39	35.43	35.26	34.89
666.400	636.40	6.31	5.83	5.62	33.00	34.65	36.01	35.87	36.42	37.60
744.210	714.21	6.48	5.84	5.52	33.58	33.43	34.37	37.35	37.93	38.56
822.030	792.03	6.52	6.00	5.57	32.19	33.14	33.71	35.23	35.39	36.51
899.840	869.84	6.26	5.78	5.49	31.98	33.09	33.50	32.30	32.26	32.82
977.650	947.65	6.02	5.48	4.98	32.50	32.58	33.12	29.54	30.17	30.75
1055.500	1025.50	6.40	6.01	5.77	31.24	31.93	33.07	29.21	30.37	31.94
1172.200	1142.20	6.86	6.59	6.51	31.96	32.33	32.22	31.58	33.65	36.10
1250.000	1220.00	7.61	7.40	7.35	30.54	30.84	30.36	33.65	35.76	37.50

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.002	2.31	2.00	1.65	2.06	2.93	4.28	1.36	1.48	1.58
10.000	2.31	2.00	1.65	1.96	2.80	4.16	1.27	1.40	1.51
20.000	2.31	2.02	1.67	1.92	2.71	4.05	1.26	1.40	1.51
50.000	2.32	2.03	1.65	2.00	2.82	4.17	1.29	1.43	1.55
121.720	2.45	2.14	1.79	1.86	2.56	3.67	1.33	1.46	1.56
199.530	2.62	2.36	2.04	1.86	2.53	3.50	1.39	1.50	1.60
238.440	2.71	2.49	2.18	1.86	2.50	3.45	1.41	1.52	1.61
316.250	2.91	2.72	2.42	1.92	2.57	3.37	1.41	1.52	1.61
394.060	2.98	2.80	2.55	2.00	2.57	3.27	1.39	1.49	1.57
471.880	2.90	2.67	2.44	2.10	2.63	3.28	1.32	1.40	1.45
549.690	2.77	2.52	2.28	2.21	2.66	3.25	1.19	1.25	1.28
588.590	2.66	2.36	2.15	2.22	2.61	3.21	1.10	1.17	1.21
666.410	2.52	2.19	1.94	2.38	2.80	3.29	1.16	1.19	1.28
744.220	2.41	2.03	1.71	2.53	2.98	3.43	1.52	1.53	1.62
822.030	2.37	2.04	1.70	2.65	3.12	3.58	2.05	2.05	2.18
899.840	2.43	2.21	1.88	2.74	3.17	3.57	2.76	2.72	2.78
977.660	2.46	2.42	2.09	2.71	3.14	3.43	3.57	3.47	3.43
1055.500	2.30	2.32	2.09	2.71	3.13	3.46	4.37	4.25	4.10
1172.200	2.01	2.10	2.07	3.25	3.47	3.67	5.02	4.84	4.69
1250.000	2.00	2.15	2.29	3.62	3.60	3.88	5.25	4.79	4.64

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mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	32	23	36	43	35	44	36	61	46	63
1	–	17	–	39	17	33	37	38	39	39	47	51
2	81	43	60	45	56	51	60	65	52	58	41	69
3	>95	44	34	49	35	49	36	45	50	52	57	50
4	>95	76	68	56	72	56	61	57	65	76	75	66
5	>95	66	75	67	53	57	48	58	47	71	70	67
6	>94	69	76	>83	84	70	71	64	75	64	78	79
7	>95	72	71	73	74	73	67	64	63	63	61	71
8	>96	>85	>84	>81	>85	85	>85	>83	76	73	76	71
9	>94	>85	>83	>84	>83	>84	>85	>83	77	71	71	71
10	>96	>84	>84	>83	>85	>84	>83	>84	>84	>83	81	81

Harmonic LO Order

test conditions: RF = IN: FREQ.500.1 MHZ DRIVE -3.97 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 7.04 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -11.06 DBM

RF CAL

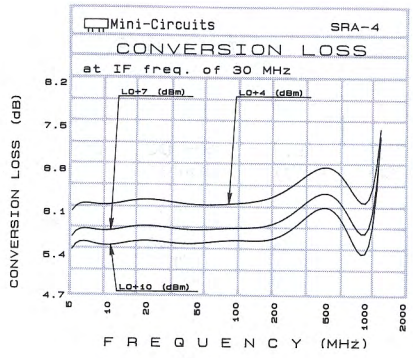
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	22	14	26	30	20	31	19	40	29	43
1	–	18	–	36	17	29	33	33	34	31	40	37
2	>95	49	65	48	67	50	62	62	59	52	42	62
3	>95	64	55	64	53	67	51	63	71	67	68	67
4	>94	>73	>74	>74	>75	74	>75	71	>74	>74	>73	>72
5	>94	>74	>73	>73	>75	>74	>75	>73	>75	>75	74	>74
6	96	>74	>74	>72	>75	>74	>73	>74	>73	>74	>75	>73
7	>96	>75	>73	>73	>74	>74	>74	>74	>74	>74	>74	>73
8	>97	>74	>74	>75	>73	>74	>73	>74	75	>73	>76	>74
9	>94	>75	>74	>75	>74	>74	>74	>72	>73	>75	>73	>73
10	96	>75	>73	>75	>75	>74	>74	>74	>74	>73	>74	>74

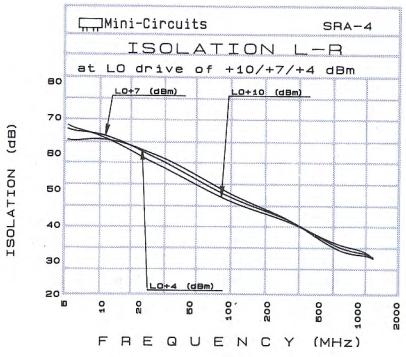
Harmonic LO Order

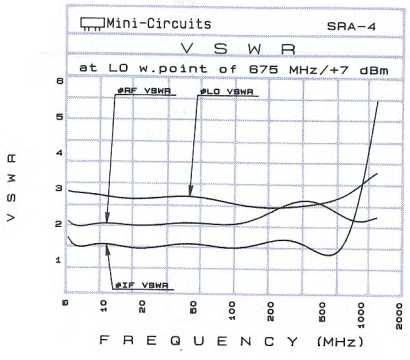
test condition: RF. = IN: FREQ.500.1 MHZ DRIVE -13.99 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 7.03 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -21.17 DBM

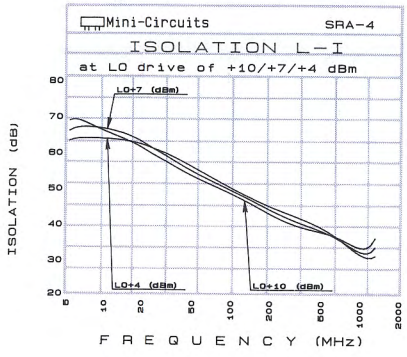
typical performance curves

(production unit)









most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
ZP-10514

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.200	30.20	9.17	8.36	7.86	>64.00	59.54	62.04	52.01	51.65	53.47
.500	30.50	7.55	6.85	6.42	55.84	57.86	60.96	49.41	50.98	53.52
2.000	32.00	6.82	6.13	5.80	54.49	56.96	59.91	49.09	50.94	53.57
10.000	40.00	6.29	5.67	5.35	53.72	55.15	56.21	48.79	50.65	52.76
32.445	62.45	6.01	5.43	5.20	51.70	51.84	51.79	47.98	49.39	50.53
64.690	94.69	6.23	5.61	5.29	49.42	48.95	48.04	46.61	47.53	47.89
100.000	70.00	6.17	5.53	5.27	48.04	47.52	46.63	46.06	46.53	46.75
145.300	115.30	6.36	5.74	5.42	46.01	45.03	44.42	44.48	44.48	44.82
177.550	147.55	5.96	5.41	5.24	43.72	42.85	42.50	42.67	42.69	43.01
200.000	170.00	6.26	5.73	5.48	42.35	41.70	41.42	41.45	41.72	41.88
225.920	195.92	5.96	5.49	5.30	41.03	40.73	40.48	40.28	40.61	40.65
258.160	228.16	6.13	5.71	5.47	39.27	39.01	39.10	38.71	39.00	39.35
290.410	260.41	5.90	5.50	5.27	38.44	38.47	38.27	37.99	38.33	38.28
322.650	292.65	6.18	5.79	5.51	37.51	37.73	37.71	36.88	37.34	37.49
354.900	324.90	5.88	5.52	5.28	36.11	36.24	36.64	35.77	35.86	36.45
387.140	357.14	5.97	5.63	5.40	35.06	35.26	35.53	34.86	34.80	35.10
419.390	389.39	6.15	5.74	5.44	34.65	35.03	35.44	34.28	34.31	34.71
435.510	405.51	6.00	5.66	5.43	34.42	35.44	35.96	34.08	34.71	35.19
467.750	437.75	6.48	6.15	5.88	33.63	35.03	35.77	33.16	34.13	34.76
500.000	470.00	6.29	5.98	5.77	33.08	34.57	35.18	32.48	33.52	33.89

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.19	1.28	1.46	2.33	1.46	1.41	1.41	1.59	1.87
10.000	1.15	1.26	1.47	2.30	1.41	1.34	1.41	1.60	1.88
20.000	1.12	1.25	1.45	2.25	1.39	1.33	1.40	1.58	1.86
34.118	1.11	1.24	1.45	2.30	1.48	1.14	1.41	1.59	1.89
63.235	1.09	1.21	1.42	2.23	1.45	1.15	1.39	1.57	1.84
100.000	1.08	1.20	1.40	2.15	1.42	1.16	1.39	1.57	1.83
121.470	1.08	1.20	1.41	2.08	1.39	1.18	1.41	1.60	1.88
150.590	1.08	1.19	1.40	2.09	1.38	1.20	1.42	1.61	1.90
179.710	1.07	1.17	1.36	2.02	1.36	1.22	1.40	1.58	1.86
200.000	1.07	1.17	1.37	2.01	1.37	1.22	1.43	1.62	1.90
237.940	1.08	1.16	1.35	1.97	1.36	1.26	1.44	1.62	1.91
267.060	1.09	1.16	1.35	2.01	1.42	1.24	1.47	1.65	1.93
296.180	1.10	1.16	1.33	2.08	1.43	1.29	1.45	1.63	1.89
339.850	1.14	1.19	1.34	2.02	1.51	1.32	1.49	1.66	1.94
354.410	1.15	1.20	1.36	2.03	1.53	1.34	1.53	1.71	2.01
383.530	1.17	1.22	1.35	2.06	1.58	1.37	1.54	1.70	1.98
398.090	1.19	1.24	1.38	2.07	1.58	1.39	1.58	1.76	2.07
427.210	1.21	1.26	1.38	2.19	1.62	1.44	1.59	1.76	2.03
470.880	1.26	1.30	1.42	2.17	1.67	1.54	1.66	1.82	2.11
500.000	1.27	1.32	1.42	2.17	1.65	1.57	1.67	1.82	2.08

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.200	−232.81	−.83
1.000	−291.85	−.86
5.000	−305.20	−.83
33.520	−303.90	−.79
66.840	−301.66	−.79
100.000	−303.60	−.88
116.820	−301.78	−.92
150.140	−302.79	−.98
183.460	−308.60	−1.01
200.120	−312.40	−1.03
233.440	−320.90	−.83
266.760	−323.40	−.95
300.080	−327.00	−.54
333.400	−313.00	−.09
350.060	−302.94	−.03
383.380	−289.39	−.14
400.040	−282.90	−.16
433.360	−277.11	−.14
466.680	−279.21	−.33
500.000	−279.37	−.73

Measurements at RF & LO Power +7 dBm

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	29	32	44	47	48	46	61	53	50	64
1	-	18	-	42	14	46	28	41	39	41	32	45
2	75	62	62	63	60	64	59	63	63	59	61	64
3	97	54	58	55	52	58	44	>84	42	56	40	53
4	>96	80	72	76	71	76	71	75	73	76	77	75
5	>95	72	71	74	61	77	56	75	55	71	56	70
6	>97	>85	84	>85	83	84	83	84	>85	>83	>85	>86
7	>96	82	78	82	76	83	71	83	71	82	74	82
8	>95	>86	>85	>85	85	>86	>86	>88	>85	>85	>86	>85
9	>95	>86	>85	>85	>85	>86	>85	>85	>85	>85	>86	>85
10	>96	>84	>85	>84	>86	>86	>85	86	>86	>85	>86	>85

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1003 MHZ DRIVE −4.96 DBM
LO.=IN: FREQ.155.0097 MHZ DRIVE 7 DBM
IF=MEASURED: FREQ.30.0909 MHZ AMP. −10.72 DBM

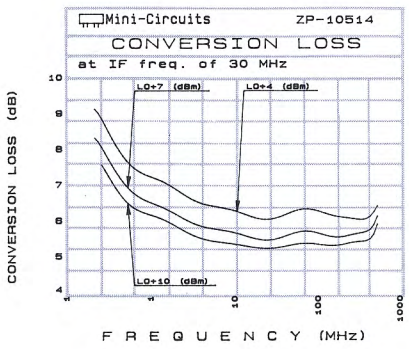
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	22	32	35	35	34	39	39	32	51
1	-	18	-	39	15	42	37	36	28	35	25	41
2	87	72	64	69	63	65	64	65	68	64	74	69
3	>96	69	69	71	59	72	55	>75	53	72	54	70
4	>95	>75	>75	>76	>75	>75	>75	>75	>74	>75	>77	>76
5	>96	>75	>75	>74	>75	>75	>74	>75	>76	>75	>75	>75
6	>96	>75	>75	>76	>76	>76	>75	>74	>76	75	>76	>76
7	>96	>75	>75	>74	>75	>75	>75	>75	>75	>74	76	>75
8	>96	>75	>76	>75	>75	>75	>77	>75	>75	>76	>74	>76
9	>95	>75	>75	>73	>75	>74	>76	>75	>76	>76	>76	>75
10	>96	>74	>74	>74	>75	>75	>76	>75	>75	>76	>75	>76

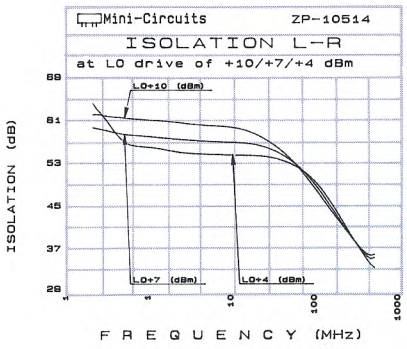
Harmonic LO Order

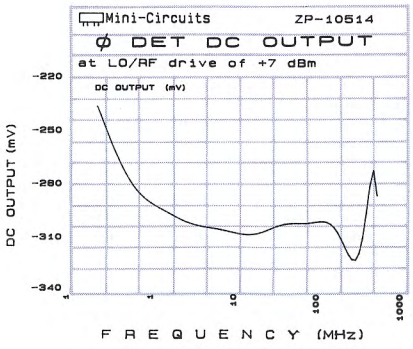
test conditions: RF.=IN: FREQ.185.1004 MHZ DRIVE −14.95 DBM
LO.=IN: FREQ.155.0097 MHZ DRIVE 7 DBM
IF=MEASURED: FREQ.30.0909 MHZ AMP. −20.81 DBM

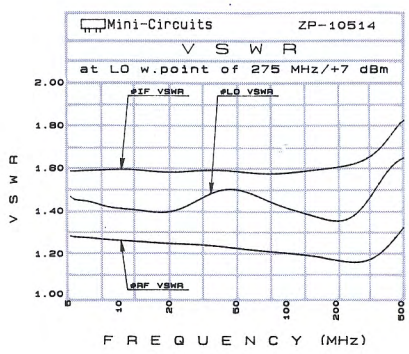
typical performance curves

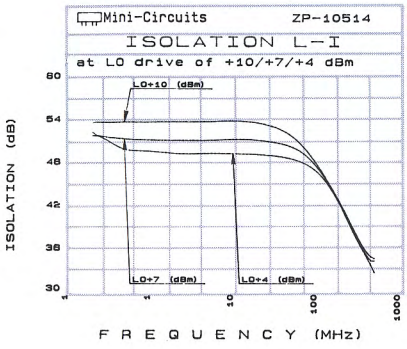
(production unit)

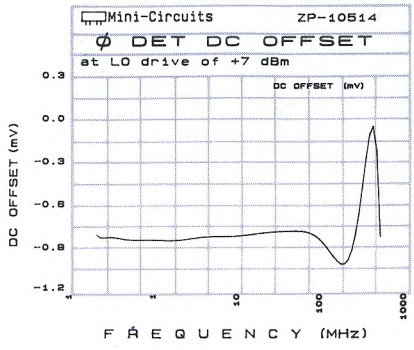












broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Models
TFM-15
ZFM-15



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–I (dB) LO +7dBm	LO +10dBm	LO +13dBm
10.000	40.00	7.09	6.53	6.23	23.88	26.10	27.81	23.04	25.08	27.01
20.000	50.00	7.15	6.60	6.36	28.07	30.38	32.40	27.25	29.74	31.89
100.000	70.00	7.10	6.55	6.27	33.54	35.82	38.01	32.56	35.93	38.89
200.000	170.00	7.14	6.60	6.32	35.25	37.35	39.48	34.67	38.21	41.31
400.000	370.00	7.36	6.74	6.38	35.50	36.49	37.50	37.43	39.50	39.44
500.000	470.00	7.13	6.52	6.23	34.59	35.42	36.65	37.49	38.00	37.53
790.000	760.00	7.40	6.70	6.39	31.76	32.94	34.27	35.00	33.60	34.14
920.000	890.00	7.71	6.76	6.35	30.94	32.80	34.84	33.13	33.97	33.68
1180.000	1150.00	8.13	7.30	6.99	30.06	31.62	33.62	31.75	32.89	33.47
1310.000	1280.00	8.32	7.30	6.91	29.59	31.27	33.27	32.10	34.31	35.08
1500.000	1470.00	7.32	6.54	6.25	28.50	29.76	30.77	30.68	32.85	34.76
1700.000	1670.00	7.69	6.91	6.53	28.13	28.49	28.63	31.86	30.87	31.34
1830.000	1800.00	7.60	6.97	6.65	28.52	29.46	29.52	29.41	28.22	28.72
2000.000	1970.00	7.61	7.07	6.84	27.07	28.32	29.26	28.50	27.77	27.62
2200.000	2170.00	7.47	6.97	6.80	27.16	27.89	28.41	29.65	27.68	25.61
2480.000	2450.00	7.51	6.93	6.70	28.24	28.37	28.05	25.87	24.64	20.89
2610.000	2580.00	7.71	7.08	6.90	27.17	27.10	27.02	24.02	23.13	20.35
2740.000	2710.00	8.11	7.45	7.20	27.49	26.79	26.50	22.65	21.95	20.52
2870.000	2840.00	8.18	7.56	7.37	26.75	26.23	24.58	21.48	21.25	20.52
3000.000	2970.00	8.63	8.31	8.20	27.78	29.30	29.14	20.68	20.32	19.50

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
10.000	2.11	1.84	1.62	1.62	1.71	2.26	1.56	1.45	1.39
20.000	1.77	1.54	1.35	1.26	1.51	2.32	1.48	1.29	1.22
50.000	1.75	1.50	1.30	1.08	1.37	2.18	1.50	1.25	1.17
100.000	1.81	1.55	1.33	1.07	1.44	2.07	1.53	1.26	1.17
200.000	2.02	1.72	1.48	1.23	1.40	1.96	1.56	1.27	1.19
316.150	2.26	1.99	1.72	1.43	1.34	1.78	1.56	1.26	1.20
500.000	2.79	2.45	2.22	1.75	1.33	1.57	1.55	1.23	1.19
622.300	3.09	2.70	2.51	1.96	1.36	1.40	1.52	1.20	1.16
851.920	3.28	2.85	2.67	2.19	1.36	1.11	1.43	1.16	1.07
1000.000	3.18	2.75	2.04	2.35	1.38	1.12	1.40	1.20	1.24
1200.000	2.64	2.28	1.96	1.98	1.30	1.33	1.48	1.37	1.14
1311.100	2.23	1.94	1.83	1.74	1.27	1.51	1.58	1.48	1.04
1500.000	1.63	1.44	1.52	1.27	1.29	1.75	1.74	1.56	1.19
1617.300	1.38	1.25	1.27	1.12	1.34	1.92	1.76	1.52	1.37
1770.400	1.49	1.42	1.24	1.08	1.34	1.98	1.59	1.31	1.62
2000.000	2.09	1.97	1.83	1.50	1.44	1.89	1.34	1.14	1.87
2200.000	2.17	2.18	2.12	1.71	1.52	1.60	1.37	1.30	1.80
2500.000	2.63	2.37	2.45	2.94	1.93	1.31	2.37	2.66	1.72
2800.000	2.10	2.09	1.95	2.96	2.25	2.04	3.68	3.79	3.80
3000.000	2.21	2.18	2.28	3.00	2.63	1.80	3.82	4.88	3.98

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
10.000	+216.05	−2.26
20.000	+216.68	−.18
50.000	+217.07	+.25
100.000	+214.73	+.40
200.000	+218.98	+.57
324.690	+232.84	+.80
414.600	+206.43	+1.02
500.000	+192.47	+.93
639.370	+223.80	+1.05
729.280	+205.59	+1.39
800.000	+179.59	+1.40
909.100	+183.16	+1.28
1000.000	+190.29	+1.27
1200.000	+196.42	+1.71
1500.000	+178.74	+3.01
1800.000	+175.84	+2.71
2000.000	+195.03	+1.08
2200.000	+171.75	−.67
2500.000	+177.30	−2.90
2800.000	+163.24	−5.28
3000.000	+180.13	−6.79

Measurements at RF & LO Power +10 dBm

Mini-Circuits™
Distribution Centers NORTH AMERICA P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	22	24	16	31	30	32	36	45	48	65
1	–	33	–	35	18	44	27	45	38	51	41	59
2	94	69	57	52	56	61	52	48	63	47	52	50
3	>94	59	47	56	45	56	46	74	51	67	55	75
4	93	77	82	>83	75	80	72	77	70	80	80	65
5	>95	>83	>84	>84	73	83	72	78	73	80	80	84
6	>90	>77	>83	>83	>85	>84	>84	>84	>84	>84	>82	>84
7	89	>77	>77	>84	>84	>84	>83	>83	>85	>86	>84	>83
8	>89	>78	>78	>77	>84	>84	>85	>82	>84	>84	>84	>83
9	>89	>78	>79	>77	>78	>83	>84	>83	>83	>83	>84	>83
10	89	>79	78	>78	>78	>76	>84	>84	>84	>83	>84	>83

Harmonic LO Order

test conditions: RF.=IN: FREQ.1000.1 MHZ DRIVE −4 DBM
LO.=IN: FREQ.970.01 MHZ DRIVE +9.98 DBM
IF=MEASURED: FREQ.30.09 AMP.=−11.23 DBM

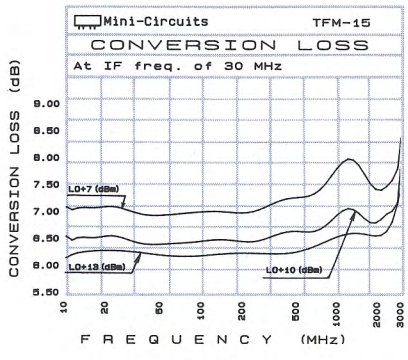
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	12	15	6	19	20	18	24	28	36	41
1	–	32	–	36	17	45	25	46	38	48	40	60
2	>94	73	66	62	68	71	61	58	67	55	59	57
3	>94	>73	68	>73	66	>73	67	73	70	>72	>74	>66
4	>96	>73	>72	>73	>74	>74	>73	>74	>77	>74	>74	>74
5	>96	>74	>74	>73	>74	>74	>74	>72	>74	>73	>74	>73
6	>89	>69	>75	>75	>73	>73	>74	>75	>74	>72	>73	>74
7	89	>67	>67	>73	>74	>74	73	>73	>74	>72	>73	74
8	90	>68	>66	>68	>74	>75	>74	>73	>74	74	>73	73
9	>89	>68	>68	>67	>68	>74	>75	>74	>73	>74	>75	>73
10	>89	>69	>68	>68	>69	>68	>74	>73	>73	>74	>72	>75

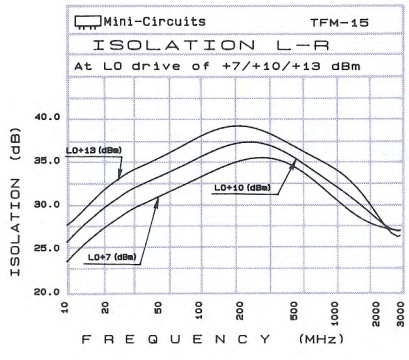
Harmonic LO Order

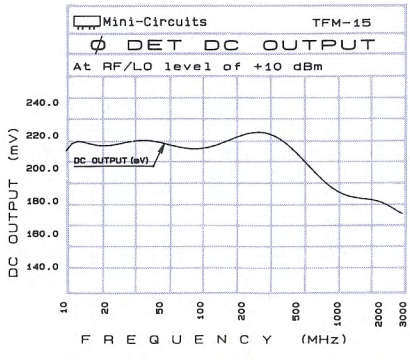
test conditions: RF.=IN: FREQ.1000.1 MHZ DRIVE −14.07 DBM
LO.=IN: FREQ.970.01 MHZ DRIVE +9.98 DBM
IF=MEASURED: FREQ.30.09 AMP.=−21.46 DBM

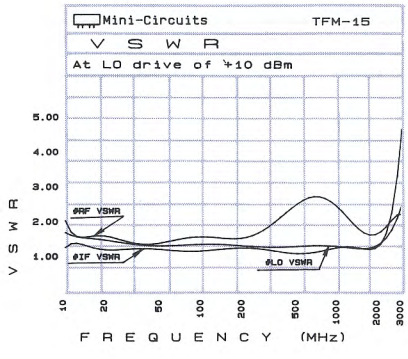
typical performance curves

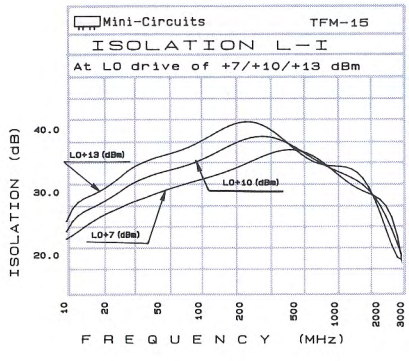
(production unit)

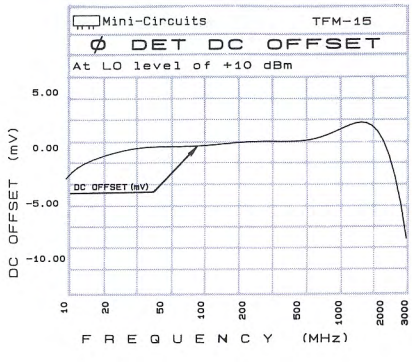












broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Models
TFM-150
ZFM-150



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–I (dB) LO +7dBm	LO +10dBm	LO +13dBm
10.000	40.00	6.86	6.45	6.13	23.51	25.80	27.54	22.38	24.40	26.34
20.000	50.00	7.14	6.61	6.34	27.97	30.46	32.63	26.63	29.11	31.31
130.610	100.61	6.67	6.30	6.00	34.46	36.94	39.60	32.59	35.84	38.84
251.210	221.21	6.94	6.42	6.17	35.54	37.51	39.45	34.37	37.82	39.94
432.120	402.12	6.84	6.38	6.09	35.30	36.22	37.73	36.99	37.58	36.81
500.000	470.00	7.12	6.61	6.25	34.85	35.79	37.53	36.86	36.42	35.18
552.730	522.73	6.97	6.47	6.11	34.54	35.50	37.47	36.16	35.14	35.44
673.330	643.33	7.02	6.53	6.27	33.75	34.67	36.91	34.23	33.34	33.16
793.940	763.68	7.22	6.64	6.26	33.34	34.16	36.05	32.63	31.81	31.03
914.550	884.43	7.46	6.67	6.23	30.90	32.34	34.63	30.74	30.81	32.29
974.850	944.91	6.89	6.11	5.73	30.08	31.59	34.71	29.97	30.10	31.00
1035.200	1005.40	7.68	7.04	6.58	29.48	30.74	33.95	29.59	29.56	29.88
1155.800	1125.60	7.87	7.24	6.86	29.06	30.26	33.04	30.57	30.08	29.66
1276.400	1246.50	7.25	6.75	6.45	28.54	29.72	32.56	30.95	30.93	30.95
1397.000	1366.80	7.13	6.57	6.29	27.77	28.85	31.02	31.65	31.94	31.72
1517.600	1487.50	7.13	6.59	6.31	27.47	28.61	30.81	31.07	31.80	31.80
1638.200	1608.00	7.27	6.63	6.41	26.64	27.94	31.04	28.51	29.65	29.86
1758.800	1728.70	7.54	6.91	6.59	27.21	28.39	31.71	26.22	26.17	26.74
1879.400	1849.50	7.63	7.01	6.70	29.18	30.98	33.15	26.60	26.61	26.54
2000.000	1970.00	8.00	7.24	7.00	30.21	32.51	39.43	25.08	24.79	24.71

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
10.000	1.78	1.62	1.57	1.65	1.69	2.23	1.45	1.35	1.36
50.000	1.43	1.29	1.21	1.10	1.49	2.18	1.34	1.15	1.09
100.000	1.43	1.29	1.20	1.09	1.39	2.01	1.36	1.15	1.05
200.000	1.52	1.34	1.25	1.18	1.36	1.96	1.39	1.16	1.04
251.210	1.55	1.38	1.28	1.24	1.34	1.91	1.39	1.17	1.04
371.820	1.70	1.49	1.37	1.36	1.30	1.77	1.43	1.20	1.05
492.420	1.81	1.60	1.45	1.49	1.29	1.66	1.48	1.23	1.08
552.730	1.88	1.62	1.46	1.56	1.28	1.60	1.49	1.23	1.10
673.330	1.98	1.70	1.53	1.66	1.26	1.48	1.50	1.24	1.14
793.940	2.03	1.79	1.62	1.75	1.26	1.40	1.49	1.24	1.17
914.550	2.13	1.89	1.74	1.80	1.22	1.31	1.44	1.21	1.17
1000.000	2.24	2.02	1.87	1.73	1.20	1.25	1.47	1.24	1.20
1095.500	2.35	2.07	1.93	1.90	1.20	1.20	1.49	1.25	1.20
1216.100	2.44	2.13	1.98	1.86	1.18	1.21	1.51	1.26	1.18
1336.700	2.43	2.13	2.00	1.86	1.13	1.30	1.51	1.27	1.15
1457.300	2.30	2.05	1.95	1.65	1.07	1.43	1.47	1.26	1.15
1577.900	2.12	1.88	1.79	1.41	1.12	1.88	1.41	1.23	1.18
1698.500	1.88	1.45	1.61	1.31	1.18	1.79	1.33	1.19	1.20
1819.100	1.75	1.43	1.47	1.26	1.21	1.76	1.27	1.16	1.19
2000.000	1.69	1.55	1.42	1.22	1.26	1.72	1.18	1.12	1.16

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
10.000	+210.73	−2.85
20.000	+214.48	−.81
50.000	+212.90	+0.00
100.000	+210.61	+.22
124.110	+210.10	+.33
200.000	+216.58	+.50
238.230	+221.12	+.34
352.340	+223.97	+.50
428.420	+194.95	+.42
500.000	+185.02	+.71
542.530	+191.96	+.74
656.650	+223.05	+.75
770.760	+183.02	+1.43
846.840	+171.52	+2.48
922.910	+195.29	+1.61
1000.000	+173.82	+2.06
1250.000	+177.10	+2.00
1500.000	+188.05	+3.99
1750.000	+181.99	+4.17
2000.000	+199.73	+4.20

Measurements at RF & LO Power +10 dBm

Mini-Circuits™
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Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	17	23	10	28	23	24	33	37	49	58
1	-	25	-	32	57	43	24	43	77	48	39	57
2	>93	60	56	48	59	50	43	50	54	47	48	51
3	>95	62	50	61	78	61	45	69	84	66	60	69
4	>96	73	80	81	77	79	76	80	72	77	75	70
5	>94	82	>86	>83	82	80	82	81	79	82	77	>85
6	>90	>79	>85	>86	>85	>85	>84	>84	>86	>84	>84	>84
7	>90	>78	>78	>86	>85	>86	>84	>84	>85	>85	>84	>84
8	>90	>79	>78	>79	>86	>85	>85	>84	>84	>87	>85	>84
9	>89	>79	>79	>78	>78	>84	>85	>84	>83	>84	>84	>83
10	>90	>77	>78	>78	>79	>79	>84	>85	>85	>84	>83	>86

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -3.97 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 10.08 DBM
IF = MEASURED: FREQ.30.093 MHZ AMP. -11.08 DBM

RF ORDER HARMONIC

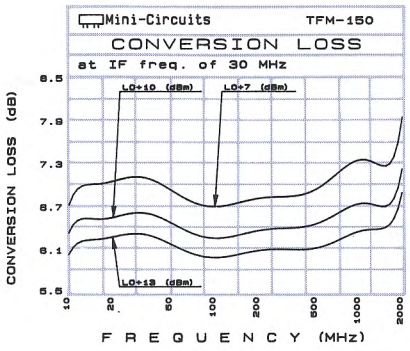
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	7	13	1	18	13	13	21	24	37	45
1	-	25	-	32	16	44	23	44	35	46	37	55
2	>95	69	65	58	69	59	52	59	62	54	56	57
3	>95	>73	70	>74	66	>73	65	>74	74	>74	75	>67
4	>96	>74	>74	>74	>73	>75	>73	>74	>75	>74	>74	>74
5	>96	>75	>75	>75	>75	>74	>74	>74	>74	>75	>75	>75
6	>90	>68	76	>75	>75	>74	>74	>75	>75	>74	>73	>75
7	>89	>68	>67	>74	>74	>74	>73	>74	>75	>75	>75	>75
8	>90	>69	69	>68	>75	>75	>74	>73	>75	>75	>75	>74
9	>89	>67	>68	>68	>67	>74	>74	>73	>73	>74	>74	>74
10	>90	>68	>68	>69	>68	>68	>73	>75	>75	>73	>74	77

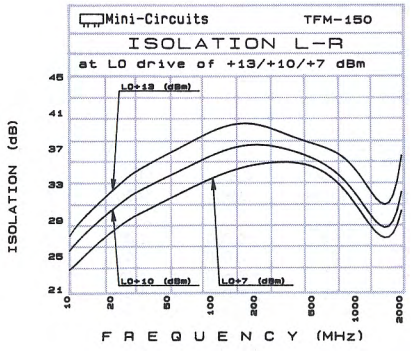
Harmonic LO Order

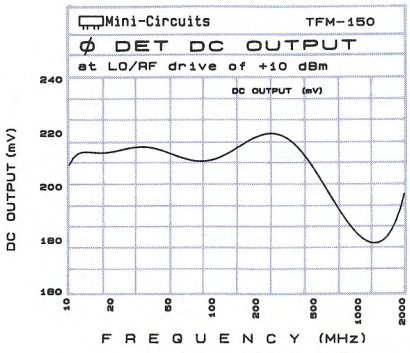
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -13.96 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 10.02 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -21.28 DBM

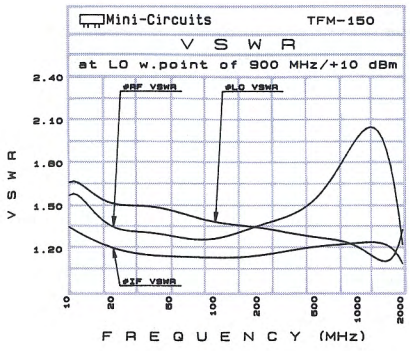
typical performance curves

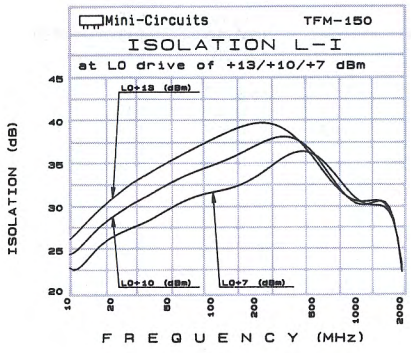
(production unit)

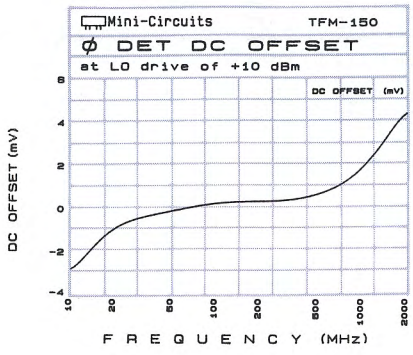












broadband high dynamic range

Frequency Mixers

Model
LMX-123

LEVEL 10 (+10dBm LO, up to +5dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	Isolation L-R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L-I (dB) LO +7dBm	LO +10dBm	LO +13dBm
10.000	40.000	7.50	7.00	6.58	10.000	48.60	51.60	53.30	34.20	37.80	40.90
20.000	50.000	7.20	6.80	6.30	20.000	48.40	51.60	53.00	33.80	37.30	40.50
103.440	73.440	6.94	6.24	5.93	103.440	49.20	51.70	52.60	33.80	37.00	40.10
200.000	170.000	7.01	6.59	5.97	200.000	51.00	50.10	48.00	33.20	36.20	38.00
383.750	353.750	7.13	6.56	6.03	383.750	49.90	45.10	43.10	33.80	34.80	34.50
500.000	470.000	7.28	6.65	6.10	500.000	47.00	43.70	41.70	33.80	33.70	32.90
664.070	634.070	7.55	6.86	6.10	664.070	45.10	42.20	40.10	33.40	32.00	30.80
850.940	820.940	7.41	6.75	6.00	850.940	46.50	43.10	41.00	32.50	30.30	29.00
1000.000	970.000	7.59	6.91	6.65	1000.000	46.80	46.50	43.00	32.80	29.80	28.10
1131.300	1101.300	7.88	7.12	6.76	1131.300	43.40	50.00	48.00	32.80	29.50	27.40
1318.100	1288.100	8.46	7.41	6.88	1318.100	40.20	43.30	45.00	35.70	31.00	27.00
1505.000	1475.000	9.08	7.87	7.21	1505.000	35.50	36.20	37.20	35.00	30.70	27.40
1691.900	1661.900	9.02	7.91	7.28	1691.900	32.10	32.60	32.90	33.10	30.90	28.40
1878.800	1848.800	9.11	7.97	7.33	1878.800	31.00	31.50	31.60	33.20	31.30	30.10
2000.000	1970.000	8.87	7.88	7.31	2000.000	30.60	30.90	31.00	32.60	31.20	31.90
2159.100	2129.100	8.53	7.68	7.31	2159.100	29.70	29.90	30.10	32.00	30.50	33.00
2439.400	2409.400	7.95	7.29	6.89	2439.400	30.60	30.60	30.30	29.70	28.90	30.40
2626.300	2596.300	8.20	7.52	7.12	2626.300	30.90	30.60	30.60	29.10	28.90	29.30
2813.100	2783.100	8.33	7.75	7.36	2813.100	29.00	28.50	28.40	28.50	29.00	28.50
3000.000	2970.000	8.82	8.24	7.88	3000.000	29.20	28.20	28.30	27.70	31.40	28.90

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
10.000	1.65	1.45	1.33	1.15	1.34	1.92	10.000	1.45	1.19	1.07
50.000	1.66	1.46	1.33	1.17	1.30	1.91	50.000	1.46	1.19	1.06
100.610	1.66	1.45	1.33	1.21	1.27	1.87	100.610	1.46	1.18	1.05
200.000	1.71	1.49	1.37	1.25	1.27	1.81	200.000	1.43	1.16	1.03
372.420	1.84	1.60	1.48	1.32	1.25	1.74	372.420	1.36	1.09	1.04
500.000	1.96	1.71	1.58	1.40	1.22	1.65	500.000	1.31	1.04	1.09
644.240	2.10	1.81	1.67	1.49	1.17	1.56	644.240	1.25	1.02	1.15
825.450	2.25	1.92	1.76	1.62	1.18	1.45	825.450	1.18	1.07	1.21
1000.000	2.37	2.03	1.85	1.76	1.21	1.36	1000.000	1.13	1.10	1.24
1097.300	2.52	2.16	1.97	1.81	1.26	1.31	1097.300	1.12	1.12	1.26
1369.100	2.80	2.43	2.25	1.92	1.31	1.16	1369.100	1.16	1.16	1.25
1550.300	2.80	2.46	2.25	2.04	1.33	1.07	1550.300	1.18	1.12	1.19
1731.500	2.72	2.40	2.23	2.01	1.36	1.20	1731.500	1.38	1.22	1.19
1912.700	2.76	2.43	2.23	1.91	1.39	1.39	1912.700	1.60	1.40	1.33
2003.300	2.61	2.30	2.12	1.80	1.41	1.48	2003.300	1.68	1.48	1.40
2184.500	2.58	2.43	2.12	1.91	1.47	1.57	2184.500	1.81	1.59	1.54
2456.400	2.10	1.91	1.67	1.34	1.51	1.77	2456.400	1.97	1.75	1.66
2637.600	2.10	1.84	1.75	1.27	1.48	1.70	2637.600	1.65	1.51	1.43
2818.800	1.87	1.67	1.65	1.63	2.03	2.30	2818.800	1.54	1.59	1.53
3000.000	1.34	1.33	1.33	2.12	2.61	2.92	3000.000	1.88	1.99	1.96

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	15	18	17	14	39	25	45	33	47	35
1	–	14	–	35	27	41	35	36	41	50	46	54
2	95	47	58	48	56	44	81	42	49	39	58	53
3	>95	54	54	60	50	70	51	70	58	66	58	69
4	>96	67	>82	72	81	74	80	67	72	70	75	64
5	>96	>82	82	>82	>82	>82	>83	>82	>81	>82	>83	>83
6	>89	>76	>83	>83	>84	>83	>82	>83	>83	>82	>82	>84
7	>88	>76	>76	>82	>83	>83	>82	>81	>83	>83	>82	>81
8	>89	>78	>77	>76	>82	>82	>82	>81	>83	>83	>83	>81
9	>90	>78	>78	78	>76	>83	>82	>81	>82	>82	>82	>82
10	>90	>76	>76	>77	>76	>77	>84	>82	>83	>82	>83	>84

Harmonic LO Order

test conditions: RF.=IN: FREQ.999.1 MHZ DRIVE –4.04 DBM
LO. IN: FREQ.969.01 MHZ DRIVE 10.01 DBM
IF MEASURED: FREQ.30.094 MHZ AMP. –12.87 DBM

RF ORDER HARMONIC

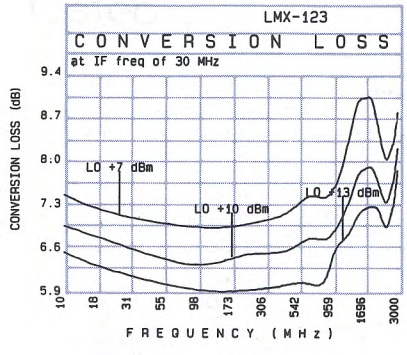
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	6	8	6	3	29	13	33	21	36	23
1	–	14	–	35	28	39	34	35	38	49	43	53
2	>94	55	68	55	63	52	56	50	56	47	>65	61
3	>96	73	73	>77	>78	>78	>79	>76	>77	>75	>80	>70
4	>96	74	>72	>72	>72	>72	>72	>71	>74	>73	>72	>74
5	>95	>73	>72	>72	>73	>72	>74	>73	>72	>71	>73	>72
6	>89	>66	>73	>71	>74	>72	>72	>74	>73	>72	>73	>74
7	>88	>65	>66	>73	>73	73	>72	>72	>73	>72	>73	>71
8	>90	>67	>66	>66	>73	>73	>73	>72	>72	>73	>72	>73
9	>90	>67	>66	>67	>66	>73	>75	>73	>71	>72	>72	>73
10	>90	>67	>67	>67	>67	>66	>73	>73	>72	>72	>72	>73

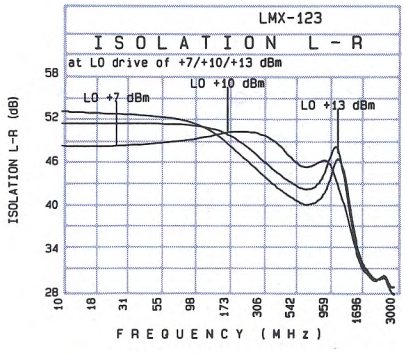
Harmonic LO Order

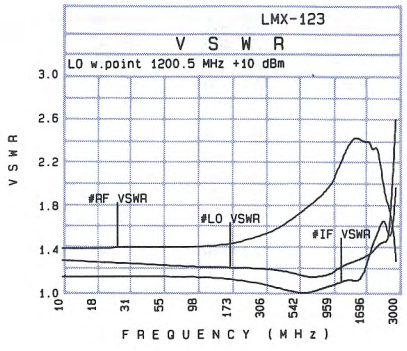
test conditions: RF.=IN: FREQ.999.1 MHZ DRIVE –13.98 DBM
LO. IN: FREQ.969.01 MHZ DRIVE 9.99 DBM
IF=MEASURED: FREQ.30.094 MHZ AMP. –22.94 DBM

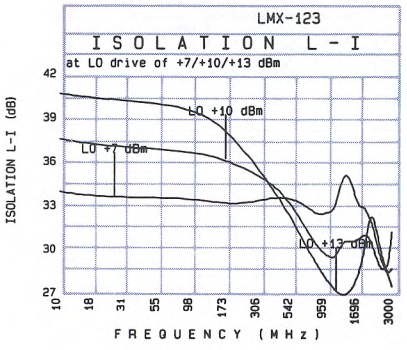
typical performance curves

(production unit)









In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Model
LMX-148

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–I (dB) LO +7dBm	LO +10dBm	LO +13dBm
10.000	40.00	7.37	6.90	6.65	>67.00	64.68	62.31	61.17	60.27	59.92
20.000	50.00	7.40	6.90	6.59	58.80	57.03	55.86	56.53	55.29	54.47
145.460	115.46	6.97	6.64	6.36	41.16	40.03	39.26	39.55	38.47	37.87
190.610	160.61	7.02	6.65	6.49	39.35	38.12	37.24	37.49	36.59	36.12
235.760	205.76	7.06	6.70	6.56	37.82	36.49	35.69	35.96	35.34	35.03
326.060	296.06	6.92	6.62	6.48	35.29	33.99	33.20	33.58	33.41	33.18
416.370	386.37	6.93	6.61	6.28	33.43	32.19	31.31	32.03	32.13	31.67
500.000	470.00	6.84	6.49	6.19	32.21	31.44	30.69	30.59	31.07	30.85
551.820	521.82	6.94	6.69	6.46	31.88	30.70	29.81	29.47	29.80	29.54
642.130	612.13	6.99	6.77	6.42	31.42	30.59	30.17	28.14	28.89	28.44
732.430	702.43	7.15	6.76	6.51	30.92	30.56	29.70	27.20	28.27	28.10
822.740	792.62	7.21	6.83	6.59	29.91	29.70	29.30	26.33	27.37	27.26
913.040	883.14	7.22	6.83	6.60	29.34	28.80	28.79	25.55	26.25	26.42
1000.000	969.69	7.15	6.70	6.51	29.13	28.33	28.90	24.39	25.23	25.58
1048.500	1018.40	7.11	6.66	6.42	28.85	28.38	29.46	23.97	25.01	25.26
1138.800	1109.00	7.39	6.92	6.61	29.03	28.78	29.02	23.11	24.73	25.55
1229.100	1199.00	7.48	6.98	6.63	29.58	29.42	28.32	22.32	24.27	25.44
1319.400	1289.30	7.51	7.04	6.91	28.71	28.58	28.24	21.83	23.87	25.00
1409.700	1379.70	7.75	7.26	7.06	29.45	29.70	30.28	21.28	22.98	24.10
1500.000	1470.20	8.02	7.52	7.22	30.21	30.65	31.63	20.91	22.63	23.60

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
10.000	1.19	1.23	1.28	1.48	2.19	3.30	2.22	1.80	1.56
50.000	1.06	1.13	1.19	1.50	2.33	3.52	2.17	1.77	1.54
100.000	1.05	1.13	1.19	1.42	2.12	3.12	2.18	1.78	1.54
145.450	1.06	1.14	1.20	1.40	2.13	3.06	2.16	1.77	1.53
200.000	1.07	1.16	1.22	1.40	2.10	3.04	2.10	1.75	1.52
280.910	1.11	1.20	1.28	1.42	2.17	3.09	2.04	1.72	1.52
371.210	1.18	1.29	1.36	1.52	2.20	3.08	1.95	1.67	1.52
461.520	1.30	1.41	1.48	1.63	2.34	3.16	1.87	1.64	1.52
506.670	1.37	1.49	1.55	1.68	2.38	3.17	1.86	1.64	1.53
596.970	1.54	1.64	1.70	1.82	2.51	3.34	1.82	1.63	1.54
687.270	1.77	1.88	1.90	1.95	2.65	3.46	1.82	1.64	1.55
777.580	1.99	2.07	2.05	2.08	2.79	3.62	1.81	1.64	1.57
867.880	2.29	2.35	2.26	2.33	2.95	3.82	1.83	1.64	1.54
958.180	2.67	2.71	2.50	2.56	3.10	4.03	1.93	1.69	1.54
1003.300	2.88	2.90	2.64	2.68	3.19	4.08	1.96	1.71	1.54
1093.600	3.34	3.38	2.95	2.98	3.44	4.40	1.98	1.75	1.55
1183.900	3.79	3.69	3.20	3.13	3.46	4.21	2.02	1.77	1.55
1274.200	4.22	4.10	3.41	3.26	3.38	3.82	2.05	1.80	1.55
1364.500	4.70	4.68	3.60	3.52	3.31	3.85	2.01	1.79	1.52
1500.000	4.95	6.17	3.83	4.22	3.81	4.40	1.94	1.73	1.45

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
10.000	−344.80	+.06
20.000	−347.60	+.07
48.038	−341.00	+.12
50.000	−342.50	+.13
100.000	−341.70	+.21
162.150	−352.50	+.34
200.190	−352.60	+.52
276.270	−371.30	+.94
352.340	−340.80	+2.43
390.380	−325.60	+2.53
466.460	−315.10	+2.37
504.490	−326.60	+2.35
580.570	−350.30	+3.50
694.680	−303.50	+5.10
770.760	−288.52	+4.55
884.870	−312.80	+5.62
960.950	−297.30	+7.04
1250.000	−281.48	+5.52
1333.300	−287.26	+2.70
1500.000	−296.21	+3.60

Measurements at RF & LO Power +10 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+1	29	10	25	21	46	73	68	53	50
1	-	12	-	41	14	29	57	42	46	75	62	72
2	95	50	36	81	34	44	41	52	47	60	71	>78
3	>95	58	56	53	81	57	53	56	68	62	63	>76
4	>95	>84	>82	73	65	68	62	72	76	72	72	75
5	>95	>85	>82	>81	>82	78	75	74	72	>83	>83	82
6	>89	>76	>83	>82	>83	>83	>82	>81	>82	>83	>82	>83
7	>89	>75	>76	>83	>83	>82	>82	>84	>83	>83	>82	>83
8	>90	>78	>76	>77	>83	>83	>82	>82	>83	>84	>82	>82
9	>89	>77	>79	>78	>74	>83	>82	>82	>82	>83	>82	>83
10	>91	>76	>78	>78	>77	>76	>82	>83	>82	>82	>83	>83

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -4 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 9.95 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -12.82 DBM

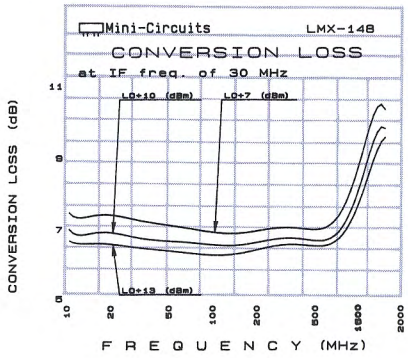
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+11	20	+1	15	9	36	55	58	40	36
1	-	12	-	39	13	28	54	40	45	>66	61	>65
2	>96	59	47	60	44	53	51	60	57	68	>64	>66
3	96	75	74	72	>79	>78	>77	>77	>78	>77	>78	>70
4	>95	>73	>72	>71	>74	>73	>72	>72	>73	>73	74	>74
5	>95	>73	>73	>71	>72	>72	>74	73	>73	>73	>73	>74
6	>90	>67	>73	>73	>74	>72	>74	>74	>72	>72	>73	>73
7	>89	>66	>66	>73	>73	>72	>71	>72	>74	>72	>72	>72
8	>90	>67	>66	>67	>73	>73	>72	>72	>74	>73	>73	>72
9	>89	>67	>66	>68	>67	>73	>72	>72	>71	>71	>72	>73
10	>89	>67	67	>66	>67	>66	>74	>74	>72	>71	>73	>72

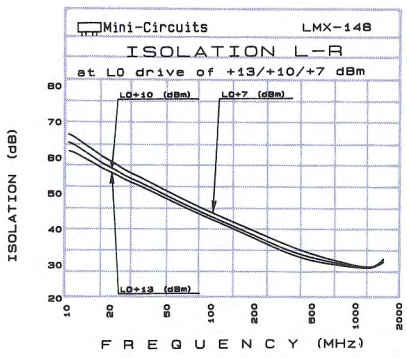
Harmonic LO Order

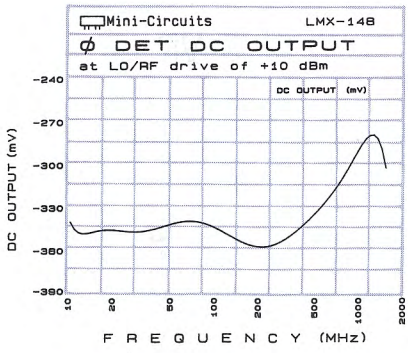
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -14 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 10 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -22.85 DBM

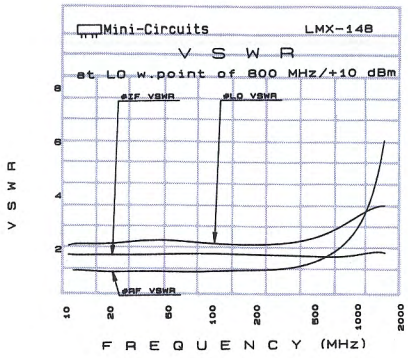
typical performance curves

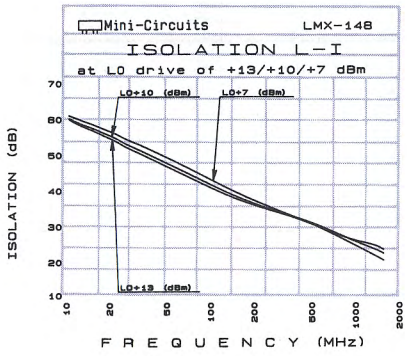
(production unit)

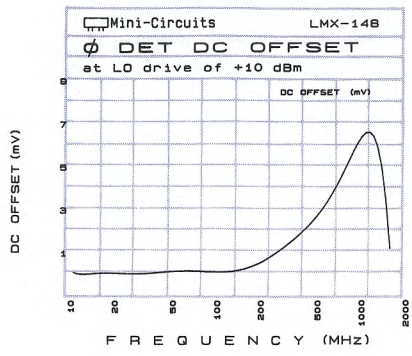












broadband, high dynamic range

Frequency Mixers

Model SRA-215

LEVEL 10 (+10dBm LO, up to +5dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–I (dB) LO +7dBm	LO +10dBm	LO +13dBm
.050	30.05	5.77	5.33	5.05	22.98	24.71	26.17	21.28	23.12	24.73
10.000	40.00	5.47	5.08	4.87	45.65	48.23	50.78	43.04	46.45	49.49
115.430	85.43	5.57	5.19	5.03	44.59	45.24	45.16	44.45	46.67	47.45
173.120	143.12	5.64	5.24	5.06	43.32	43.11	42.59	44.48	45.09	44.76
230.810	200.81	6.03	5.59	5.32	42.11	41.58	41.28	43.12	42.58	42.64
346.190	316.19	6.11	5.62	5.36	39.99	40.30	40.19	40.21	40.08	40.44
403.880	373.88	6.41	5.89	5.58	40.31	41.28	40.80	41.29	41.07	40.45
461.570	431.57	6.81	6.16	5.82	41.55	41.91	40.76	44.70	43.59	41.14
519.260	489.26	7.21	6.64	6.31	41.80	41.57	40.14	42.78	42.48	40.13
576.950	546.95	7.40	6.70	6.40	41.71	41.57	40.17	39.62	41.28	40.37
634.640	604.64	8.16	7.21	6.77	41.11	40.91	39.79	37.06	40.14	41.88
750.020	720.27	8.94	7.47	6.94	35.49	36.00	35.86	30.90	32.11	34.08
807.710	777.89	8.72	7.54	7.06	32.59	33.02	33.07	28.44	29.22	30.52
923.090	893.31	8.71	7.72	7.20	29.59	29.93	29.91	25.01	25.21	25.92
1000.000	970.32	8.09	7.20	6.75	29.52	29.90	29.59	23.75	23.76	23.95
1038.500	1008.50	7.82	6.97	6.57	29.89	30.30	30.15	23.63	23.38	23.44
1096.200	1066.30	7.58	6.73	6.40	29.83	30.30	30.09	23.34	22.89	22.61
1211.500	1181.60	7.60	6.90	6.59	30.04	30.75	31.15	24.46	23.23	22.20
1384.600	1354.60	7.79	7.21	6.89	32.70	32.95	32.65	23.21	21.78	20.16
1500.000	1470.40	8.29	7.62	7.30	33.63	33.70	33.14	22.13	20.86	19.38

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
5.001	1.68	1.43	1.28	1.09	1.50	2.29	1.69	1.22	1.03
10.000	1.69	1.43	1.29	1.11	1.45	2.13	1.69	1.22	1.03
20.000	1.71	1.46	1.31	1.16	1.44	2.12	1.71	1.23	1.03
50.000	1.73	1.48	1.32	1.09	1.50	2.17	1.69	1.22	1.03
100.000	1.81	1.57	1.41	1.17	1.39	2.01	1.68	1.23	1.04
200.000	2.25	1.96	1.79	1.25	1.35	1.88	1.69	1.27	1.09
285.310	2.79	2.44	2.24	1.39	1.29	1.77	1.73	1.36	1.20
425.470	3.72	3.21	2.97	1.61	1.22	1.58	1.98	1.69	1.52
500.000	4.02	3.50	3.27	1.77	1.24	1.49	2.18	1.90	1.73
565.630	4.16	3.45	3.19	1.83	1.24	1.41	2.30	2.03	1.86
705.780	3.80	3.26	3.09	1.83	1.19	1.24	2.35	2.12	1.98
752.500	3.80	3.30	3.10	1.83	1.20	1.23	2.37	2.14	1.99
845.940	3.29	2.97	2.83	1.67	1.15	1.30	2.21	2.03	1.94
986.090	2.40	2.18	2.09	1.38	1.16	1.46	1.96	1.87	1.80
1000.000	2.31	2.10	2.02	1.38	1.16	1.50	1.93	1.85	1.79
1079.500	1.88	1.75	1.67	1.27	1.20	1.57	1.91	1.87	1.82
1219.700	1.32	1.21	1.15	1.11	1.24	1.59	2.06	2.11	2.08
1313.100	1.21	1.16	1.15	1.08	1.28	1.62	2.21	2.35	2.31
1406.600	1.37	1.34	1.35	1.20	1.32	1.62	2.57	2.83	2.80
1500.000	1.54	1.48	1.47	1.29	1.35	1.61	2.62	3.04	2.98

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	18	28	37	31	34	57	48	45	68
1	–	14	–	76	21	43	38	49	44	52	52	53
2	>94	47	48	48	51	52	56	59	54	54	66	67
3	>93	66	53	58	45	61	54	65	65	69	55	66
4	>95	79	>83	78	70	63	72	69	81	75	76	67
5	>94	82	84	83	77	76	66	75	77	>84	>83	85
6	>89	>78	>85	>84	>85	>83	>84	81	>83	>82	>85	>84
7	>90	>78	>77	>84	>84	>84	>85	>85	>83	>85	>83	>84
8	>90	>78	>78	>79	>83	>85	>84	>83	>84	>84	>84	>85
9	90	>77	>79	>78	>77	>83	>85	>85	>83	>84	>84	>83
10	>90	>78	>78	>78	>78	>77	>84	>83	>84	>84	>86	>84

Harmonic LO Order

test conditions: RF.=IN: FREQ.999.1 MHZ DRIVE –3.98 DBM
LO.=IN: FREQ.969.01 MHZ DRIVE 10.01 DBM
IF=MEASURED: FREQ.30.094 MHZ AMP. –11.34 DBM

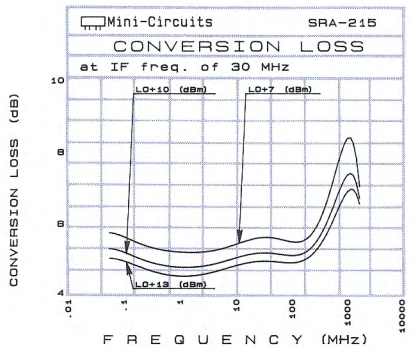
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+ 6	8	17	27	20	21	37	35	33	47
1	–	14	–	35	22	41	38	46	41	62	45	48
2	97	57	57	56	62	60	66	67	65	59	>67	>68
3	>95	>74	71	>73	64	>72	72	76	>74	>74	74	>67
4	>96	>74	>74	>74	>75	>75	>73	>74	>73	74	>74	>74
5	>95	>74	>73	>74	>73	>73	>74	>74	>74	>74	>74	>74
6	>90	>69	>75	>74	>76	>73	>74	>75	>74	>72	>72	>75
7	>89	>67	>67	>74	>74	>74	>74	>73	>74	>74	>73	>74
8	>92	>69	>68	>69	>75	>74	>74	>73	>73	>74	>74	>73
9	>89	>68	>68	>70	>69	>74	>74	76	>73	>74	>75	>74
10	>92	>68	>68	>70	>68	>68	>75	>74	>74	>73	>75	>75

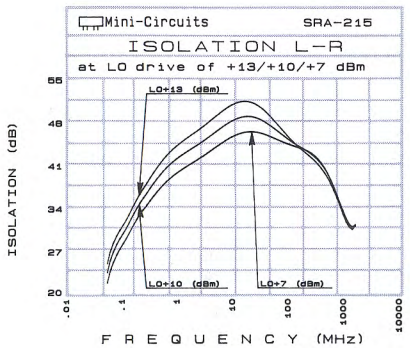
Harmonic LO Order

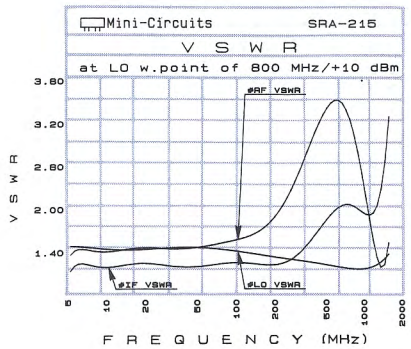
test conditions: RF.=IN: FREQ.999.1 MHZ DRIVE –14.03 DBM
LO.=IN: FREQ.969.01 MHZ DRIVE 10.07 DBM
IF=MEASURED: FREQ.30.094 MHZ AMP. –21.44 DBM

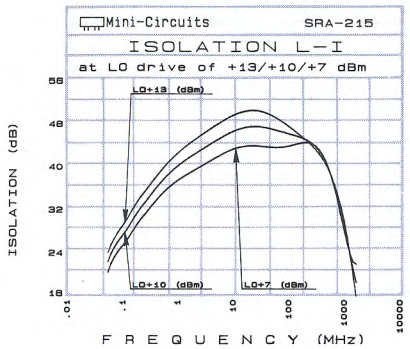
typical performance curves

(production unit)









broadband, high dynamic range

Frequency Mixers

Model SRA-220

LEVEL 10 (+10dBm LO, up to +5dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L–I (dB) LO +7dBm	LO +10dBm	LO +13dBm
.050	30.05	6.72	6.31	6.12	19.76	20.56	21.43	19.41	20.32	21.13
1.000	31.00	5.70	5.23	4.97	34.56	37.02	39.25	32.42	35.22	37.57
5.000	35.00	5.72	5.34	5.14	38.79	41.42	44.03	37.41	40.80	43.89
20.000	50.00	6.05	5.57	5.34	40.05	42.73	45.50	38.84	42.42	45.76
50.000	80.00	6.00	5.59	5.34	40.21	42.75	45.39	38.91	42.09	44.58
100.000	70.00	5.89	5.50	5.26	40.21	42.49	44.61	38.78	40.87	41.49
153.890	123.89	5.87	5.49	5.31	40.00	42.03	43.89	38.30	38.92	38.67
230.810	200.81	6.20	5.78	5.49	39.83	41.75	43.18	36.73	36.48	36.04
307.730	277.73	6.21	5.75	5.50	39.84	41.49	42.59	34.88	34.62	34.09
500.000	470.00	6.52	5.97	5.69	36.82	38.13	39.37	33.67	32.70	31.47
615.420	585.42	6.87	6.37	6.05	40.83	40.61	41.60	37.12	34.50	31.97
692.340	662.34	7.57	6.90	6.63	42.69	42.63	42.42	37.25	35.22	32.66
846.180	816.12	8.43	7.39	6.93	40.44	40.51	40.40	32.43	34.89	35.43
1076.900	1047.20	8.19	7.31	6.89	38.74	36.30	34.19	26.42	27.82	29.03
1230.800	1200.80	7.55	6.91	6.52	33.08	32.05	31.14	23.07	23.22	23.11
1307.700	1277.80	7.39	6.81	6.47	31.81	30.96	29.93	21.58	21.56	21.16
1461.500	1431.70	8.11	7.49	7.14	26.03	24.40	23.02	19.18	19.73	19.59
1615.400	1585.50	7.86	7.29	7.00	34.22	34.31	35.01	20.11	19.71	18.51
1769.200	1739.20	8.28	7.80	7.55	38.09	38.84	37.67	19.64	18.84	17.68
2000.000	1970.30	9.50	8.89	8.50	32.05	31.97	33.54	19.92	19.56	18.37

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
5.002	1.80	1.42	1.25	1.16	1.38	2.09	1.72	1.18	1.04
10.000	1.80	1.42	1.27	1.14	1.38	2.03	1.73	1.18	1.03
20.000	1.82	1.44	1.27	1.18	1.34	2.02	1.74	1.18	1.01
50.000	1.82	1.45	1.29	1.12	1.41	2.08	1.73	1.18	1.02
67.344	1.80	1.44	1.28	1.17	1.37	1.96	1.73	1.19	1.01
100.000	1.84	1.49	1.32	1.19	1.34	1.94	1.75	1.21	1.03
200.000	1.95	1.63	1.49	1.30	1.30	1.81	1.81	1.31	1.11
316.720	2.33	2.03	1.89	1.47	1.24	1.65	1.99	1.50	1.28
441.410	3.04	2.73	2.61	1.65	1.22	1.51	2.25	1.80	1.55
566.090	3.50	3.06	3.05	1.88	1.24	1.35	2.47	2.01	1.79
690.780	3.69	3.23	3.33	2.06	1.30	1.20	2.51	2.12	1.94
877.810	3.79	3.35	3.32	1.83	1.25	1.22	2.58	2.35	2.24
1000.000	3.27	2.98	2.97	1.76	1.34	1.44	2.60	2.47	2.34
1127.200	2.65	2.40	2.36	1.61	1.38	1.60	2.59	2.42	2.30
1314.200	1.75	1.60	1.59	1.31	1.36	1.67	2.19	2.20	2.17
1438.900	1.30	1.20	1.17	1.20	1.31	1.61	2.25	2.37	2.38
1625.900	1.12	1.04	1.06	1.07	1.35	1.66	2.56	2.73	2.71
1750.600	1.11	1.19	1.26	1.12	1.37	1.61	3.15	3.34	3.25
1875.300	1.24	1.31	1.38	1.22	1.43	1.65	4.26	4.20	4.03
2000.000	1.36	1.41	1.48	1.34	1.56	1.83	5.13	6.37	5.68

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	26	26	42	28	44	40	48	52	72
1	-	23	-	29	64	31	41	44	41	58	38	52
2	>94	51	50	50	52	61	63	64	67	57	73	58
3	>96	61	51	63	44	58	53	59	63	66	59	74
4	>96	85	>83	79	77	70	76	82	>83	79	81	72
5	>95	>83	>84	>84	77	>83	69	75	78	78	>84	82
6	>90	>78	>84	>84	>85	>84	>84	>83	>86	>83	>83	>85
7	>89	>79	>77	>85	>85	>84	>84	>83	>84	>83	>84	>84
8	>90	>78	>77	>77	>84	>84	>84	>83	>83	>84	>84	>84
9	>91	>78	>79	>78	>77	>84	>83	>84	>83	>84	>84	>84
10	>91	>78	>78	>79	>78	>77	>85	>84	>84	>83	>85	>83

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -4.02 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 9.97 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -11.79 DBM

RF ORDER HARMONIC

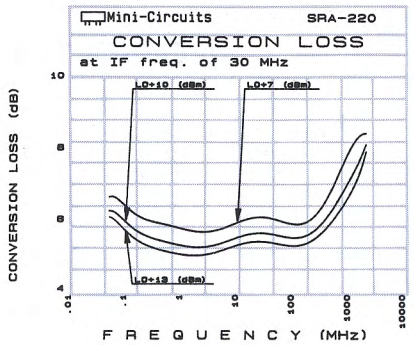
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	1	16	16	31	52	33	28	68	49	63
1	-	23	-	29	23	30	42	43	38	56	35	48
2	>95	61	59	59	61	66	71	70	72	64	>67	67
3	>94	>72	69	>74	63	>73	72	>71	>74	>74	>74	67
4	>96	75	>73	>73	>74	>74	>74	>74	>74	>74	>73	>75
5	>97	>74	>74	>73	>73	>72	75	>73	>72	>74	>74	>73
6	>90	>68	>74	>74	73	>73	>73	>75	>73	>73	>74	>74
7	>89	>67	>67	>74	>75	>75	74	>74	>74	>75	>73	>73
8	>90	>67	>69	>67	>73	>74	>74	>73	>73	>73	>74	>74
9	>89	>68	>68	>68	>67	>74	>74	>73	>74	>72	>74	>73
10	>91	>68	68	>68	>68	>68	>74	>74	>74	>71	>74	>74

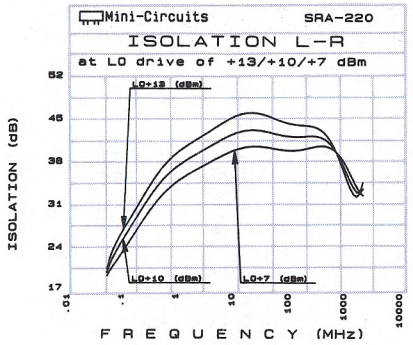
Harmonic LO Order

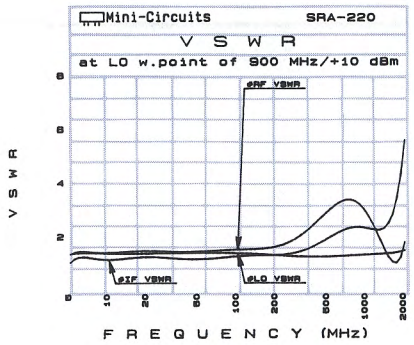
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -13.99 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 10 DBM
IF = MEASURED: FREQ.30.095 MHZ AMP. -21.81 DBM

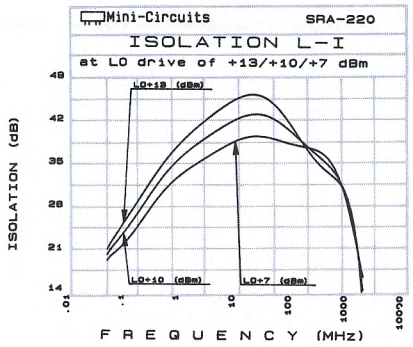
typical performance curves

(production unit)









broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Models

TFM-1MH
TUF-1MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
2.000	32.00	7.06	6.55	6.24	65.69	61.53	59.57	> 70.00	62.13	57.11
5.000	35.00	6.49	6.06	5.82	64.70	60.97	59.24	> 70.00	60.92	56.61
10.000	40.00	6.42	5.98	5.73	64.09	60.65	59.12	> 70.00	60.61	56.57
20.000	50.00	6.47	6.00	5.73	62.88	60.05	58.36	> 70.00	59.98	56.14
34.130	64.13	6.40	5.97	5.72	60.04	58.47	57.25	64.40	59.11	55.82
50.000	80.00	6.34	5.96	5.71	57.81	56.47	55.53	60.98	57.96	55.23
98.390	68.39	6.20	5.88	5.69	52.57	52.10	51.25	54.82	54.24	52.74
100.000	70.00	6.21	5.89	5.69	52.48	52.04	51.17	54.67	54.11	52.66
130.520	100.52	6.24	5.90	5.69	50.38	49.90	49.14	52.37	52.13	51.57
162.650	132.65	6.40	5.95	5.76	48.58	47.90	47.13	50.32	50.16	50.32
200.000	170.00	6.41	6.00	5.84	46.76	45.86	45.12	48.20	48.87	47.95
259.040	229.04	6.08	5.85	5.75	43.95	43.28	43.00	45.59	46.20	44.51
291.170	261.17	6.06	5.87	5.78	42.69	42.16	41.98	44.62	44.62	42.93
323.300	293.30	6.16	6.02	5.93	41.51	41.14	41.06	43.63	43.00	41.88
355.430	325.43	6.40	6.19	6.04	40.55	40.26	40.19	42.70	41.67	40.76
387.560	357.56	6.38	6.19	6.04	40.00	39.90	39.94	41.59	41.00	40.08
419.690	389.69	6.51	6.32	6.13	39.33	39.24	39.19	40.82	40.20	39.53
451.820	421.82	6.50	6.22	5.98	38.62	38.55	38.88	40.01	38.94	38.26
483.950	453.95	6.43	6.16	5.96	37.86	38.04	38.47	39.22	37.91	37.19
500.000	470.00	6.45	6.17	5.96	37.70	37.96	38.29	38.55	37.30	36.53

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.001	1.31	1.24	1.23	1.25	1.92	2.86	1.54	1.35	1.25
10.000	1.23	1.12	1.11	1.15	1.78	2.68	1.55	1.35	1.26
20.000	1.19	1.06	1.04	1.20	1.84	2.66	1.54	1.35	1.25
35.938	1.17	1.03	1.04	1.15	1.82	2.64	1.53	1.34	1.24
50.000	1.16	1.02	1.05	1.13	1.80	2.75	1.54	1.35	1.25
66.876	1.15	1.02	1.05	1.12	1.78	2.51	1.53	1.34	1.24
100.000	1.15	1.02	1.05	1.12	1.78	2.51	1.54	1.35	1.25
144.220	1.14	1.01	1.05	1.12	1.75	2.40	1.53	1.35	1.25
175.160	1.14	1.01	1.06	1.12	1.73	2.40	1.55	1.36	1.27
200.000	1.13	1.01	1.06	1.10	1.68	2.31	1.55	1.37	1.27
237.040	1.13	1.01	1.06	1.10	1.67	2.28	1.59	1.40	1.30
267.970	1.12	1.01	1.07	1.10	1.71	2.34	1.61	1.42	1.32
298.910	1.11	1.01	1.07	1.09	1.65	2.28	1.64	1.44	1.34
329.850	1.11	1.02	1.08	1.08	1.71	2.35	1.68	1.47	1.36
360.790	1.10	1.02	1.09	1.10	1.69	2.29	1.69	1.49	1.38
391.730	1.09	1.03	1.09	1.14	1.70	2.37	1.74	1.53	1.41
422.660	1.08	1.04	1.10	1.13	1.71	2.30	1.80	1.57	1.45
453.600	1.07	1.05	1.11	1.17	1.72	2.34	1.83	1.60	1.48
484.540	1.06	1.06	1.12	1.17	1.72	2.33	1.89	1.63	1.51
500.000	1.05	1.06	1.13	1.20	1.74	2.36	1.89	1.64	1.52

ϕ detection

max. output/DC offset vs. freq.

Freq. (MHz)	max. DC output mV	DC offset mV
2.000	−509.70	+.20
5.000	−528.00	+.26
10.000	−529.40	+.28
20.000	−528.30	+.29
47.273	−519.90	+.30
50.000	−519.30	+.30
100.000	−524.40	+.32
122.730	−534.10	+.30
152.910	−539.70	+.33
183.090	−545.40	+.41
200.000	−547.90	+.48
243.460	−562.60	+.69
288.730	−576.40	+1.04
334.000	−538.60	+1.57
349.090	−524.10	+1.73
379.280	−503.50	+1.78
424.550	−497.90	+1.85
454.730	−490.70	+1.96
469.820	−496.30	+1.89
500.000	−508.30	+1.87

Measurements at RF & LO Power +13 dBm

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>99	–	39	37	40	57	46	58	55	68	60	62
1	>99	25	–	47	13	54	23	51	37	53	45	56
2	69	62	56	70	55	76	54	73	55	66	57	67
3	73	52	47	54	52	56	58	65	50	59	41	57
4	95	76	70	77	68	79	68	78	66	75	67	74
5	94	77	59	82	52	85	50	75	48	71	47	69
6	96	88	84	91	77	87	76	90	79	90	82	89
7	94	73	74	74	73	77	63	80	60	78	59	75
8	93	87	79	88	82	89	81	90	82	>91	84	>91
9	93	76	68	79	68	78	71	77	70	83	69	90
10	93	88	84	87	82	87	83	90	85	>91	88	>91

Harmonic LO Order

test conditions: RF. = IN: FREQ. 185.100 MHZ DRIVE + 5.04 DBM
LO. = IN: FREQ. 155.010 MHZ DRIVE + 13.06 DBM
IF = MEASURED: FREQ. 30.09 AMP. = – 1.34 DBM

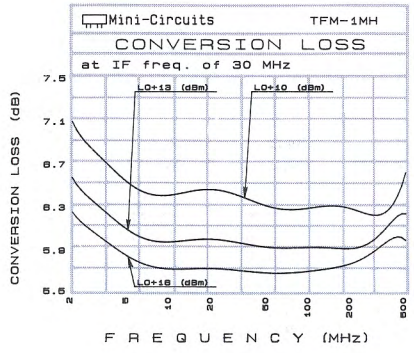
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	_	31	27	28	48	32	42	37	42	41	47
1	>90	24	_	43	13	46	25	41	31	42	30	42
2	79	69	55	70	55	72	55	70	57	64	61	62
3	>90	63	62	67	53	70	48	74	46	68	45	67
4	>90	>81	71	80	69	>82	71	>82	75	>80	77	79
5	>90	80	74	79	72	>80	65	>82	64	>80	64	>81
6	>90	78	>80	>80	>81	>80	>80	>82	>82	>82	>80	>80
7	>90	77	78	>80	>80	>81	>81	>80	81	>82	81	>80
8	>90	78	77	78	79	>80	>81	>81	>80	>82	>82	>82
9	>90	78	78	78	78	78	>80	>81	>81	>80	>80	>82
10	>89	78	78	77	79	78	78	>80	>80	>81	>80	>80

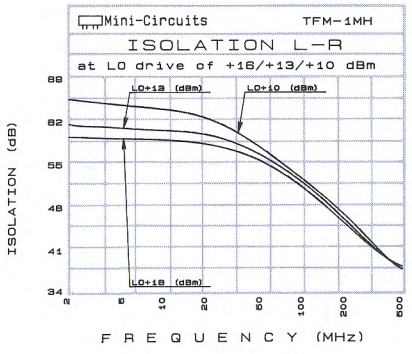
Harmonic LO Order

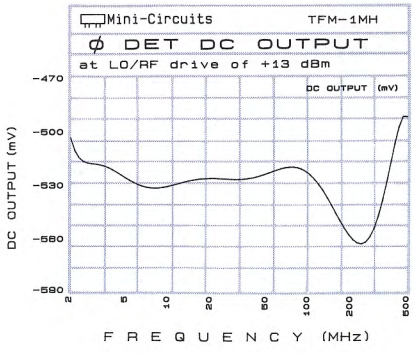
test conditions: RF. = IN: FREQ. 185.100 MHZ DRIVE – 4.96 DBM
LO. = IN: FREQ. 155.010 MHZ DRIVE + 13.06 DBM
IF = MEASURED: FREQ. 30.09 AMP. = – 11.39 DBM

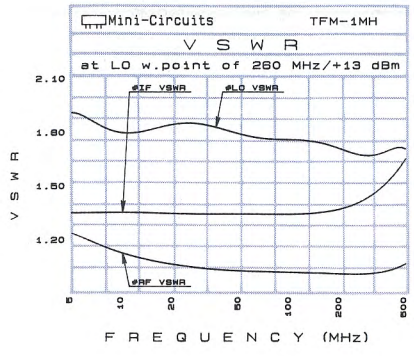
typical performance curves

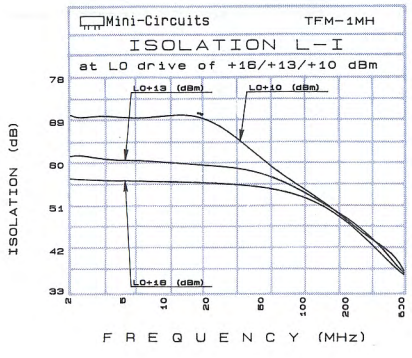
(production unit)

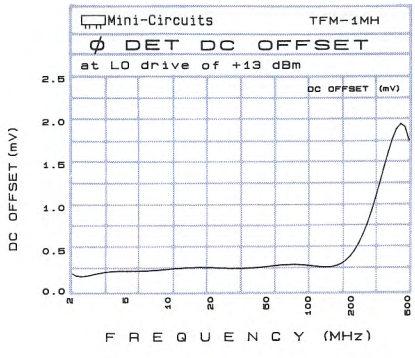












broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Models

TFM-3MH
TUF-3MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
.100	30.10	5.47	5.15	4.95	>70.00	>73.00	>76.00	59.41	60.91	63.34
1.000	31.00	4.85	4.57	4.42	>70.00	>73.00	>76.00	59.03	60.66	63.06
5.000	35.00	4.92	4.68	4.54	>70.00	>73.00	>76.00	58.89	60.53	62.89
10.000	40.00	4.99	4.73	4.56	>70.00	>73.00	71.81	58.55	60.07	62.11
20.000	50.00	5.09	4.80	4.61	65.25	65.05	64.42	57.10	58.37	59.62
33.420	63.42	4.93	4.67	4.53	59.88	59.52	59.13	54.59	55.39	56.16
50.000	80.00	4.91	4.68	4.57	55.23	55.49	53.26	51.75	52.20	51.48
58.410	88.41	4.84	4.65	4.57	53.68	53.27	50.86	50.45	50.21	49.34
66.740	96.74	4.87	4.68	4.55	52.40	50.90	49.02	49.03	48.39	47.78
83.400	53.40	4.90	4.66	4.55	48.74	46.98	45.89	45.72	45.26	44.91
100.060	70.06	4.74	4.54	4.48	45.35	44.09	43.84	43.05	42.57	42.68
116.720	86.72	4.80	4.62	4.56	42.52	41.59	41.71	40.83	40.51	40.95
133.380	103.38	4.86	4.69	4.63	40.42	40.36	40.85	38.94	38.94	39.71
150.040	120.04	4.90	4.74	4.69	38.88	38.78	39.39	37.73	37.88	38.66
166.700	136.70	4.95	4.82	4.76	36.88	37.43	38.44	36.06	36.81	38.02
183.360	153.36	5.03	4.90	4.83	36.07	36.56	37.14	35.07	35.51	36.27
200.000	170.00	5.04	4.89	4.80	35.72	36.59	37.11	34.90	35.86	36.73
216.680	186.68	5.03	4.88	4.78	34.55	35.77	36.72	33.92	35.35	36.86
233.340	203.34	4.98	4.84	4.77	32.96	33.97	35.32	32.41	33.58	35.36
250.000	220.00	5.08	4.93	4.84	32.36	33.05	34.27	32.08	32.71	33.84

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.001	1.51	1.33	1.21	1.05	1.72	2.63	1.69	1.54	1.45
10.000	1.52	1.33	1.22	1.04	1.65	2.54	1.69	1.54	1.45
20.000	1.51	1.33	1.21	1.06	1.74	2.61	1.68	1.54	1.44
27.969	1.50	1.32	1.21	1.06	1.73	2.56	1.68	1.53	1.44
35.625	1.50	1.32	1.21	1.04	1.68	2.49	1.69	1.54	1.45
50.000	1.50	1.32	1.21	1.02	1.67	2.47	1.69	1.55	1.46
58.594	1.49	1.32	1.21	1.03	1.64	2.43	1.69	1.55	1.46
73.907	1.48	1.31	1.20	1.03	1.59	2.34	1.71	1.57	1.47
96.876	1.46	1.29	1.19	1.03	1.64	2.34	1.72	1.58	1.48
100.000	1.46	1.29	1.19	1.02	1.62	2.36	1.73	1.59	1.49
119.840	1.43	1.26	1.17	1.04	1.64	2.34	1.75	1.61	1.51
135.160	1.41	1.25	1.15	1.06	1.63	2.28	1.78	1.64	1.53
150.470	1.39	1.23	1.14	1.08	1.64	2.30	1.81	1.65	1.56
165.780	1.36	1.21	1.12	1.10	1.64	2.30	1.84	1.69	1.58
181.090	1.34	1.19	1.10	1.11	1.63	2.26	1.87	1.73	1.63
200.000	1.31	1.16	1.07	1.12	1.64	2.26	1.93	1.78	1.67
211.720	1.29	1.14	1.05	1.15	1.65	2.27	1.94	1.80	1.70
227.030	1.26	1.12	1.03	1.19	1.65	2.25	2.02	1.85	1.74
242.350	1.23	1.09	1.01	1.19	1.67	2.26	2.08	1.89	1.79
250.000	1.22	1.08	1.01	1.19	1.68	2.28	2.12	1.93	1.82

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.100	-549.80	+0.00
.500	-571.90	+.01
2.000	-572.60	+.02
10.000	-572.00	+.03
25.952	-567.70	+.03
34.569	-565.30	+.03
50.000	-562.90	+.01
60.420	-567.60	-.02
77.655	-573.00	-.01
94.889	-579.40	-.07
100.000	-581.30	-.02
112.120	-583.10	-.20
129.360	-580.50	-.15
146.590	-575.90	-.06
163.830	-576.50	+0.00
181.060	-577.40	-.09
200.000	-585.90	+.68
206.910	-586.90	+.89
224.150	-584.30	+1.07
250.000	-570.10	+.49

Measurements at RF & LO Power +13 dBm

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EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	25	37	33	30	18	41	23	39	25	42
1	–	17	–	33	12	34	18	41	28	40	34	45
2	83	62	55	59	55	61	56	57	50	63	49	70
3	94	61	52	54	65	55	50	61	50	52	47	64
4	>96	80	76	75	79	74	73	77	69	77	69	75
5	>95	>87	71	73	>85	70	68	72	64	78	65	72
6	>96	>86	>85	>86	>85	>86	83	86	78	>85	76	>87
7	>96	>85	>86	>85	81	86	>85	84	81	>85	79	>87
8	>95	>88	>86	>86	>87	>86	>85	>86	>86	>87	>85	>84
9	>96	>86	>87	>85	>87	>85	>85	>85	>86	>85	>87	>86
10	>95	>86	>86	>85	>85	>88	>85	>87	>86	>86	86	>86

Harmonic LO Order

test conditions: RF. =IN: FREQ.185.1 MHZ DRIVE −3.97 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 12.92 DBM
IF MEASURED: FREQ.30.09 MHZ AMP. −9.22 DBM

RF ORDER HARMONIC

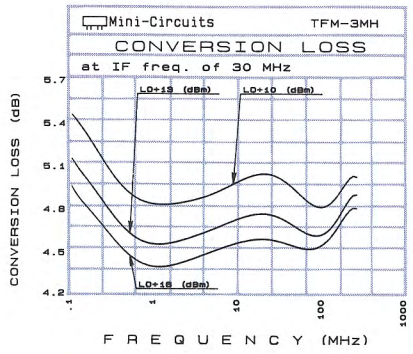
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	15	27	24	19	7	30	12	28	14	29
1	–	17	–	34	12	34	18	38	29	39	31	44
2	>95	69	71	65	66	68	60	64	60	75	58	>74
3	>95	74	68	69	69	70	62	73	65	68	60	>76
4	>95	>77	>75	>77	>77	>77	>76	>78	>76	>78	75	>76
5	>95	>76	>76	>77	>77	>76	>77	>75	>76	>75	>77	>76
6	97	>77	>76	>77	>77	>77	>76	>77	>77	>76	>76	>77
7	>94	>75	>77	>76	>76	>76	>77	>77	>76	>77	>77	>77
8	>95	>76	>76	>76	>76	>77	>76	>76	>77	>77	>76	>76
9	>96	>76	>77	>78	>76	>76	>75	>76	>76	>77	>77	>78
10	>95	>76	>75	>77	>76	>76	>76	>77	>75	>76	>77	>76

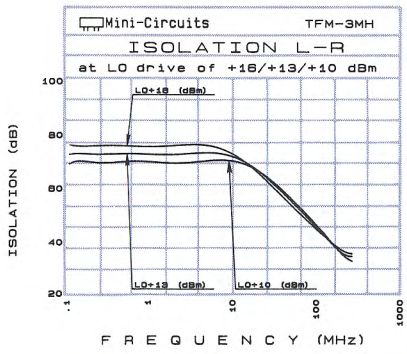
Harmonic LO Order

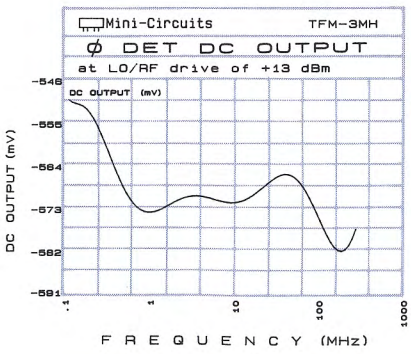
test conditions: RF. IN: FREQ.185.1 MHZ DRIVE −14 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 12.92 DBM
IF MEASURED: FREQ.30.09 MHZ AMP. −19.23 DBM

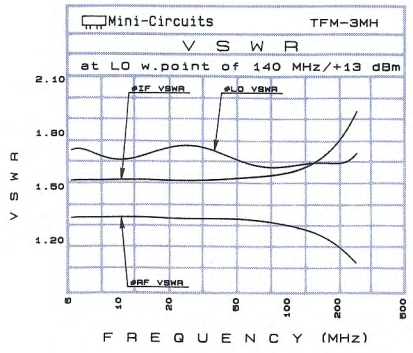
typical performance curves

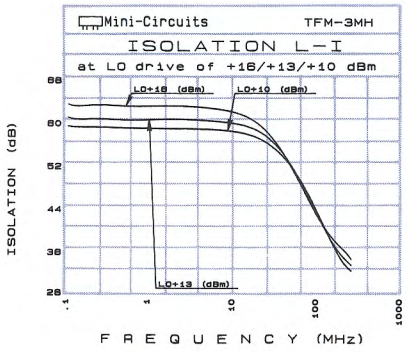
(production unit)

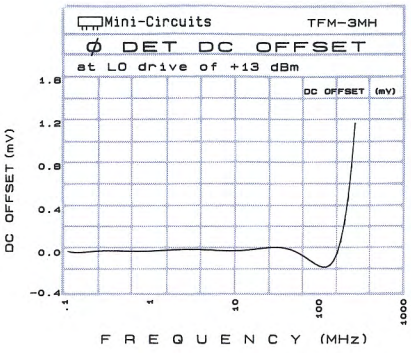












broadband, low distortion

Frequency Mixers

Model
LMX-125MH

LEVEL 13 (+13dBm LO, up to +9dBm RF)



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
.500	30.50	7.73	7.33	7.06	60.33	60.14	60.12	56.94	55.51	55.30
1.000	31.00	7.12	6.76	6.49	57.51	57.75	58.63	55.07	54.44	54.93
2.000	32.00	6.50	6.15	5.94	55.86	56.14	56.94	53.68	53.50	53.94
10.000	40.00	6.02	5.71	5.53	53.09	52.53	52.03	51.06	50.06	49.68
20.000	50.00	6.03	5.72	5.52	50.95	49.82	48.92	48.88	47.53	46.69
50.000	80.00	5.98	5.72	5.56	47.97	46.71	45.52	45.89	44.39	43.32
81.065	51.07	5.98	5.71	5.55	46.62	45.31	44.28	44.70	43.06	42.08
113.290	83.29	6.11	5.75	5.58	44.63	43.35	42.33	42.86	41.40	40.43
161.630	131.63	6.15	5.79	5.60	43.08	41.69	40.67	41.31	39.69	38.79
193.860	163.86	6.24	5.84	5.68	41.81	40.32	39.32	39.96	38.37	37.52
226.080	196.08	6.23	5.88	5.76	41.20	40.13	39.02	39.34	37.83	37.11
242.200	212.20	6.22	5.87	5.75	39.86	40.04	37.79	38.11	36.88	36.20
274.420	244.42	6.06	5.77	5.64	39.40	38.60	37.16	37.24	36.13	35.40
306.650	276.65	5.88	5.67	5.56	38.53	37.50	36.38	36.31	35.36	34.95
338.870	308.87	5.94	5.75	5.63	37.07	36.40	35.74	35.71	34.86	34.31
371.100	341.10	6.35	6.10	5.94	37.58	36.52	35.17	34.95	34.41	33.71
403.330	373.33	6.07	5.84	5.67	37.49	36.16	34.66	34.36	33.90	33.51
435.550	405.55	6.36	6.10	5.84	37.40	35.64	34.46	34.02	33.65	32.96
467.780	437.78	6.41	6.11	5.83	37.07	35.27	34.03	33.43	33.28	32.59
500.000	470.00	6.28	5.97	5.75	36.62	35.18	33.01	32.87	32.82	31.67

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.002	1.45	1.25	1.25	1.41	2.21	3.42	1.59	1.37	1.24
10.000	1.24	1.13	1.12	1.36	2.15	3.35	1.60	1.37	1.24
34.118	1.12	1.05	1.04	1.39	2.21	3.46	1.57	1.36	1.24
50.000	1.12	1.04	1.04	1.37	2.22	3.48	1.58	1.36	1.23
77.794	1.11	1.04	1.05	1.32	2.10	3.21	1.57	1.36	1.23
100.000	1.11	1.04	1.06	1.27	2.02	3.06	1.56	1.36	1.23
136.030	1.11	1.04	1.07	1.29	2.06	3.08	1.57	1.36	1.23
165.150	1.10	1.04	1.07	1.27	2.02	2.96	1.56	1.36	1.23
194.260	1.09	1.04	1.09	1.28	2.01	3.00	1.57	1.36	1.23
208.820	1.09	1.04	1.09	1.26	1.98	2.91	1.57	1.36	1.23
237.940	1.07	1.05	1.10	1.29	2.00	2.88	1.56	1.36	1.23
267.060	1.06	1.05	1.12	1.32	1.99	2.90	1.57	1.36	1.23
310.740	1.04	1.06	1.14	1.33	1.99	2.89	1.57	1.37	1.23
339.850	1.02	1.07	1.15	1.32	2.00	2.80	1.59	1.37	1.23
368.970	1.01	1.08	1.17	1.33	2.07	2.82	1.59	1.37	1.22
398.090	1.02	1.10	1.19	1.35	2.06	2.82	1.60	1.38	1.22
427.210	1.05	1.12	1.21	1.41	2.08	2.86	1.60	1.38	1.23
456.320	1.07	1.14	1.23	1.42	2.08	2.84	1.60	1.38	1.23
485.440	1.10	1.17	1.26	1.46	2.15	2.88	1.60	1.39	1.23
500.000	1.12	1.18	1.27	1.49	2.15	2.90	1.61	1.39	1.24

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.500	−486.90	−1.78
2.000	−563.60	−1.76
10.000	−579.50	−1.68
32.726	−583.80	−1.71
50.000	−578.20	−1.71
81.065	−557.90	−1.67
100.000	−544.00	−1.60
129.400	−544.90	−1.36
161.630	−547.80	−1.40
193.860	−554.50	−1.41
209.970	−555.90	−1.24
242.200	−565.00	−1.06
274.420	−582.30	−1.20
306.650	−564.90	−.45
338.870	−531.60	+.41
371.100	−506.30	+.41
403.330	−501.10	+.26
435.550	−497.50	+.39
467.780	−498.90	+.05
500.000	−517.50	−.33

Measurements at RF & LO Power +13 dBm

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EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	15	36	15	37	21	36	23	40	29	48
1	–	21	–	39	13	40	23	39	30	40	34	43
2	81	63	48	66	48	62	47	58	49	56	47	58
3	93	61	65	64	51	69	47	69	46	63	45	62
4	97	79	72	84	75	>87	68	83	63	78	62	74
5	>96	79	77	79	69	82	65	81	65	81	66	80
6	>94	>86	>86	>86	>86	>86	85	86	81	>85	79	>86
7	>94	>86	84	>86	85	>85	82	>85	80	>86	81	>86
8	>95	>85	>86	>86	>86	>86	>85	>87	>87	>86	>85	>86
9	>95	>87	>86	>86	>85	>86	>86	>86	>86	>86	>85	>86
10	>96	>85	>85	>85	>86	>87	>87	>86	>85	>85	>86	>88

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE –3.98 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 13.02 DBM
IF MEASURED: FREQ.30.091 MHZ AMP. –9.92 DBM

RF ORDER HARMONIC

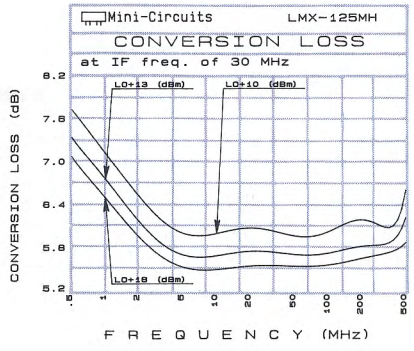
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	5	27	5	26	10	25	12	28	17	35
1	–	21	–	38	14	40	25	37	29	38	29	40
2	96	74	56	>76	56	69	56	65	56	63	55	63
3	96	76	73	>75	66	>77	62	>77	61	76	61	>77
4	>96	>75	>76	>76	>75	>76	>76	>76	>76	>75	>77	>76
5	>95	>76	77	>76	77	>75	>76	>76	>76	>75	>75	>77
6	>95	>75	>77	>76	>75	>76	>76	>75	>76	77	>77	>76
7	>96	>76	>76	>76	>77	>76	>75	>75	>75	>77	>75	>76
8	>94	>75	>77	>75	>76	>76	>76	77	>77	>76	>75	>75
9	>95	>76	>74	>76	>75	>76	>75	>75	>76	>76	>77	>76
10	>96	>75	>75	>75	>75	>75	>77	>75	>75	>75	>77	>76

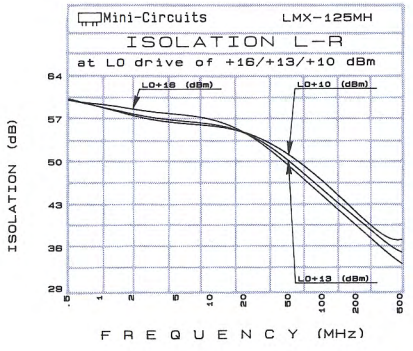
Harmonic LO Order

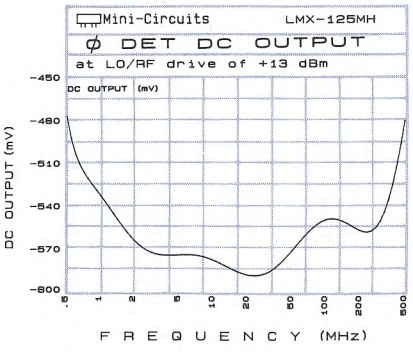
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE –14.01 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 13.02 DBM
IF MEASURED: FREQ.30.091 MHZ AMP. –19.99 DBM

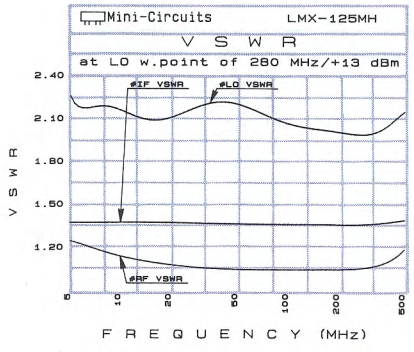
typical performance curves

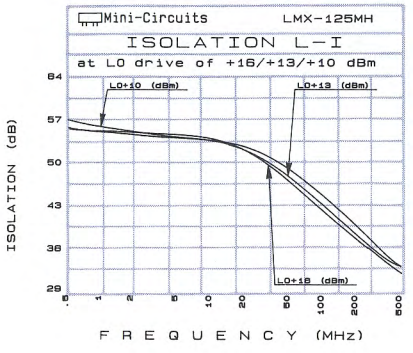
(production unit)

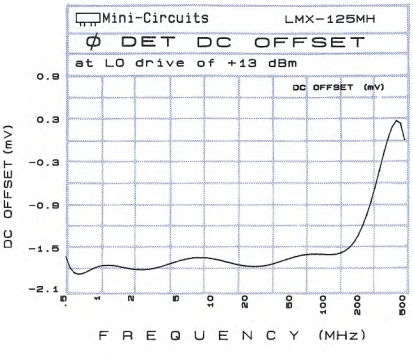












broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
SBL-1MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
1.000	31.00	7.80	7.26	6.98	65.00	66.63	67.65	60.52	59.30	58.20
2.000	32.00	6.97	6.48	6.25	64.11	65.04	67.03	59.98	58.69	58.03
20.000	50.00	6.13	5.69	5.41	61.77	63.01	64.15	55.56	55.53	55.89
47.782	77.78	6.00	5.60	5.40	58.71	58.78	58.86	49.92	50.86	51.65
63.376	93.38	5.88	5.57	5.42	56.62	56.72	56.88	47.61	48.94	50.30
141.350	111.35	5.70	5.41	5.33	50.77	48.96	48.93	41.83	44.44	46.51
172.530	142.53	5.65	5.46	5.41	47.99	47.22	47.70	40.61	43.17	45.20
203.720	173.72	5.78	5.61	5.58	45.77	45.85	46.60	39.76	42.14	44.06
219.320	189.32	5.71	5.58	5.54	44.49	44.34	44.51	39.45	41.70	43.40
234.910	204.91	5.73	5.62	5.54	43.75	44.18	44.24	38.89	40.98	42.69
266.100	236.10	5.59	5.48	5.41	43.77	44.90	45.11	38.15	40.38	42.42
281.690	251.69	5.59	5.53	5.46	43.01	43.24	43.01	37.72	40.07	42.12
328.470	298.47	5.84	5.70	5.60	40.40	41.21	41.56	36.13	38.04	39.63
359.660	329.66	6.00	5.95	5.85	39.76	41.01	42.19	35.23	37.04	38.81
390.850	360.85	5.94	5.89	5.83	37.64	39.17	40.22	34.39	36.14	37.66
422.040	392.04	6.35	6.29	6.21	36.47	38.02	39.34	33.44	34.90	36.34
453.230	423.23	6.52	6.32	6.07	35.89	37.70	39.47	33.27	34.14	35.33
468.820	438.82	6.53	6.23	5.97	35.79	37.66	39.68	33.82	34.16	35.36
484.410	454.41	6.58	6.27	5.99	36.08	37.86	39.93	34.00	34.53	35.09
500.000	470.00	6.76	6.32	5.96	36.95	38.19	40.32	33.29	35.22	35.61

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.001	1.30	1.29	1.33	1.31	1.95	2.96	1.80	1.67	1.53
30.353	1.08	1.07	1.15	1.22	1.98	2.97	1.78	1.66	1.53
59.706	1.07	1.08	1.16	1.20	1.89	2.78	1.81	1.68	1.54
74.382	1.06	1.08	1.16	1.18	1.82	2.60	1.81	1.68	1.54
100.000	1.05	1.08	1.16	1.16	1.80	2.57	1.87	1.71	1.58
118.410	1.05	1.09	1.16	1.16	1.79	2.54	1.90	1.75	1.62
147.760	1.04	1.09	1.16	1.18	1.83	2.52	1.97	1.78	1.66
177.120	1.03	1.09	1.17	1.17	1.78	2.49	2.05	1.87	1.74
191.790	1.03	1.10	1.17	1.20	1.85	2.55	2.07	1.91	1.77
206.470	1.02	1.10	1.18	1.24	1.83	2.46	2.18	1.95	1.81
235.820	1.02	1.11	1.18	1.26	1.88	2.48	2.29	2.04	1.90
265.180	1.04	1.12	1.19	1.32	1.91	2.51	2.38	2.13	2.00
294.530	1.07	1.15	1.21	1.36	1.96	2.51	2.48	2.17	2.04
323.880	1.11	1.18	1.24	1.42	2.04	2.54	2.69	2.21	2.08
353.240	1.16	1.23	1.30	1.45	2.06	2.56	2.81	2.41	2.25
397.260	1.24	1.32	1.37	1.57	2.08	2.52	3.06	2.58	2.40
426.620	1.30	1.37	1.42	1.64	2.11	2.53	3.34	2.69	2.53
441.290	1.33	1.41	1.47	1.70	2.19	2.64	3.28	2.84	2.62
470.650	1.39	1.45	1.51	1.88	2.34	2.73	3.48	2.87	2.68
500.000	1.43	1.49	1.56	1.87	2.45	2.85	3.31	3.02	2.77

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
1.000	−503.30	+.28
32.188	−538.20	+.28
50.000	−538.30	+.28
78.970	−549.50	+.21
100.000	−560.30	+.18
110.160	−553.40	+.18
141.350	−562.30	+.22
172.530	−561.80	+.27
188.130	−560.20	+.47
203.720	−561.30	+.42
234.910	−574.60	+.23
266.100	−572.70	+.56
297.290	−556.00	+.67
328.470	−521.00	+.78
359.660	−489.60	+.72
390.850	−483.90	+.94
422.040	−470.80	+.92
437.630	−464.30	+.79
468.820	−463.30	+.72
500.000	−439.10	+1.61

Measurements at RF & LO Power +13 dBm

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EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	35	47	36	49	45	67	54	74	66	74
1	–	20	–	37	12	47	22	55	27	43	41	58
2	63	>68	>63	>76	>60	>70	52	>62	51	>63	53	>67
3	67	48	41	51	42	51	47	53	45	50	41	58
4	>96	79	72	82	73	77	77	73	72	70	65	71
5	>97	64	58	64	63	64	55	63	51	70	49	67
6	>95	78	81	80	82	88	87	89	83	82	76	75
7	>96	77	62	69	65	70	72	67	68	69	59	70
8	>95	>94	89	86	81	79	76	80	81	85	>91	>94
9	>96	>91	77	85	84	73	66	75	70	71	85	74
10	>95	>93	87	>94	>90	>93	>95	86	80	84	81	85

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE 4.96 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 12.99 DBM
IF=MEASURED: FREQ.30.091 MHZ AMP. -.93 DBM

RF ORDER HARMONIC

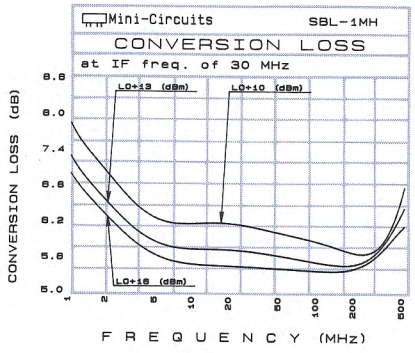
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	25	36	24	36	32	43	29	50	33	57
1	–	20	–	35	13	42	23	41	26	38	31	51
2	83	67	62	75	72	62	58	61	57	63	52	64
3	96	60	50	61	58	64	47	66	45	64	45	58
4	> 97	79	70	81	71	83	78	74	74	72	72	72
5	> 95	77	77	77	74	77	63	79	60	78	60	82
6	> 96	85	79	> 85	78	> 84	78	> 84	82	> 85	> 84	84
7	> 95	> 84	76	84	79	> 85	79	> 85	75	> 84	73	> 85
8	> 95	> 84	> 86	> 85	> 84	> 85	> 86	> 84	> 84	> 85	> 84	> 86
9	> 95	> 84	> 84	> 84	> 84	> 84	> 84	> 85	> 85	> 85	84	> 85
10	> 95	> 83	> 85	> 84	> 84	> 86	> 84	> 85	> 85	> 86	> 85	86

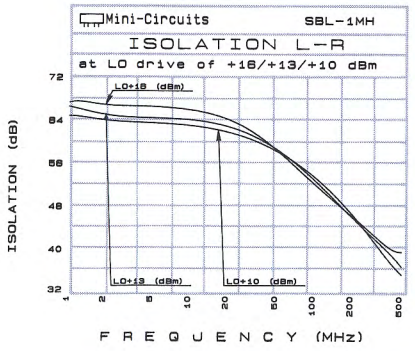
Harmonic LO Order

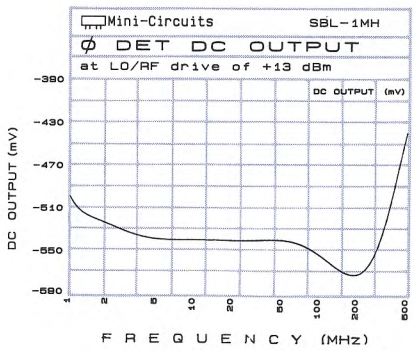
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE -4.97 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE 12.99 DBM
IF=MEASURED: FREQ.30.091 MHZ AMP. -10.91 DBM

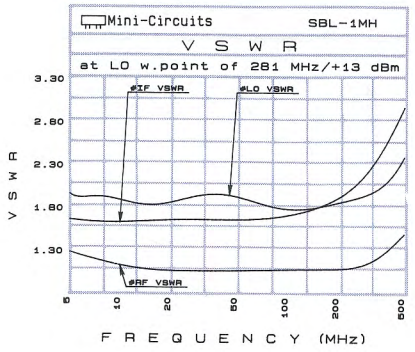
typical performance curves

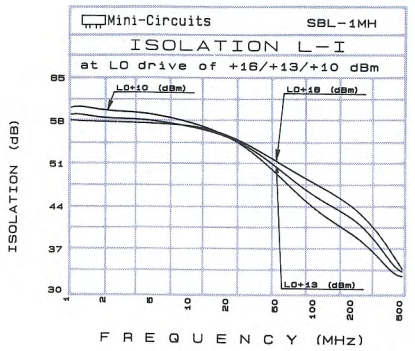
(production unit)

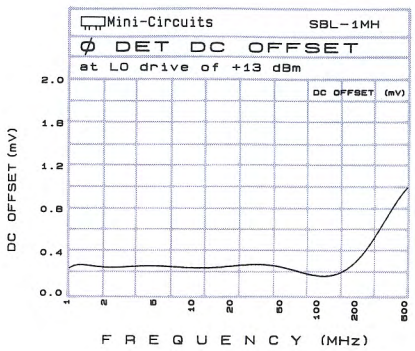












broadband, low distortion

Frequency Mixers

Model
SRA-1MH

LEVEL 13 (+13dBm LO, up to +9dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
1.000	31.00	7.80	7.26	6.98	65.00	66.63	67.65	60.52	59.30	58.20
2.000	32.00	6.97	6.48	6.25	64.11	65.04	67.03	59.98	58.69	58.03
5.000	35.00	6.18	5.80	5.58	63.48	64.44	66.47	59.23	58.27	57.87
10.000	40.00	6.18	5.74	5.49	60.53	61.13	61.76	52.68	53.40	53.84
20.000	50.00	6.13	5.69	5.41	58.47	58.51	58.55	49.57	50.54	51.38
50.000	80.00	5.96	5.58	5.39	56.62	56.72	56.88	47.61	48.94	50.30
78.970	48.97	6.00	5.62	5.41	55.09	55.44	54.35	45.80	47.33	49.28
100.000	70.00	5.82	5.44	5.31	53.72	53.92	52.29	44.32	46.33	48.44
125.750	95.75	5.79	5.44	5.32	53.39	53.09	51.79	43.87	46.06	48.14
141.350	111.35	5.70	5.41	5.33	52.79	52.16	51.00	43.26	45.59	47.85
172.530	142.53	5.65	5.46	5.41	50.77	48.96	48.93	41.83	44.44	46.51
200.000	170.00	5.77	5.64	5.58	47.99	47.22	47.70	40.61	43.17	45.20
250.500	220.50	5.67	5.55	5.46	44.49	44.34	44.51	39.45	41.70	43.40
297.290	267.29	5.69	5.63	5.55	43.67	44.71	45.46	38.59	40.68	42.41
344.070	314.07	5.90	5.80	5.72	40.87	41.06	41.30	36.61	38.65	40.40
390.850	360.85	5.94	5.89	5.83	39.76	41.01	42.19	35.23	37.04	38.81
422.040	392.04	6.35	6.29	6.21	37.64	39.17	40.22	34.39	36.14	37.66
453.230	423.23	6.52	6.32	6.07	36.47	38.02	39.34	33.44	34.90	36.34
484.410	454.41	6.58	6.27	5.99	35.89	37.70	39.47	33.27	34.14	35.33
500.000	470.00	6.76	6.32	5.96	36.95	38.19	40.32	33.29	35.22	35.61

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.001	1.30	1.29	1.33	1.31	1.95	2.96	1.80	1.67	1.53
10.000	1.16	1.13	1.18	1.24	1.91	2.72	1.80	1.63	1.49
20.000	1.10	1.07	1.14	1.16	1.85	2.81	1.76	1.66	1.52
30.353	1.08	1.07	1.15	1.22	1.98	2.97	1.78	1.66	1.53
45.029	1.07	1.07	1.15	1.24	1.94	2.83	1.80	1.66	1.53
74.382	1.06	1.08	1.16	1.18	1.82	2.60	1.81	1.68	1.54
100.000	1.05	1.08	1.16	1.16	1.80	2.57	1.87	1.71	1.58
118.410	1.05	1.09	1.16	1.16	1.79	2.54	1.90	1.75	1.62
147.760	1.04	1.09	1.16	1.18	1.83	2.52	1.97	1.78	1.66
200.000	1.03	1.10	1.17	1.23	1.85	2.52	2.13	1.94	1.80
221.150	1.02	1.11	1.18	1.26	1.88	2.56	2.25	2.03	1.88
250.500	1.03	1.11	1.19	1.29	1.87	2.60	2.32	2.11	1.99
294.530	1.07	1.15	1.21	1.36	1.96	2.51	2.48	2.17	2.04
323.880	1.11	1.18	1.24	1.42	2.04	2.54	2.69	2.21	2.08
353.240	1.16	1.23	1.30	1.45	2.06	2.56	2.81	2.41	2.25
397.260	1.24	1.32	1.37	1.57	2.08	2.52	3.06	2.58	2.40
426.620	1.30	1.37	1.42	1.64	2.11	2.53	3.34	2.69	2.53
455.970	1.36	1.42	1.49	1.80	2.22	2.64	3.29	2.83	2.60
470.650	1.39	1.45	1.51	1.88	2.34	2.73	3.48	2.87	2.68
500.000	1.43	1.49	1.56	1.87	2.45	2.85	3.31	3.02	2.77

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
1.000	−503.30	+.28
2.000	−526.90	+.27
5.000	−537.50	+.27
10.000	−540.60	+.27
20.000	−538.40	+.28
32.188	−538.20	+.28
50.000	−538.30	+.28
78.970	−549.50	+.21
100.000	−560.30	+.18
156.940	−559.80	+.17
200.000	−560.10	+.43
250.500	−575.90	+.39
297.290	−556.00	+.67
344.070	−504.10	+.78
359.660	−489.60	+.72
390.850	−463.90	+.94
422.040	−470.80	+.92
453.230	−470.20	+.65
468.820	−463.30	+.72
500.000	−439.10	+1.61

Measurements at RF & LO Power +13 dBm

Mini-Circuits™
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EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	35	47	36	49	45	67	54	74	66	74
1	–	20	–	37	12	47	22	55	27	43	41	58
2	63	>68	>63	>76	>60	>70	52	>62	51	>63	53	>67
3	67	48	41	51	42	51	47	53	45	50	41	58
4	>96	79	72	82	73	77	77	73	72	70	65	71
5	>97	64	58	64	63	64	55	63	51	70	49	67
6	>95	78	81	80	82	88	87	89	83	82	76	75
7	>96	77	62	69	65	70	72	67	68	69	59	70
8	>95	>94	89	86	81	79	76	80	81	85	>91	>94
9	>96	>91	77	85	84	73	66	75	70	71	85	74
10	>95	>93	87	>94	>90	>93	>95	86	80	84	81	85

Harmonic LO Order

test conditions: RF. =IN: FREQ.185.1 MHZ DRIVE 4.96 DBM
LO. =IN: FREQ.155.01 MHZ DRIVE 12.99 DBM
IF =MEASURED: FREQ.30.091 MHZ AMP. –.93 DBM

RF ORDER HARMONIC

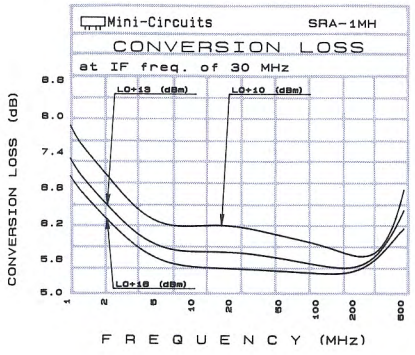
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	25	36	24	36	32	43	29	50	33	57
1	–	20	–	35	13	42	23	41	26	38	31	51
2	83	67	62	75	72	62	58	61	57	63	52	64
3	96	60	50	61	58	64	47	66	45	64	45	58
4	> 97	79	70	81	71	83	78	74	74	72	72	72
5	> 95	77	77	77	74	77	63	79	60	78	60	82
6	> 96	85	79	> 85	78	> 84	78	> 84	82	> 85	> 84	84
7	> 95	> 84	76	84	79	> 85	79	> 85	75	> 84	73	> 85
8	> 95	> 84	> 86	> 85	> 84	> 85	> 86	> 84	> 84	> 85	> 84	> 86
9	> 95	> 84	> 84	> 84	> 84	> 84	> 84	> 85	> 85	> 85	84	> 85
10	> 95	> 83	> 85	> 84	> 84	> 86	> 84	> 85	> 85	> 86	> 85	86

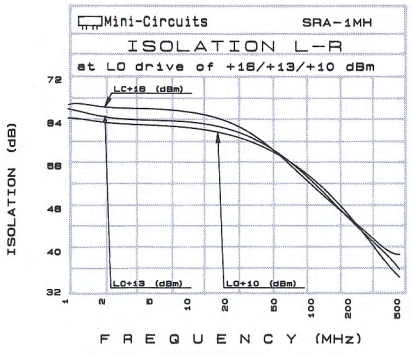
Harmonic LO Order

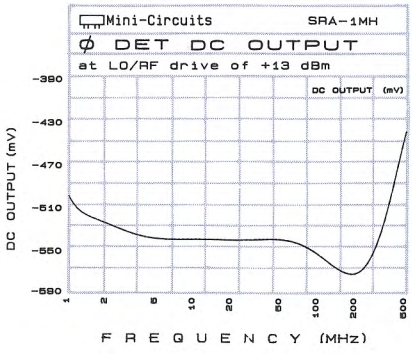
test conditions: RF. =IN: FREQ.185.1 MHZ DRIVE –4.97 DBM
LO. =IN: FREQ.155.01 MHZ DRIVE 12.99 DBM
IF =MEASURED: FREQ.30.091 MHZ AMP. –10.91 DBM

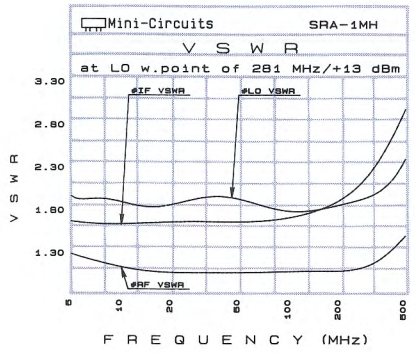
typical performance curves

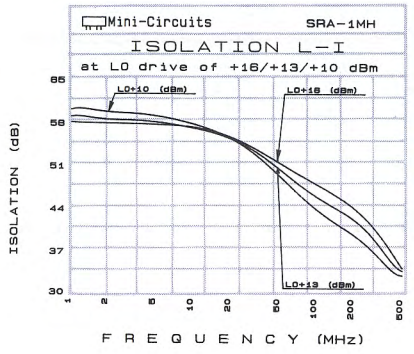
(production unit)

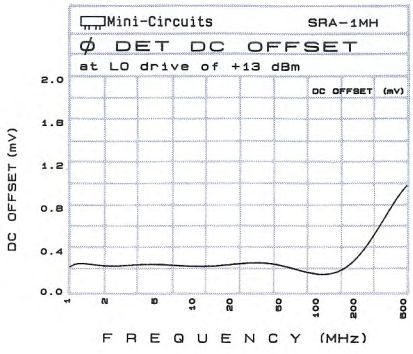












In Stock...Immediate Delivery

broadband, low distortion

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
SRA-3MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L–I (dB) LO +10dBm	LO +13dBm	LO +16dBm
.025	30.03	7.66	7.47	7.24	>70.00	>73.00	71.40	>70.00	68.27	65.79
5.000	35.00	5.25	4.97	4.89	>70.00	68.46	66.56	59.18	58.54	57.93
20.000	50.00	5.35	5.12	5.01	61.88	61.10	59.95	57.74	56.96	56.24
28.593	58.59	5.33	5.10	5.00	59.36	58.49	57.19	56.88	56.16	55.40
35.735	65.74	5.30	5.10	5.02	56.32	55.30	53.21	54.86	54.57	52.46
42.877	72.88	5.28	5.07	5.00	55.01	53.39	51.43	54.32	53.33	51.21
50.000	80.00	5.24	5.05	4.98	52.83	51.26	49.70	52.92	51.58	49.80
64.303	94.30	5.16	5.00	4.96	49.34	48.21	46.87	49.57	48.64	47.17
121.440	91.44	5.08	4.95	4.94	39.62	40.55	41.49	39.89	41.10	42.02
128.580	98.58	5.14	5.04	5.02	39.12	39.34	39.90	39.33	40.10	40.89
135.720	105.72	5.12	5.04	5.05	39.51	39.85	40.17	39.32	40.26	40.71
142.870	112.87	5.07	4.99	5.03	39.76	40.78	41.83	39.11	40.74	42.00
150.010	120.01	5.16	5.06	5.06	39.05	40.53	42.04	38.26	40.11	42.01
157.150	127.15	5.19	5.11	5.10	37.95	39.65	41.17	37.38	39.23	40.80
164.290	134.29	5.22	5.14	5.13	36.71	38.33	39.63	36.71	38.13	39.47
171.430	141.43	5.29	5.21	5.20	35.60	36.83	37.79	36.39	37.20	38.17
178.580	148.58	5.36	5.29	5.27	34.99	35.77	36.61	36.34	36.86	37.65
185.720	155.72	5.43	5.36	5.31	35.16	35.84	36.47	36.83	37.45	38.03
192.860	162.86	5.51	5.42	5.34	35.21	36.35	37.02	37.09	38.14	38.78
200.000	170.00	5.59	5.45	5.38	34.68	36.17	37.04	36.75	38.15	38.89

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.002	1.42	1.27	1.15	1.29	2.12	3.35	1.58	1.50	1.44
32.857	1.39	1.25	1.14	1.32	2.13	3.22	1.59	1.52	1.47
38.429	1.39	1.24	1.13	1.34	2.18	3.24	1.59	1.53	1.47
50.000	1.37	1.23	1.12	1.33	2.14	3.24	1.61	1.54	1.49
60.714	1.36	1.22	1.11	1.29	2.11	3.20	1.64	1.57	1.52
66.286	1.35	1.21	1.11	1.31	2.12	3.25	1.66	1.59	1.53
71.857	1.34	1.20	1.10	1.27	2.09	3.17	1.68	1.60	1.54
83.000	1.31	1.18	1.09	1.26	2.06	2.97	1.71	1.63	1.57
88.571	1.30	1.17	1.08	1.27	2.03	2.94	1.72	1.64	1.58
94.143	1.28	1.16	1.06	1.27	2.03	2.91	1.73	1.65	1.59
99.714	1.26	1.14	1.05	1.29	1.99	2.89	1.74	1.67	1.61
105.290	1.25	1.13	1.04	1.28	2.02	2.90	1.77	1.69	1.63
110.860	1.23	1.12	1.03	1.31	2.01	2.94	1.75	1.67	1.61
122.000	1.21	1.09	1.01	1.32	2.03	2.91	1.84	1.75	1.69
133.140	1.19	1.07	1.02	1.37	2.10	3.07	1.92	1.82	1.76
144.290	1.16	1.04	1.04	1.36	2.10	3.06	1.98	1.88	1.82
149.860	1.14	1.03	1.06	1.37	2.07	2.99	2.02	1.92	1.86
155.430	1.12	1.02	1.08	1.42	2.05	2.99	2.04	1.95	1.88
161.000	1.11	1.02	1.09	1.42	2.07	2.94	2.07	1.97	1.91
200.000	1.05	1.12	1.22	1.47	2.19	3.07	2.37	2.22	2.15

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.025	−505.28	−.02
5.000	−541.50	−.08
20.000	−543.80	−.06
28.593	−544.00	−.06
35.735	−541.60	−.06
42.877	−542.50	−.05
50.000	−542.80	−.03
64.303	−555.40	−.02
121.440	−549.90	+.17
128.580	−541.90	+.03
135.720	−542.80	+0.00
142.870	−541.90	+.02
150.010	−546.60	+.05
157.150	−551.60	+.27
164.290	−558.10	+.39
171.430	−557.20	+.54
178.580	−552.20	+.63
185.720	−547.40	+.54
192.860	−543.30	+.44
200.000	−541.00	+.27

Measurements at RF & LO Power +13 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

00-42

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	44	71	51	70	57	75	75	70	64	73
1	–	36	–	44	12	57	20	53	31	50	45	54
2	67	>79	>67	>81	>64	>81	>64	>78	>65	>81	>72	>77
3	59	54	48	53	43	54	45	50	46	49	44	50
4	>96	>94	76	>95	74	>93	77	>92	75	83	88	81
5	>96	69	64	69	55	73	52	66	50	60	50	56
6	>95	>96	79	>96	79	>96	80	>91	80	>90	82	87
7	>96	87	80	>93	78	>95	77	80	67	75	63	74
8	>96	>97	86	>96	86	>95	85	>97	86	>96	86	>94
9	>96	90	74	88	73	88	74	87	73	83	71	76
10	>96	>94	90	>95	91	>94	>91	>96	>96	>97	>94	>96

Harmonic LO Order

test conditions: RF. = IN: FREQ.10.1 MHZ DRIVE 5 DBM
LO. = IN: FREQ.40.01 MHZ DRIVE 12.98 DBM
IF = MEASURED: FREQ.29.91 MHZ AMP. –.08 DBM

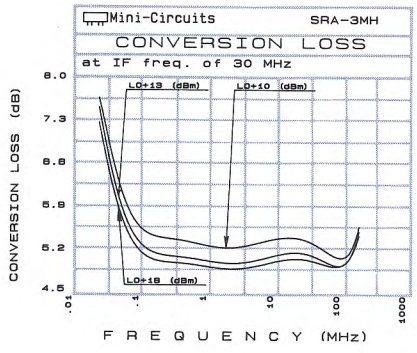
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	36	58	37	57	41	63	50	55	67	56
1	–	33	–	38	12	40	19	38	31	36	38	37
2	86	>87	62	>84	61	>85	62	>87	63	79	67	79
3	88	72	66	73	57	72	55	65	52	62	52	61
4	>95	>86	78	>85	76	>85	80	>86	78	>84	83	>86
5	>96	>81	74	>81	71	84	65	80	64	80	64	83
6	>96	>86	>86	>84	>86	>86	>87	>86	>86	>86	>84	>86
7	>96	>86	>83	>87	79	>86	77	>85	76	>85	75	>85
8	>96	>86	>86	>86	>85	>85	>86	>85	>86	>87	>87	>86
9	>95	>86	>82	>87	>82	>86	84	>86	84	>86	85	>85
10	>96	>85	>86	>85	>86	>86	>86	>86	>85	>86	>85	>87

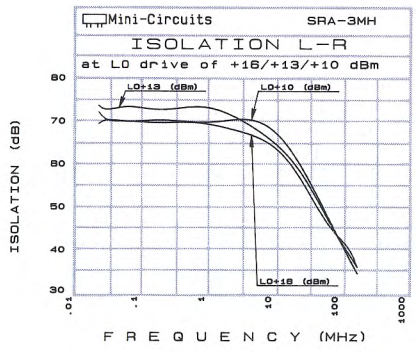
Harmonic LO Order

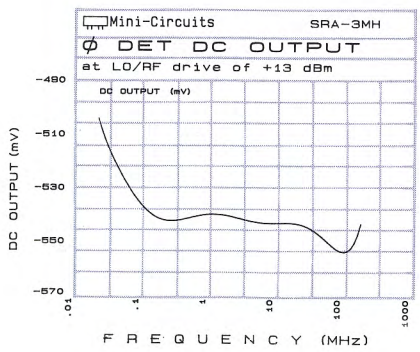
test conditions: RF. = IN: FREQ.10.1 MHZ DRIVE –5.04 DBM
LO. = IN: FREQ.40.01 MHZ DRIVE 12.96 DBM
IF = MEASURED: FREQ.29.91 MHZ AMP. –10.07 DBM

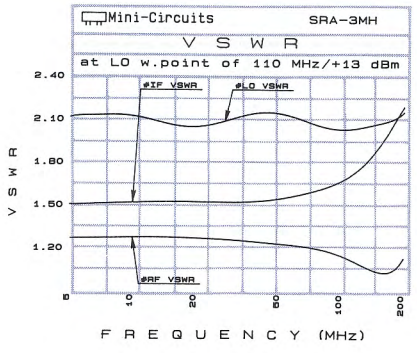
typical performance curves

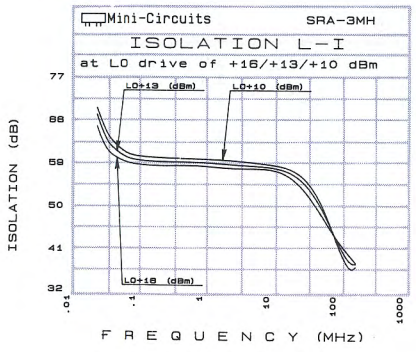
(production unit)

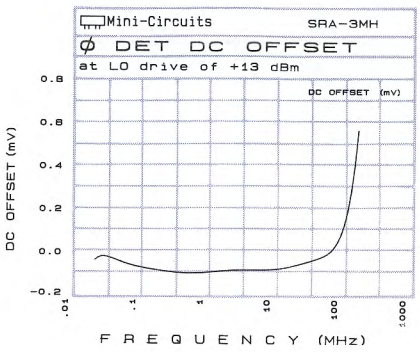












very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models

GRA-1H
SRA-1H
ZAD-1H
ZLW-1H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
.500	30.50	7.59	7.38	7.34	67.77	64.73	63.33	63.62	58.33	55.14
2.000	32.00	6.46	6.29	6.29	64.57	62.80	62.04	61.48	57.04	54.11
10.000	40.00	6.01	5.89	5.94	59.83	58.80	57.71	56.42	53.94	51.93
20.000	50.00	6.09	5.93	5.96	53.53	51.76	50.63	48.99	47.62	46.21
50.000	80.00	6.02	5.91	6.00	49.57	48.13	47.38	45.62	44.45	43.31
81.065	51.07	5.94	5.84	5.90	44.91	43.91	43.68	41.40	40.75	39.82
100.000	70.00	5.91	5.82	5.91	43.58	42.51	42.42	40.12	39.43	38.57
129.400	99.40	5.89	5.85	5.94	42.72	41.76	41.26	39.37	38.65	37.85
161.630	131.63	5.93	5.90	5.99	40.72	39.94	39.60	37.76	37.09	36.22
193.860	163.86	6.06	5.98	6.04	39.50	38.70	38.14	36.29	35.65	34.57
226.080	196.08	6.18	6.10	6.16	38.71	38.27	37.93	36.04	35.36	34.32
258.310	228.31	6.10	6.01	6.05	37.84	37.16	36.49	35.32	34.23	32.87
274.420	244.42	6.08	5.97	6.03	37.40	36.62	35.89	33.67	33.23	32.23
306.650	276.65	6.14	6.07	6.17	36.25	35.81	35.25	33.23	32.42	31.59
338.870	308.87	6.21	6.16	6.27	36.02	34.78	34.05	31.92	30.96	30.14
371.100	341.10	6.50	6.34	6.34	35.50	33.92	32.90	30.95	29.51	28.53
403.330	373.33	6.61	6.42	6.39	36.28	33.83	32.11	30.44	28.51	27.55
435.550	405.55	6.86	6.60	6.39	37.45	34.53	32.39	29.80	28.16	26.66
467.780	437.78	7.03	6.76	6.62	38.15	35.55	33.44	28.62	28.51	26.88
500.000	470.00	7.17	6.85	6.62	36.57	34.97	33.67	29.76	28.71	27.01

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm	freq. (MHz)	max. DC output mV	DC offset mv
5.001	1.23	1.26	1.28	1.95	2.93	4.04	1.47	1.30	1.17	.500	−671.80	−1.35
10.000	1.10	1.13	1.17	1.89	2.80	3.90	1.47	1.30	1.18	1.000	−709.80	−1.42
20.000	1.02	1.08	1.14	1.81	2.61	3.52	1.46	1.30	1.18	10.000	−720.20	−.69
34.118	1.02	1.09	1.15	1.84	2.57	3.35	1.45	1.29	1.18	34.130	−715.90	−.67
50.000	1.03	1.10	1.16	1.85	2.57	3.39	1.46	1.31	1.19	50.195	−716.20	−.65
77.794	1.05	1.12	1.17	1.88	2.72	3.76	1.52	1.35	1.23	82.325	−723.70	−.52
100.000	1.06	1.12	1.18	1.80	2.57	3.33	1.55	1.38	1.26	100.000	−717.90	−.49
136.030	1.08	1.14	1.19	1.77	2.45	3.12	1.59	1.43	1.31	130.520	−721.80	−.72
165.150	1.10	1.16	1.21	1.84	2.59	3.32	1.68	1.51	1.38	162.650	−704.20	−1.05
194.260	1.12	1.17	1.22	1.76	2.39	2.99	1.72	1.56	1.42	194.780	−706.00	−1.53
208.820	1.13	1.18	1.23	1.76	2.34	2.95	1.74	1.59	1.45	210.850	−708.20	−1.56
252.500	1.18	1.24	1.28	1.87	2.56	3.19	1.90	1.73	1.57	242.980	−718.00	−1.83
281.620	1.20	1.26	1.30	1.80	2.43	3.06	1.94	1.77	1.61	275.110	−723.30	−2.91
310.740	1.24	1.28	1.33	1.83	2.47	3.11	1.95	1.80	1.64	307.240	−706.60	−3.24
339.850	1.28	1.33	1.39	1.92	2.54	3.15	2.14	1.95	1.75	339.370	−674.20	−3.34
368.970	1.30	1.34	1.38	1.89	2.45	2.99	2.14	1.95	1.75	371.500	−642.80	−3.19
398.090	1.33	1.36	1.41	1.95	2.59	3.21	2.16	1.97	1.78	403.630	−613.30	−3.29
441.760	1.37	1.39	1.44	1.88	2.55	3.12	2.27	2.11	1.86	435.760	−597.90	−3.37
470.880	1.37	1.40	1.45	1.91	2.52	3.06	2.21	2.07	1.83	467.890	−600.20	−5.58
500.000	1.40	1.42	1.47	1.92	2.52	3.10	2.30	2.17	1.88	500.000	−604.10	−3.89

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

00-63

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	26	28	36	36	45	37	45	54	51
1	-	15	-	55	16	36	28	32	39	40	60	64
2	67	47	28	55	30	57	50	55	45	54	52	>61
3	>85	55	31	37	37	52	36	61	47	49	51	58
4	>85	58	53	62	47	68	58	63	57	70	58	60
5	>85	56	51	65	51	59	52	55	56	77	58	62
6	>83	65	66	61	64	>78	56	75	60	64	70	>76
7	>84	73	71	72	68	74	64	64	65	62	64	73
8	>84	>82	72	75	>81	70	71	>78	74	73	74	68
9	>85	>83	>82	>81	>81	>80	71	74	74	>83	74	73
10	>84	>82	>82	>81	>77	>80	>81	>78	>80	>81	>78	>77

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 4.96 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 16.99 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -2.32 DBM

RF CAL

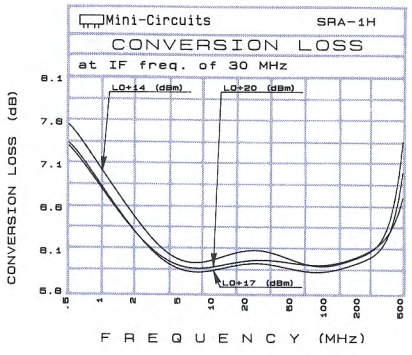
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	2	15	17	23	20	27	25	33	41	37
1	-	15	-	40	13	35	26	29	35	35	50	53
2	86	62	45	59	46	57	55	71	63	59	64	61
3	>86	>73	55	65	59	74	58	>74	63	62	63	69
4	>85	>73	73	>72	67	>74	69	>75	>73	>74	>71	>72
5	>83	>72	>72	>72	>73	>72	>73	75	>73	>73	>73	>73
6	>83	>71	>71	>73	>73	>73	>73	>75	>73	>73	>72	>72
7	>84	>72	>71	>71	>72	>74	>73	>73	>73	>74	>73	>74
8	>86	>73	>73	>72	>71	>73	>73	>73	>74	>74	>74	>75
9	>84	>72	>73	>72	>71	>70	>72	>73	>74	>75	>74	>74
10	>84	>72	>71	>71	>73	>72	>72	>72	>72	>73	>73	>73

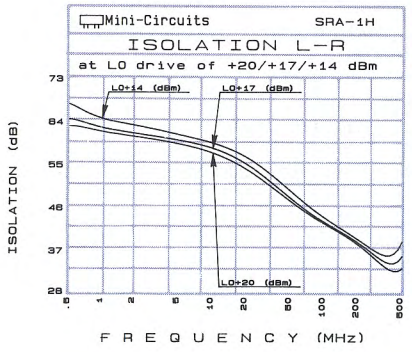
Harmonic LO Order

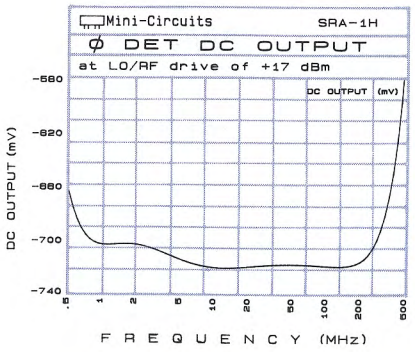
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE -4.92 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 16.99 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -12.32 DBM

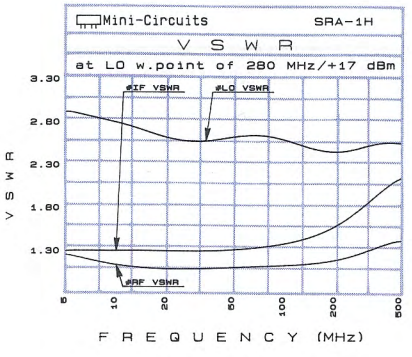
typical performance curves

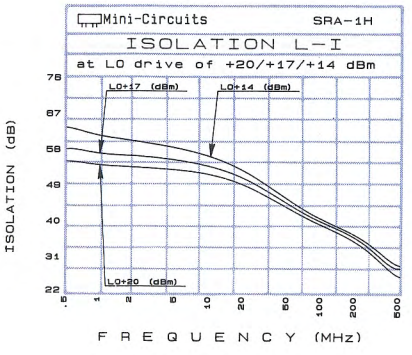
(production unit)

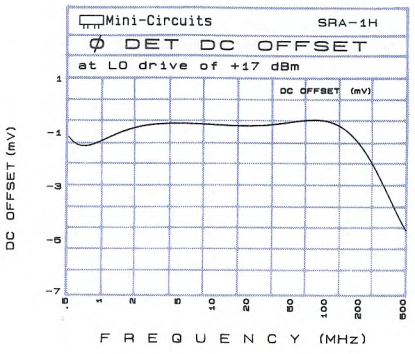












very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models

SRA-1WH
ZAD-1WH
ZLW-1WH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
1.000	31.00	7.14	6.91	6.75	60.43	59.17	57.31	57.95	55.91	53.06
5.000	35.00	6.27	6.06	5.93	59.29	55.98	53.74	55.96	51.59	48.81
20.000	50.00	6.20	5.98	5.85	59.53	56.29	53.93	56.41	51.86	49.03
50.000	80.00	6.16	5.98	5.87	59.44	56.10	53.54	55.96	51.57	48.59
75.901	45.90	6.10	5.94	5.85	58.28	55.67	53.32	54.89	51.09	48.26
100.870	70.87	6.01	5.88	5.83	56.39	54.02	51.68	52.32	49.21	47.12
150.800	120.80	6.04	5.94	5.89	51.14	48.90	47.58	47.13	45.61	44.68
225.700	195.70	6.20	6.05	5.95	45.88	44.92	44.58	43.31	42.84	42.59
250.670	220.67	6.04	5.93	5.88	44.01	43.34	43.27	41.56	41.39	41.63
275.640	245.64	6.01	5.92	5.85	41.51	41.46	41.32	40.17	40.34	40.39
350.540	320.54	6.37	6.22	6.12	40.62	40.96	41.22	39.87	39.92	39.74
400.470	370.47	6.53	6.34	6.23	38.50	38.85	38.80	38.61	39.12	38.97
450.410	420.41	6.46	6.25	6.08	36.13	35.90	35.87	35.38	35.56	35.71
500.000	470.00	6.74	6.34	6.08	35.98	35.92	35.30	33.74	33.02	32.63
525.310	495.31	7.10	6.71	6.34	36.02	36.74	35.75	34.77	33.42	31.76
575.240	545.24	7.48	7.06	6.60	36.54	37.19	37.29	35.88	34.02	31.91
625.180	595.18	7.19	6.59	6.20	36.18	37.15	36.99	36.56	33.53	30.16
675.110	645.11	6.85	6.45	6.40	35.15	35.08	34.39	34.31	31.94	28.55
725.040	695.04	7.09	6.86	6.49	34.37	34.11	33.35	32.33	30.41	25.93
750.000	720.00	7.28	6.96	6.27	35.04	34.12	33.72	29.43	26.97	23.38

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.23	1.21	1.21	3.35	2.46	1.77	1.29	1.43	1.58
10.000	1.14	1.10	1.10	3.23	2.36	1.72	1.29	1.43	1.58
20.000	1.10	1.05	1.04	3.10	2.36	1.74	1.29	1.42	1.57
29.032	1.10	1.04	1.02	3.04	2.38	1.72	1.29	1.42	1.57
50.000	1.11	1.05	1.01	3.20	2.39	1.69	1.30	1.43	1.58
100.000	1.13	1.07	1.02	2.98	2.27	1.63	1.32	1.46	1.61
125.160	1.13	1.08	1.03	2.89	2.23	1.67	1.34	1.47	1.62
173.220	1.16	1.10	1.05	2.91	2.29	1.68	1.39	1.53	1.69
221.290	1.19	1.13	1.07	2.94	2.30	1.67	1.44	1.58	1.76
269.350	1.21	1.17	1.10	2.90	2.32	1.71	1.50	1.64	1.86
341.450	1.25	1.21	1.14	2.90	2.29	1.76	1.59	1.75	1.99
365.480	1.27	1.22	1.15	2.80	2.23	1.76	1.63	1.80	2.04
437.580	1.28	1.24	1.18	2.87	2.34	1.85	1.71	1.86	2.11
485.640	1.27	1.23	1.18	2.86	2.35	1.91	1.74	1.89	2.14
500.000	1.26	1.23	1.18	2.90	2.37	1.90	1.73	1.88	2.11
557.740	1.27	1.23	1.20	2.89	2.38	1.98	1.74	1.89	2.12
605.800	1.30	1.27	1.25	2.84	2.33	1.92	1.70	1.85	2.05
653.860	1.40	1.37	1.36	2.86	2.38	1.92	1.64	1.79	1.95
701.930	1.57	1.54	1.54	2.81	2.36	1.99	1.60	1.73	1.86
750.000	1.78	1.78	1.78	2.74	2.28	1.99	1.54	1.65	1.77

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
1.000	−706.70	−1.88
5.000	−728.60	−1.83
10.000	−736.40	−1.85
30.960	−736.80	−1.91
50.000	−729.10	−1.80
90.880	−742.90	−1.89
120.840	−750.10	−1.98
180.760	−754.20	−2.27
210.720	−749.00	−2.19
270.640	−759.80	−2.32
330.560	−725.90	−2.52
360.520	−688.40	−2.53
420.440	−641.80	−2.36
480.360	−641.30	−4.62
500.000	−644.90	−5.29
540.280	−634.40	−4.12
600.000	−623.20	+.70
660.120	−606.10	+.65
700.000	−605.40	+1.18
750.000	−644.30	+4.48

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>99*	–	17	30	19	61	31	42	54	55	70	67
1	>99*	16	–	38	11	35	46	79	34	50	58	59
2	68*	54	37	56	35	69	39	81	43	54	56	70
3	78*	48	42	47	34	54	37	62	57	57	44	67
4	94*	69	66	65	56	73	58	64	61	72	61	67
5	95*	61	54	75	53	70	51	70	54	64	64	71
6	95*	81	73	77	78	92	68	72	72	75	70	82
7	96*	77	70	72	64	75	66	84	59	72	72	>92
8	94*	85	82	86	85	85	91	77	77	85	76	82
9	93*	84	83	87	86	82	78	83	72	>90	65	82
10	95*	87	87	87	87	87	86	86	>92	90	>90	83

Harmonic LO Order

test conditions: RF=500.100 MHZ INPUT P. +5.03DBM
LO 470.010 MHZ INPUT P. +16.96DBM
IF= 30.090MHZ IF AMPLIT. -2.29 DBM

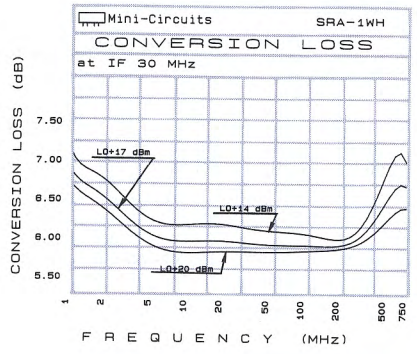
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	>90	–	10	20	8	51	17	29	37	41	44	49
1	>90	17	–	37	10	34	46	48	28	47	50	48
2	78	60	46	60	47	71	47	71	53	60	60	75
3	>90	73	68	68	65	70	57	77	72	70	60	77
4	>90	77	>82	81	>81	>81	>80	>81	>83	>82	77	77
5	>90	77	77	>82	>82	>81	>81	>80	>81	>83	>82	77
6	>90	76	78	77	>82	>82	>81	>81	>80	>81	>82	>82
7	>90	78	77	77	77	>82	>82	>81	>81	>80	>81	>82
8	>90	77	78	78	76	78	>82	>82	>81	>81	>81	>81
9	>90	77	78	78	77	78	77	>82	>82	>81	>80	>81
10	>89	78	77	77	78	77	77	76	>82	>82	>81	>80

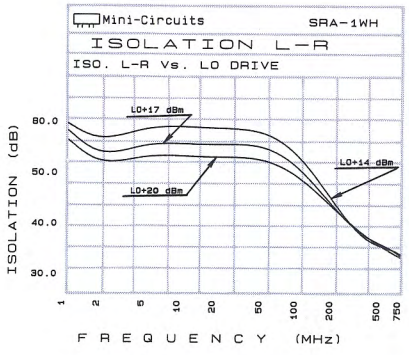
Harmonic LO Order

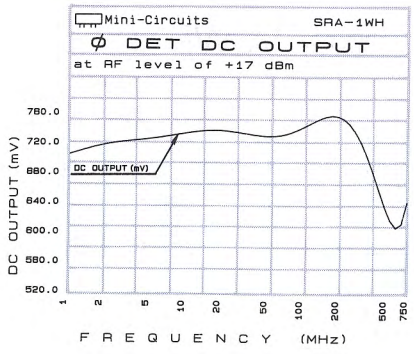
test conditions: RF 500.100 MHZ INPUT P. -4.94DBM
LO 470.010 MHZ INPUT P. +16.96DBM
IF= 30.090MHZ IF AMPLIT. -11.88 DBM

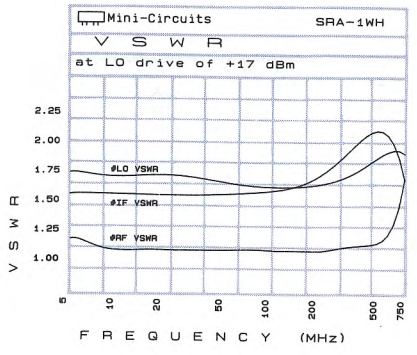
typical performance curves

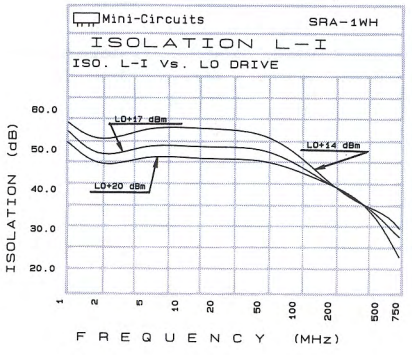
(production unit)

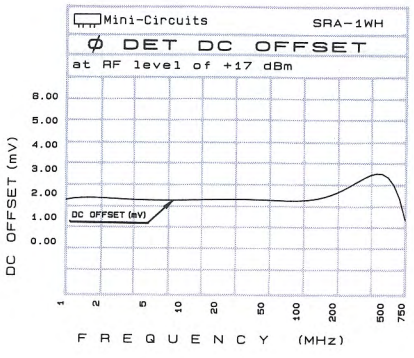












In Stock...Immediate Delivery

very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models

SRA-2H
ZAD-2H
ZLW-2H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
2.000	32.00	6.93	6.71	6.48	52.91	49.37	46.27	49.31	47.92	43.98
34.194	64.19	6.30	6.17	6.03	49.62	46.77	43.88	47.55	45.60	42.10
66.388	96.39	6.37	6.25	6.18	48.79	45.81	43.01	45.80	44.10	41.18
130.780	100.78	6.29	6.14	6.03	47.13	44.80	42.75	41.01	41.52	40.71
195.160	165.16	6.40	6.30	6.19	45.10	43.07	41.76	39.16	39.47	39.17
227.360	197.36	6.45	6.32	6.20	42.87	41.46	40.52	37.32	37.60	37.35
291.750	261.75	6.33	6.23	6.13	40.85	39.76	38.85	34.92	35.26	35.12
356.130	326.13	6.56	6.42	6.28	39.56	38.97	38.28	32.79	33.32	33.47
420.520	390.52	6.70	6.62	6.47	39.57	37.70	36.28	30.93	31.07	31.04
484.910	454.91	6.83	6.65	6.40	39.10	37.81	36.00	29.95	29.46	29.08
517.100	487.10	6.90	6.59	6.40	38.41	37.82	36.22	29.98	29.13	28.32
549.300	519.30	7.32	6.96	6.60	37.39	38.18	37.18	29.72	30.50	29.89
645.880	615.88	7.74	7.10	6.67	36.98	37.13	35.93	28.19	29.06	27.86
678.070	648.07	7.67	7.02	6.65	33.72	33.22	32.85	26.17	26.56	24.82
742.460	712.46	7.38	6.87	6.50	33.81	32.76	32.02	24.46	24.80	23.87
806.850	776.85	7.48	7.04	6.63	32.85	31.78	32.24	23.69	23.82	22.91
871.240	841.24	8.64	8.09	7.55	32.04	32.53	33.39	23.09	23.46	22.87
935.630	905.63	9.31	8.66	8.07	32.55	33.52	34.06	22.99	23.26	22.52
967.820	937.82	9.39	8.70	8.18	32.76	34.06	34.42	22.83	22.82	22.53
1000.000	970.00	9.34	8.81	8.38	32.61	33.66	33.51	22.51	22.59	22.51

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.000	1.31	1.29	1.35	1.73	2.33	3.08	2.04	1.50	1.22
35.121	1.11	1.02	1.16	1.59	2.11	2.78	1.97	1.47	1.22
65.242	1.11	1.01	1.18	1.61	2.15	2.92	2.01	1.50	1.25
100.000	1.12	1.01	1.20	1.53	2.04	2.68	2.02	1.53	1.31
155.610	1.15	1.02	1.24	1.56	2.05	2.82	2.08	1.60	1.41
200.000	1.17	1.04	1.27	1.54	1.99	2.62	2.03	1.62	1.45
245.970	1.19	1.05	1.32	1.53	1.99	2.60	2.12	1.69	1.53
336.330	1.22	1.07	1.34	1.56	1.98	2.58	2.11	1.70	1.56
366.450	1.24	1.08	1.36	1.62	2.04	2.75	2.13	1.71	1.57
426.700	1.27	1.09	1.34	1.61	2.01	2.60	2.05	1.63	1.50
500.000	1.35	1.12	1.28	1.68	2.01	2.61	1.93	1.50	1.35
547.180	1.44	1.15	1.23	1.68	2.02	2.62	1.87	1.41	1.22
637.550	1.64	1.30	1.20	1.66	1.97	2.53	1.73	1.30	1.10
667.670	1.73	1.38	1.23	1.64	1.93	2.50	1.68	1.32	1.21
727.910	1.98	1.62	1.43	1.65	1.92	2.46	1.71	1.49	1.54
788.150	2.42	2.00	1.80	1.71	1.96	2.50	1.88	1.82	2.06
848.390	2.95	2.47	2.27	1.79	1.97	2.57	2.15	2.27	2.75
908.640	3.42	3.33	2.72	1.81	1.98	2.57	2.54	2.80	3.62
938.760	3.74	3.56	2.96	1.81	2.02	2.63	2.78	3.22	4.32
1000.000	4.10	3.82	3.37	1.93	2.11	2.69	3.30	3.87	5.46

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
2.000	−711.40	+3.28
33.188	−755.00	+4.40
64.376	−759.10	+4.15
100.000	−749.60	+3.83
157.940	−762.10	+4.25
200.000	−753.40	+3.77
251.500	−768.70	+2.77
313.880	−761.30	+2.01
376.260	−700.90	+.48
438.630	−650.60	+1.04
500.000	−680.80	+1.03
532.200	−657.30	+.11
625.760	−636.50	+2.34
656.950	−623.10	+4.71
719.320	−599.60	+5.21
781.700	−594.40	+2.49
844.080	−547.40	+4.53
906.450	−565.00	+5.64
937.640	−551.90	+8.10
1000.000	−466.70	10.32

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	13	27	21	47	26	46	46	43	49	55
1	-	13	-	40	11	32	87	45	32	37	40	52
2	63	55	47	54	38	52	>86	>58	43	51	44	49
3	74	45	42	44	36	52	39	56	58	>84	43	50
4	>96	75	58	64	60	65	70	62	68	77	73	66
5	>95	60	59	69	54	71	80	65	86	62	71	78
6	>94	69	70	68	73	71	74	76	67	70	63	>90
7	>95	75	69	73	66	81	63	85	58	70	71	78
8	>96	86	72	79	78	75	79	73	69	80	65	75
9	>96	>92	>93	86	89	>89	82	>89	79	86	69	86
10	>96	>91	>93	>91	83	86	86	>91	85	87	85	>90

Harmonic LO Order

test conditions: RF.=IN: FREQ.500.1 MHZ DRIVE 4.92 DBM
LO.=IN: FREQ.470.01 MHZ DRIVE 17.02 DBM
IF=MEASURED: FREQ.30.092 MHZ AMP. -2.4 DBM

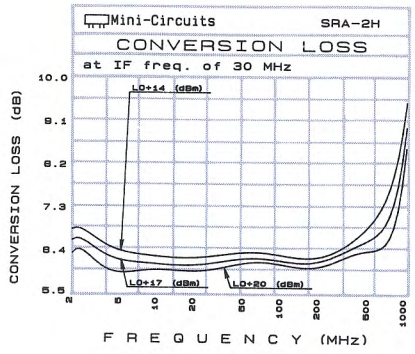
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	18	11	35	15	30	27	26	30	39
1	-	13	-	36	11	31	52	38	28	34	36	46
2	82	56	56	56	52	56	52	66	52	59	52	54
3	>96	67	71	63	62	67	62	70	75	68	61	70
4	>95	>83	83	>84	>84	>83	>82	>84	>83	>83	>82	>83
5	>95	>83	>82	>84	>85	>83	>83	>84	>83	>84	>83	>83
6	>95	>82	>84	>83	>84	>83	>83	>85	>84	>84	>84	>83
7	>96	>83	>83	>83	>83	>84	>84	>83	>84	>84	>84	>85
8	>97	>84	>83	>85	>84	>83	>84	>83	>83	>84	>83	>84
9	>95	>84	>84	86	>85	>85	>84	>83	>85	>85	>84	>84
10	>97	>84	>83	>85	>83	>84	>83	>81	>85	>85	>83	>84

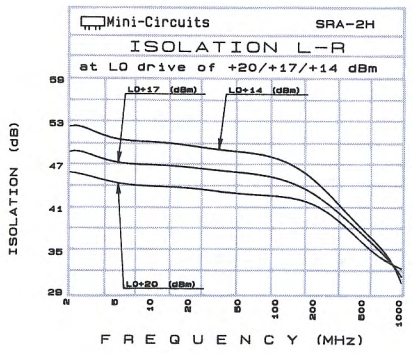
Harmonic LO Order

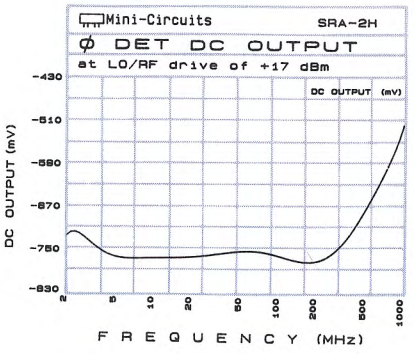
tets conditions: RF.=IN: FREQ.500.1 MHZ DRIVE -5.03 DBM
LO.=IN: FREQ.470.01 MHZ DRIVE 16.96 DBM
IF=MEASURED: FREQ.30.092 MHZ AMP. -11.99 DBM

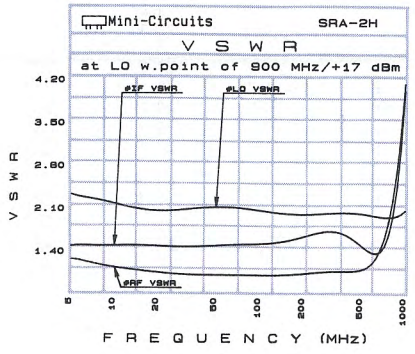
typical performance curves

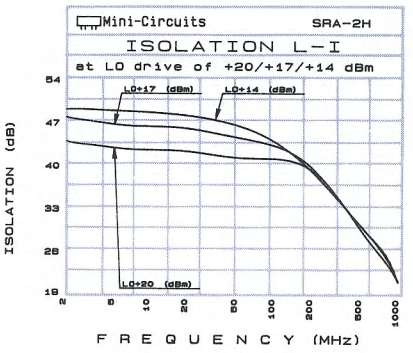
(production unit)

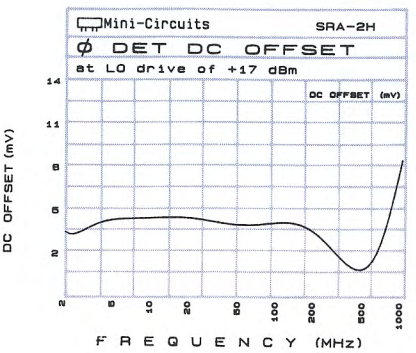












very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models

GRA-3H
SRA-3H
ZAD-3H
ZLW-3H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
.050	30.05	5.94	5.79	5.69	63.58	61.52	59.06	63.39	58.47	54.35
.200	30.20	5.43	5.33	5.26	63.56	61.30	59.59	63.01	55.83	51.32
1.000	31.00	5.36	5.25	5.17	63.21	61.00	59.26	62.31	55.41	51.09
5.000	35.00	5.30	5.18	5.09	59.91	58.85	57.26	59.04	54.15	50.39
10.000	40.00	5.45	5.36	5.31	55.77	54.85	53.74	54.60	51.92	49.03
20.000	50.00	5.47	5.40	5.33	49.45	48.89	47.90	48.40	47.33	45.75
41.419	71.42	5.44	5.37	5.34	41.90	41.07	40.20	41.58	40.89	39.80
50.000	80.00	5.42	5.37	5.32	40.52	39.79	38.86	40.62	39.78	38.31
68.998	99.00	5.41	5.34	5.35	38.92	39.34	39.48	39.24	38.19	35.81
89.682	59.68	5.34	5.33	5.35	37.88	38.45	37.92	37.20	35.45	32.36
103.470	73.47	5.36	5.34	5.31	36.43	36.25	35.85	36.57	36.39	35.76
110.370	80.37	5.43	5.37	5.35	36.01	35.73	35.39	36.26	35.84	35.00
117.260	87.26	5.44	5.38	5.38	35.44	35.17	34.90	36.13	35.59	34.54
131.050	101.05	5.47	5.40	5.42	34.56	34.48	34.34	35.04	35.04	34.25
137.950	107.95	5.48	5.42	5.44	33.93	33.95	33.85	34.02	34.10	33.54
151.740	121.74	5.59	5.50	5.46	32.76	32.91	32.94	32.01	31.97	31.41
165.530	135.53	5.76	5.66	5.59	31.48	31.97	32.47	30.24	30.09	29.81
179.310	149.31	5.87	5.76	5.71	30.68	31.41	31.64	29.03	28.67	28.08
193.100	163.10	5.84	5.77	5.71	31.03	31.62	31.68	29.24	28.17	27.46
200.000	170.00	5.84	5.75	5.75	31.73	32.02	31.51	30.13	28.21	26.97

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.32	1.22	1.15	1.61	2.35	3.15	1.63	1.53	1.40
10.000	1.33	1.23	1.15	1.57	2.27	3.04	1.64	1.54	1.41
20.000	1.32	1.22	1.15	1.54	2.14	2.85	1.64	1.53	1.41
27.286	1.31	1.21	1.14	1.56	2.17	2.81	1.63	1.53	1.41
38.429	1.30	1.20	1.13	1.62	2.19	2.83	1.65	1.55	1.43
44.000	1.29	1.20	1.13	1.61	2.19	2.85	1.66	1.56	1.44
50.000	1.29	1.19	1.12	1.61	2.18	2.87	1.70	1.60	1.47
66.286	1.28	1.18	1.11	1.62	2.27	2.99	1.76	1.66	1.53
77.429	1.24	1.15	1.09	1.61	2.20	2.97	1.76	1.66	1.55
83.000	1.24	1.15	1.09	1.60	2.21	2.92	1.79	1.71	1.58
94.143	1.22	1.13	1.08	1.58	2.14	2.77	1.83	1.73	1.61
100.000	1.21	1.13	1.08	1.57	2.07	2.69	1.87	1.77	1.65
110.860	1.20	1.11	1.08	1.59	2.12	2.71	1.90	1.79	1.66
127.570	1.17	1.10	1.08	1.62	2.15	2.76	2.02	1.91	1.77
138.710	1.16	1.10	1.09	1.65	2.24	2.88	2.06	1.94	1.82
149.860	1.16	1.11	1.11	1.68	2.21	2.88	2.15	2.03	1.90
166.570	1.16	1.12	1.14	1.64	2.17	2.74	2.32	2.18	2.02
177.710	1.17	1.14	1.16	1.66	2.13	2.67	2.43	2.30	2.12
188.860	1.19	1.17	1.19	1.68	2.20	2.72	2.56	2.40	2.22
200.000	1.20	1.19	1.22	1.74	2.23	2.77	2.59	2.43	2.26

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.050	−715.82	−.19
.200	−730.20	−.31
1.000	−777.50	−.37
5.000	−776.90	−.34
10.000	−780.10	−.35
20.000	−779.70	−.37
27.629	−781.70	−.40
34.524	−777.00	−.41
50.000	−773.40	−.53
68.998	−778.30	−.62
82.788	−781.90	−1.02
100.000	−785.10	−1.24
110.370	−754.50	−1.37
124.160	−746.40	−1.54
137.950	−741.40	−1.89
151.740	−751.90	−2.28
165.530	−768.40	−3.12
179.310	−750.20	−2.75
186.210	−739.60	−3.02
200.000	−715.40	−4.31

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	15	29	26	38	28	61	45	57	48	65
1	–	18	–	29	12	36	25	43	46	47	45	50
2	75	60	47	52	44	59	45	56	51	59	50	>71
3	>87	48	42	55	40	60	42	70	45	53	69	54
4	>86	73	61	66	58	72	56	76	56	64	64	78
5	>85	>84	61	66	64	59	61	56	59	58	57	69
6	>86	>84	>85	>86	>84	80	78	>80	77	78	>84	71
7	>87	75	70	>85	73	>84	71	78	72	71	68	68
8	>85	>84	>81	>84	>85	>85	>83	>80	78	>79	75	78
9	>86	>84	>84	>84	>85	>85	>85	>86	>85	>84	>83	79
10	>85	>83	>85	>85	>85	>84	>86	>85	>84	>85	>84	78

Harmonic LO Order

test conditions: RF. = IN: FREQ.185.1 MHZ DRIVE 4.92 DBM
LO. = IN: FREQ.155.01 MHZ DRIVE 17.05 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. –.81 DBM

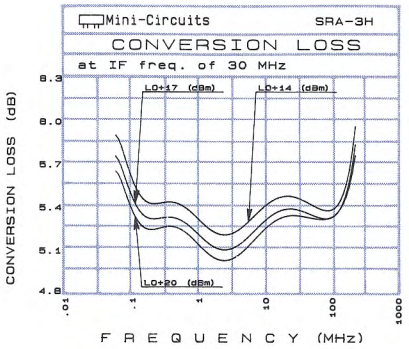
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	6	18	14	28	17	53	32	41	38	47
1	–	17	–	31	11	36	24	38	47	39	37	38
2	>85	58	56	60	52	62	51	65	60	68	57	69
3	>87	66	69	65	69	62	>75	65	72	70	69	69
4	>87	>74	77	>75	>75	>76	>76	>76	>74	>76	>74	>75
5	>85	>75	76	>75	>76	>75	>75	>75	>74	>76	>76	>75
6	>85	>76	>74	>75	76	>74	>74	>75	>75	>76	>75	>75
7	>87	>75	>75	>74	>76	>76	>76	>77	>76	>75	>76	>76
8	>86	>76	>75	>74	>75	>75	>75	>75	>74	>75	>74	>75
9	>84	>74	>74	>75	>75	>75	>74	>77	>75	>75	>75	>76
10	>85	>74	>76	>73	75	>74	>75	>75	>77	>75	>74	>75

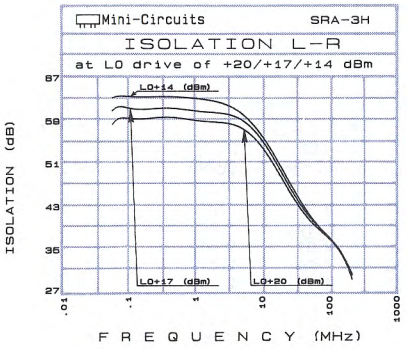
Harmonic LO Order

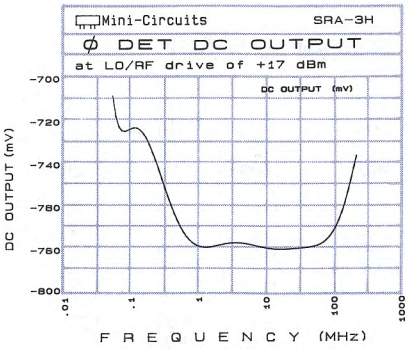
test conditions: RF. = IN: FREQ.185.1 MHZ DRIVE –5.03 DBM
LO. = IN: FREQ.155.01 MHZ DRIVE 17.05 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. –10.64 DBM

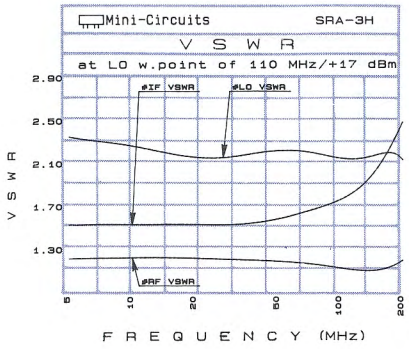
typical performance curves

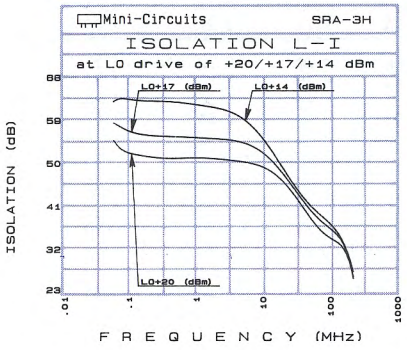
(production unit)

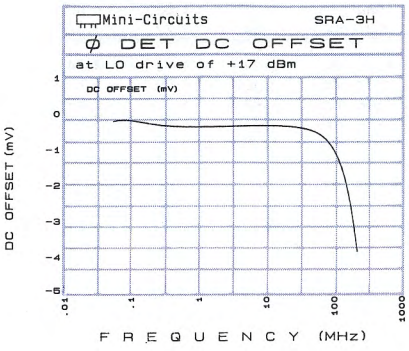












very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models

SRA-11H
ZAD-11H
ZLW-11H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
10.000	40.00	6.65	6.43	6.25	29.46	32.26	35.15	31.29	35.01	38.32
20.000	50.00	6.86	6.58	6.38	30.90	33.52	36.23	32.90	36.85	40.67
103.440	73.44	6.82	6.60	6.56	30.27	32.25	34.14	31.34	33.97	35.97
200.000	170.00	6.97	6.78	6.69	29.63	30.89	31.97	30.19	32.03	32.50
290.310	260.31	6.98	6.75	6.69	29.02	29.76	30.82	29.68	30.61	30.29
500.000	470.00	7.33	6.94	6.74	28.37	28.74	29.10	29.59	29.28	27.72
570.630	540.69	7.10	6.81	6.69	28.55	28.80	28.62	30.12	29.04	26.81
757.500	727.50	7.47	7.00	6.71	28.55	28.06	27.68	30.93	28.08	25.88
944.380	913.91	7.46	7.05	6.78	28.81	28.00	27.12	29.49	26.87	24.90
1037.800	1007.40	7.78	7.37	7.11	29.43	28.67	28.02	28.79	26.49	24.62
1318.100	1288.00	7.07	6.81	6.68	29.84	27.69	25.93	28.34	26.66	24.74
1505.000	1474.90	6.96	6.68	6.61	31.40	27.57	26.66	29.47	27.97	27.14
1598.400	1568.30	6.85	6.65	6.51	31.75	27.30	26.37	29.82	28.78	27.76
1785.300	1755.00	6.96	6.71	6.55	28.51	27.75	27.33	28.81	28.96	28.87
1972.200	1942.10	6.81	6.57	6.40	28.55	29.51	29.42	31.67	31.44	30.97
2065.600	2035.10	7.10	6.76	6.62	28.65	28.94	29.95	33.33	33.79	33.26
2252.500	2222.10	6.97	6.61	6.61	29.37	30.22	32.20	36.04	36.80	35.41
2439.400	2408.60	6.83	6.63	6.65	29.97	31.19	32.76	42.63	37.00	33.69
2626.300	2596.00	7.07	6.95	6.93	29.64	30.21	31.34	34.17	30.13	28.25
3000.000	2969.30	8.76	8.58	8.44	33.36	32.46	36.85	31.03	26.88	26.71

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
10.000	1.18	1.13	1.09	1.40	2.07	3.20	1.24	1.13	1.07
50.000	1.13	1.07	1.02	1.46	2.19	3.04	1.20	1.08	1.02
100.000	1.14	1.08	1.04	1.36	2.01	2.84	1.20	1.09	1.03
196.880	1.18	1.13	1.08	1.35	1.96	2.69	1.24	1.13	1.06
290.310	1.24	1.18	1.12	1.32	1.91	2.76	1.30	1.19	1.11
477.190	1.36	1.29	1.20	1.33	1.83	2.54	1.37	1.28	1.19
570.630	1.42	1.34	1.24	1.33	1.81	2.40	1.38	1.29	1.20
757.500	1.57	1.48	1.36	1.36	1.81	2.35	1.36	1.27	1.17
944.380	1.78	1.66	1.50	1.30	1.80	2.24	1.36	1.27	1.18
1037.800	1.84	1.72	1.57	1.30	1.74	2.21	1.37	1.32	1.26
1224.700	2.04	1.92	1.74	1.38	1.69	2.20	1.53	1.55	1.58
1411.600	2.19	1.99	1.87	1.43	1.65	2.37	1.84	1.97	1.76
1598.400	1.94	1.75	1.89	1.50	1.91	3.60	1.96	2.35	2.14
1785.300	1.71	1.89	1.81	1.51	1.91	4.51	1.87	2.73	2.49
1972.200	1.79	1.76	1.66	1.50	1.75	2.40	2.74	3.31	2.87
2065.600	1.82	1.68	1.70	1.51	1.66	2.11	3.26	3.87	3.37
2252.500	1.80	1.68	1.64	1.46	1.49	1.72	5.79	7.31	4.88
2439.400	1.79	1.69	1.62	1.35	1.14	1.39	9.33	11.77	7.70
2626.300	1.63	1.49	1.42	1.31	1.26	1.49	14.50	16.72	10.50
3000.000	1.70	1.90	1.86	2.15	2.47	3.16	9.28	14.03	6.78

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+ 1	23	20	49	17	32	40	29	28	49
1	-	21	-	75	24	78	30	38	72	52	33	55
2	95	57	55	56	49	67	59	58	53	58	50	61
3	>95	74	57	69	54	73	61	81	70	74	59	75
4	>96	>83	>83	>84	78	>85	77	>83	>83	>84	>83	>84
5	>95	>85	>83	>85	>83	>85	>86	>85	>83	>83	>84	>84
6	>89	>78	>85	>84	>83	>82	>84	>84	>84	>83	>83	>84
7	>89	>77	>77	>86	>84	>83	>83	>83	>83	>83	>83	>83
8	>91	>78	>79	>77	>84	>84	>84	>83	>84	>85	>83	>84
9	>90	>78	>79	>77	78	>84	>85	>84	>83	>83	>85	>85
10	>91	>78	>78	>78	>80	>77	>84	>84	>84	>83	>82	>85

Harmonic LO Order

test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE -4.02 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 17 DBM
IF = MEASURED: FREQ.30.095 MHZ AMP. -11.73 DBM

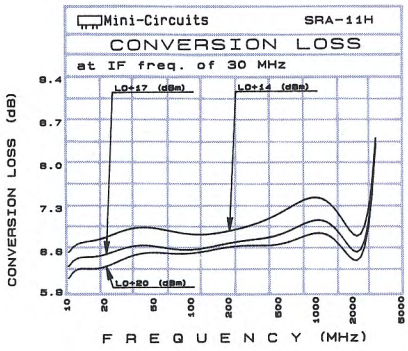
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	7	25	26	46	28	41	45	40	36	60
1	-	22	-	34	16	77	28	39	31	55	39	55
2	81	48	45	50	43	60	50	>85	44	>86	49	56
3	>95	62	45	>87	41	>89	43	65	86	64	48	67
4	>95	80	70	83	86	84	58	74	65	79	68	77
5	>96	72	>90	80	69	83	64	78	70	77	82	73
6	>89	72	77	>84	77	>82	72	>85	75	>82	>86	>92
7	>88	>85	72	80	>90	>93	>87	>91	>83	>88	>80	>83
8	>90	>85	>86	75	>82	>92	>92	>90	>91	>93	>84	>92
9	>90	>87	>86	>87	82	>89	>92	>91	>92	>90	>91	>92
10	>89	>85	>85	>85	>85	>85	>92	>90	>91	>90	>90	>93

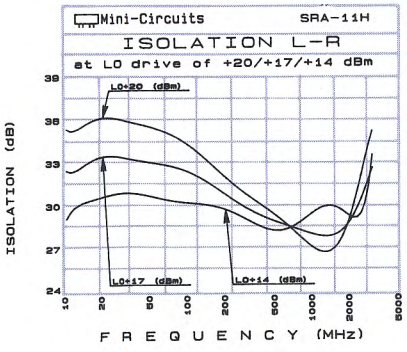
Harmonic LO Order

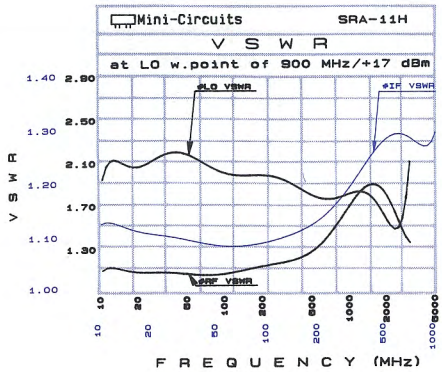
test conditions: RF. = IN: FREQ.999.1 MHZ DRIVE 4 DBM
LO. = IN: FREQ.969.01 MHZ DRIVE 16.92 DBM
IF = MEASURED: FREQ.30.094 MHZ AMP. -4.03 DBM

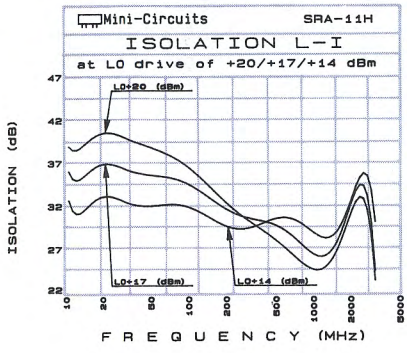
typical performance curves

(production unit)









very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Models
SRA-173H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
5.000	35.00	5.61	5.36	5.21	38.90	40.90	43.43	37.50	39.89	41.78
10.000	40.00	5.47	5.22	5.15	39.23	41.90	44.17	40.65	43.43	45.51
20.000	50.00	5.63	5.36	5.25	40.04	42.71	45.06	41.68	44.48	46.35
50.000	80.00	5.57	5.33	5.26	39.43	41.81	43.72	40.61	42.82	43.93
100.000	70.00	5.55	5.34	5.26	38.64	40.38	41.69	39.38	40.38	40.76
128.620	98.62	5.59	5.36	5.33	38.20	39.66	40.47	38.61	39.17	39.09
200.000	170.00	5.70	5.47	5.38	37.19	38.20	38.80	36.75	36.56	36.05
252.240	222.24	5.83	5.54	5.42	36.66	37.74	37.96	35.55	35.15	34.45
334.660	304.66	5.69	5.46	5.40	36.35	37.00	36.84	33.82	33.06	32.19
417.070	387.07	5.75	5.47	5.39	35.71	36.23	36.50	32.59	31.39	30.37
500.000	470.00	5.95	5.65	5.57	36.91	37.19	36.50	32.04	30.16	28.71
581.900	551.90	5.78	5.49	5.40	37.93	37.86	37.28	32.32	29.87	28.35
623.110	593.11	5.97	5.61	5.52	34.30	34.99	35.07	32.27	29.66	27.90
705.520	675.52	6.10	5.76	5.59	35.89	35.63	34.99	32.51	29.66	27.57
800.000	770.00	6.75	6.43	6.38	37.22	36.96	36.12	32.61	29.67	27.61
911.550	881.55	7.21	6.71	6.39	35.14	35.83	35.11	32.87	30.27	28.30
1000.000	970.00	7.15	6.65	6.34	35.08	33.44	31.61	33.03	32.10	30.71
1076.400	1046.40	7.01	6.45	6.20	36.33	35.45	33.54	30.48	31.19	31.23
1158.800	1128.80	7.04	6.29	6.04	34.81	35.75	35.82	33.57	36.16	37.63
1200.000	1170.00	6.80	6.08	6.01	34.39	34.68	34.53	34.21	37.45	39.04

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.25	1.18	1.09	1.68	2.53	3.86	1.10	1.06	1.12
10.000	1.24	1.18	1.08	1.69	2.52	3.46	1.09	1.03	1.10
20.000	1.25	1.18	1.07	1.70	2.54	3.85	1.08	1.00	1.10
50.000	1.24	1.17	1.06	1.62	2.44	3.65	1.08	1.01	1.11
100.000	1.26	1.18	1.08	1.65	2.36	3.41	1.09	1.01	1.10
124.500	1.27	1.20	1.09	1.69	2.40	3.40	1.10	1.02	1.10
200.000	1.34	1.26	1.14	1.57	2.16	2.92	1.14	1.05	1.07
283.830	1.42	1.34	1.21	1.48	1.99	2.77	1.20	1.10	1.04
363.500	1.52	1.44	1.29	1.43	1.93	2.59	1.25	1.14	1.03
443.160	1.67	1.56	1.40	1.32	1.75	2.37	1.31	1.20	1.06
500.000	1.76	1.66	1.47	1.28	1.67	2.21	1.36	1.25	1.10
602.500	1.95	1.85	1.61	1.26	1.55	2.01	1.42	1.32	1.18
682.160	2.12	2.01	1.76	1.24	1.40	1.87	1.46	1.38	1.27
761.830	2.37	2.24	1.98	1.20	1.29	1.70	1.55	1.48	1.39
841.490	2.59	2.43	2.15	1.23	1.21	1.60	1.64	1.59	1.52
921.160	2.82	2.66	2.31	1.20	1.17	1.52	1.74	1.71	1.66
1000.000	2.92	2.61	2.37	1.24	1.20	1.52	1.81	1.79	1.75
1080.500	2.99	2.78	2.46	1.31	1.32	1.54	1.91	1.88	1.83
1160.200	2.78	2.59	2.33	1.39	1.48	1.64	1.85	1.83	1.78
1200.000	2.68	2.53	2.26	1.49	1.59	1.73	1.87	1.84	1.81

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
5.000	+397.20	−1.85
10.000	+397.00	−1.96
20.000	+392.50	−2.11
50.000	+385.40	−2.50
100.000	+390.90	−2.89
200.000	+397.50	−1.99
289.000	+407.20	−1.11
360.000	+387.50	+0.00
431.000	+334.40	−.48
537.500	+352.60	−1.94
608.500	+357.50	−4.39
679.500	+311.20	−3.23
750.500	+293.80	−2.37
800.000	+297.03	−1.95
857.000	+309.00	−1.18
928.000	+319.80	−.76
1000.000	+346.00	−.84
1100.000	+353.40	−.53
1150.000	+361.10	−.93
1200.000	+351.60	−1.13

Measurements at RF & LO Power +17 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS
5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	29	36	38	29	28	47	42	40	61
1	–	23	–	34	18	44	30	50	35	57	54	43
2	77	49	42	43	53	48	68	59	53	48	53	54
3	>94	69	45	62	41	60	48	62	57	58	61	63
4	>96	71	76	68	66	64	68	65	71	81	75	67
5	>96	82	76	81	70	78	64	75	67	77	84	74
6	>90	79	>93	>86	>89	79	81	77	>84	78	>86	>87
7	>88	>86	>85	>93	>94	>93	>90	>93	>86	>83	>89	>88
8	>89	>87	>87	>87	>93	>92	>92	>90	>94	>86	>93	>89
9	>90	>87	>89	>88	>88	>92	>92	>93	>93	>92	>93	>92
10	>90	>88	>87	>87	>88	>87	>94	>93	>93	>93	>93	>92

Harmonic LO Order

test conditions: RF. = IN: FREQ 1000.1 MHz DRIVE +5.06 dBM
LO. = IN: FREQ 970.01 MHz DRIVE +16.97 dBM
IF = MEASURED: FREQ 30.09 MHz AMP. −1.85 dBM

RF ORDER HARMONIC

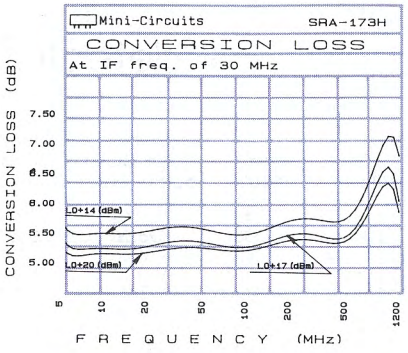
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	4	18	25	27	19	17	32	31	29	48
1	–	23	–	33	18	43	31	47	36	55	43	39
2	>95	56	52	51	60	56	72	70	61	59	61	59
3	>94	>83	64	81	61	74	68	77	74	73	73	75
4	>95	>85	>81	>81	>83	>83	>83	>82	>83	>83	83	>83
5	>95	>86	>83	>83	>83	83	>82	>84	>82	>84	>85	>83
6	>89	>78	>83	>83	>83	>82	>83	>82	>84	>81	>82	>85
7	>89	>76	>77	>82	>83	>83	>82	>84	>83	>84	>82	>82
8	>89	>78	>77	>77	>84	>84	>84	>81	>83	>83	>83	>84
9	>88	>77	>77	>76	>77	>84	>83	>84	>82	>83	>83	>85
10	>89	>76	>77	>78	>78	>76	>84	>83	>83	>82	>83	>83

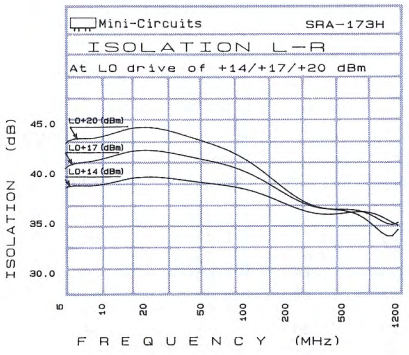
Harmonic LO Order

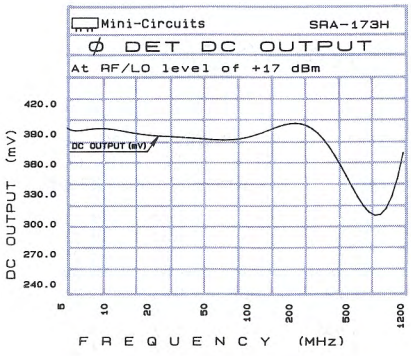
test conditions: RF. = IN: FREQ. 1000.1 MHZ DRIVE −5.06 DBM
LO. = IN: FREQ. 970.01 MHZ DRIVE +16.97 DBM
IF = MEASURED: FREQ. 30.09 AMP. −11.97 DBM

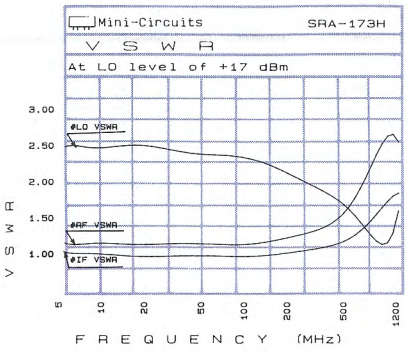
typical performance curves

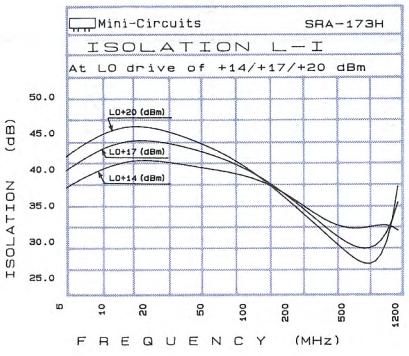
(production unit)

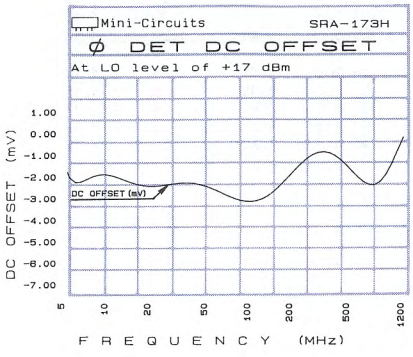












very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Model GRA-6H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
.010	10.01	5.92	5.62	5.42	43.33	46.56	49.30	46.90	51.09	54.83
.050	10.05	5.73	5.43	5.23	42.58	45.58	48.19	46.82	51.49	56.32
1.000	11.00	5.50	5.12	4.91	42.61	45.58	48.08	46.98	51.68	56.53
2.000	12.00	5.61	5.21	5.02	42.60	45.54	48.01	47.06	51.74	56.56
5.181	15.18	5.54	5.17	4.96	42.31	45.34	47.48	46.90	51.91	55.58
8.629	18.63	5.44	5.12	4.94	41.97	44.70	46.04	46.70	50.82	50.82
10.353	20.35	5.33	4.99	4.86	41.97	44.63	45.26	46.84	50.65	47.94
12.077	22.08	5.46	5.14	4.98	41.37	42.99	42.09	46.65	47.65	45.24
15.524	25.52	5.54	5.22	5.04	41.05	43.04	42.82	45.55	47.43	45.02
18.972	28.97	5.56	5.23	5.06	40.67	41.43	40.61	43.85	42.53	41.12
20.696	30.70	5.46	5.15	5.00	40.72	41.90	42.20	43.06	42.00	41.06
24.143	34.14	5.33	5.09	4.98	40.51	40.47	39.70	40.69	39.58	38.89
29.315	19.32	5.42	5.11	4.98	39.39	39.44	38.13	39.85	38.64	37.56
31.038	21.04	5.43	5.15	5.02	37.98	38.02	36.56	38.30	37.39	36.36
34.486	24.49	5.32	5.06	4.95	37.39	38.02	37.21	37.34	37.16	36.94
37.934	27.93	5.31	5.10	5.02	36.58	36.77	36.47	36.10	35.53	36.04
41.381	31.38	5.37	5.14	5.06	35.34	35.53	34.68	35.32	34.73	34.04
44.829	34.83	5.41	5.19	5.11	33.71	34.19	34.01	34.11	33.90	33.73
46.553	36.55	5.45	5.20	5.11	32.44	32.84	32.27	32.99	32.71	32.42
50.000	40.00	5.49	5.28	5.17	32.15	32.37	31.41	32.57	32.14	31.65

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.56	1.34	1.20	1.20	1.49	2.48	1.64	1.45	1.34
7.434	1.56	1.34	1.20	1.23	1.47	2.49	1.64	1.46	1.34
8.650	1.56	1.34	1.21	1.22	1.42	2.46	1.64	1.46	1.35
10.000	1.56	1.34	1.21	1.23	1.46	2.40	1.65	1.46	1.35
12.297	1.55	1.33	1.20	1.23	1.43	2.39	1.66	1.47	1.36
15.946	1.54	1.33	1.20	1.24	1.40	2.30	1.68	1.49	1.38
18.378	1.53	1.32	1.20	1.27	1.39	2.27	1.69	1.50	1.39
20.811	1.52	1.32	1.19	1.25	1.40	2.24	1.71	1.52	1.40
23.243	1.51	1.30	1.18	1.25	1.40	2.22	1.72	1.53	1.43
25.676	1.49	1.29	1.18	1.22	1.43	2.21	1.73	1.55	1.44
28.108	1.48	1.28	1.17	1.20	1.45	2.24	1.75	1.56	1.46
31.757	1.45	1.26	1.15	1.18	1.49	2.26	1.77	1.59	1.49
35.405	1.43	1.25	1.15	1.19	1.52	2.28	1.81	1.63	1.53
37.838	1.41	1.24	1.14	1.19	1.54	2.27	1.84	1.66	1.55
39.054	1.40	1.23	1.14	1.18	1.55	2.30	1.85	1.68	1.57
41.486	1.39	1.23	1.14	1.19	1.55	2.31	1.89	1.70	1.60
45.135	1.36	1.21	1.14	1.21	1.56	2.32	1.95	1.75	1.65
46.351	1.35	1.21	1.15	1.22	1.56	2.32	1.94	1.76	1.67
48.784	1.34	1.21	1.15	1.25	1.57	2.31	1.99	1.81	1.71
50.000	1.34	1.20	1.16	1.26	1.58	2.31	2.02	1.83	1.73

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.010	−951.02	−1.88
.100	−976.20	−3.28
1.000	−978.60	−3.33
3.343	−980.30	−3.40
5.000	−977.30	−3.40
8.342	−972.70	−3.39
10.000	−983.50	−3.50
11.674	−985.10	−3.64
15.007	−1006.10	−3.74
18.339	−1002.70	−3.19
21.672	−1023.00	−3.39
25.005	−1015.60	−3.74
28.337	−1010.00	−4.33
31.670	−1002.70	−4.53
35.002	−1008.70	−5.81
38.335	−1000.30	−6.67
41.668	−1000.50	−7.57
45.000	−993.30	−7.78
48.333	−982.30	−6.82
50.000	−975.30	−6.43

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	29	35	30	34	26	51	43	58	44	66
1	–	17	–	26	12	37	21	33	35	47	38	51
2	80	43	40	61	43	55	40	54	50	60	64	62
3	>86	46	51	52	58	53	61	48	45	57	47	67
4	>85	67	60	67	63	70	60	65	63	67	71	73
5	>86	63	75	62	72	66	62	73	59	66	59	76
6	>85	>84	75	78	75	78	74	>80	73	77	>82	>85
7	>86	80	79	73	>82	73	75	79	71	>83	70	80
8	>86	>86	>85	>83	>83	>80	>81	>78	>81	>81	>83	>83
9	>87	>86	>85	>84	>84	>83	>80	81	>81	>82	81	>83
10	>86	>85	>84	>84	80	>82	76	>81	71	>80	72	>80

Harmonic LO Order

test conditions: RF.=IN: FREQ.30.1 MHZ DRIVE 5.08 DBM
LO. IN: FREQ.40.01 MHZ DRIVE 17.05 DBM
IF MEASURED: FREQ.9.9103 MHZ AMP. .02 DBM

RF ORDER HARMONIC

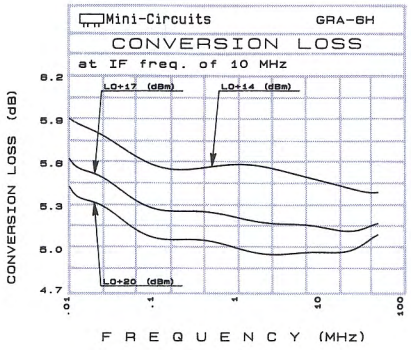
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	21	29	16	24	14	38	32	42	30	46
1	–	16	–	25	12	33	22	31	33	45	34	48
2	>85	55	47	61	48	54	47	59	63	63	59	66
3	>86	60	64	64	66	69	64	61	55	71	58	>76
4	>85	>75	>74	>76	>73	>75	73	76	>76	>74	76	>75
5	>85	>74	>76	>74	>74	>76	>75	>74	>76	>75	>75	>75
6	>86	>75	>74	>76	>75	>75	>76	>76	>74	>75	>75	>76
7	>85	>76	>76	>75	>75	>76	>74	>77	>74	>76	>75	>74
8	>85	>76	>74	>75	>75	>73	>75	>73	>75	>75	>75	>75
9	>86	>77	>76	76	>75	>75	>75	75	>75	75	>75	>74
10	>85	>76	>77	>75	>76	>76	74	>74	71	>75	70	>75

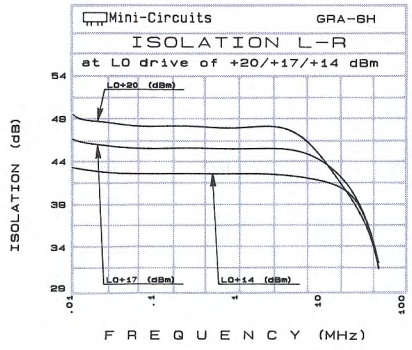
Harmonic LO Order

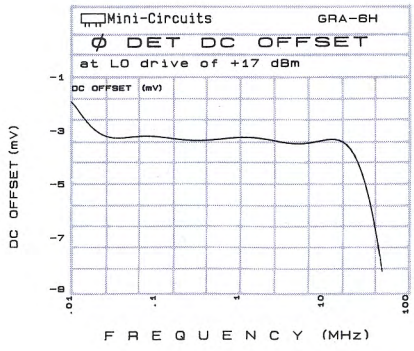
test conditions: RF.=IN: FREQ.30.1 MHZ DRIVE -4.97 DBM
LO. IN: FREQ.40.01 MHZ DRIVE 17.05 DBM
IF MEASURED: FREQ.9.9103 MHZ AMP. -9.96 DBM

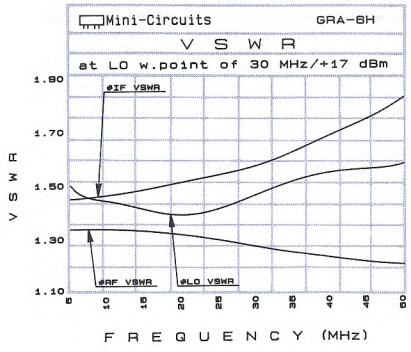
typical performance curves

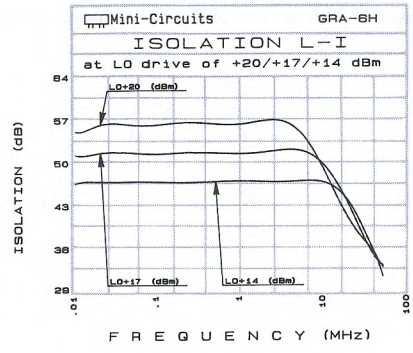
(production unit)

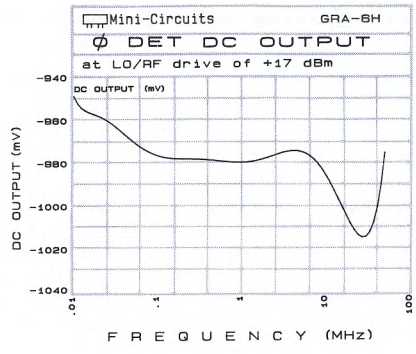












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models

TAK-1H
TFM-1H
TUF-1H
ZAD-1SH
ZFM-1H
ZLW-1SH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-I (dB) LO +14dBm	LO +17dBm	LO +20dBm
2.000	32.00	6.99	6.30	5.96	59.73	62.98	64.42	49.91	52.28	53.48
5.000	35.00	6.55	5.95	5.64	58.95	62.06	63.57	50.65	52.79	53.94
10.000	40.00	6.49	5.92	5.61	58.36	60.47	61.17	50.51	52.35	53.27
20.000	50.00	6.50	5.91	5.56	56.65	57.14	56.42	49.94	51.13	51.39
34.130	64.13	6.36	5.81	5.52	54.15	53.27	52.36	49.01	49.30	48.99
50.000	80.00	6.25	5.72	5.45	51.52	50.24	49.08	47.71	47.27	46.43
66.260	96.26	6.18	5.66	5.41	49.53	48.03	46.97	46.55	45.61	44.80
82.325	52.33	6.26	5.71	5.44	47.86	46.33	45.28	45.48	44.27	43.40
100.000	70.00	6.11	5.63	5.41	46.57	44.99	43.58	44.56	43.26	41.99
130.520	100.52	6.17	5.61	5.39	45.09	43.18	41.88	43.49	41.91	40.57
162.650	132.65	6.18	5.61	5.47	43.61	41.46	40.35	42.55	40.45	39.27
200.000	170.00	5.98	5.60	5.49	42.31	40.12	38.78	41.40	39.22	37.84
259.040	229.04	5.65	5.42	5.35	39.68	38.10	36.88	38.80	37.51	36.43
307.240	277.24	5.78	5.62	5.51	39.02	37.54	36.24	37.22	36.13	34.78
355.430	325.43	6.08	5.86	5.65	38.51	37.41	36.33	37.11	36.94	36.74
387.560	357.56	6.14	5.92	5.76	37.04	36.35	35.45	36.53	35.99	35.89
435.760	405.76	6.05	5.81	5.70	36.29	35.35	33.81	34.02	33.91	32.80
467.890	437.89	6.02	5.90	5.85	36.52	36.34	34.94	33.70	33.81	33.32
483.950	453.95	6.15	6.08	6.03	36.00	36.44	35.92	33.21	33.54	33.58
500.000	470.00	6.33	6.27	6.18	35.43	36.27	36.07	32.39	33.21	33.60

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.002	1.28	1.22	1.25	1.27	1.67	2.71	1.51	1.33	1.25
10.000	1.20	1.10	1.14	1.20	1.60	2.58	1.51	1.34	1.25
20.000	1.16	1.03	1.09	1.07	1.63	2.60	1.51	1.33	1.25
35.938	1.14	1.02	1.10	1.08	1.61	2.56	1.50	1.33	1.25
50.000	1.14	1.04	1.12	1.13	1.58	2.55	1.51	1.34	1.26
82.345	1.14	1.06	1.13	1.12	1.57	2.33	1.52	1.36	1.27
100.000	1.15	1.07	1.14	1.11	1.55	2.46	1.55	1.38	1.29
128.750	1.15	1.08	1.15	1.12	1.54	2.30	1.58	1.41	1.32
175.160	1.18	1.09	1.16	1.10	1.57	2.33	1.68	1.49	1.41
200.000	1.18	1.10	1.16	1.08	1.55	2.24	1.73	1.54	1.45
252.500	1.20	1.10	1.16	1.06	1.55	2.23	1.89	1.70	1.60
298.910	1.21	1.08	1.15	1.08	1.60	2.29	2.12	1.85	1.72
329.850	1.21	1.07	1.14	1.11	1.67	2.37	2.30	1.96	1.83
360.790	1.20	1.06	1.13	1.16	1.70	2.33	2.43	2.10	1.91
391.730	1.19	1.05	1.12	1.20	1.76	2.38	2.63	2.24	2.05
422.660	1.17	1.04	1.12	1.21	1.82	2.41	2.86	2.38	2.19
453.600	1.14	1.05	1.13	1.28	1.84	2.51	3.02	2.52	2.28
469.070	1.12	1.06	1.14	1.31	1.85	2.49	3.14	2.61	2.35
484.540	1.10	1.08	1.16	1.38	1.87	2.48	3.22	2.69	2.43
500.000	1.08	1.09	1.17	1.42	1.90	2.52	3.27	2.73	2.44

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
2.000	−896.40	+.84
5.000	−910.70	+.82
10.000	−925.30	+.82
20.000	−928.20	+.82
50.000	−907.30	+.86
70.688	−918.40	+.93
100.000	−923.40	+.89
122.200	−943.50	+.97
156.550	−957.90	+1.21
173.720	−976.00	+1.21
200.000	−989.10	+1.53
242.410	−1025.60	+1.08
276.750	−1017.80	+1.54
300.000	−987.00	+1.77
328.270	−939.20	+2.14
362.610	−883.40	+1.02
400.000	−847.50	+.71
431.300	−861.90	+1.38
465.640	−903.30	+1.34
500.000	−877.00	+1.67

Measurements at RF & LO Power +17 dBm

Mini-Circuits™
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL		0		1		2		3		4		5		6		7		8		9		10	
0	–	–	29		52		28		50		35		50		44		54		49		66			
1	–	–	25		38		14		45		34		38		33		43		32		47			
2	64	>65	56	>72			54	>73			52	>72			55	>78			57	>65				
3	68	60	55	>64			62	>67			51	>73			45	60			43	58				
4	>95	>89	77		84		71		81		73		81	>95			79		72		83			
5	>95	82	67		73		65		74		56		73		55		75		55		84			
6	>96	86	78	>91			77		89		76		86		78		86		84	>91				
7	>95	86	76	>94			81		85		71		82		66		82		65		84			
8	>94	>94	82	>91			85	>94			84	>92			86	>95		>90		>95				
9	94	>94	>94	>95			83	>90			82	>90			80	>94			77	>94				
10	>95	>93	>94		>94		>91	>95			>93	>95			>92	>95			>94	>94				

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE +4.97 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE +16.91 DBM
IF=MEASURED: FREQ.30.09 AMP.=–.93 DBM

RF ORDER HARMONIC

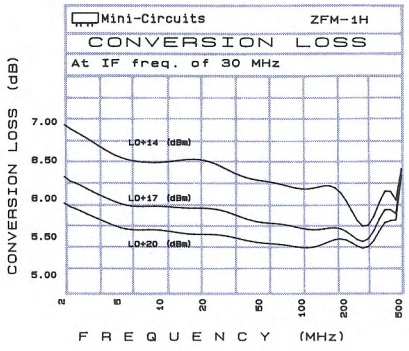
	RF CAL		0		1		2		3		4		5		6		7		8		9		10	
0	–	–	20		42		17		41		23		39		32		39		32		50			
1	–	25	–		39		15		44		54		35		29		38		24		41			
2	83	>77	58		71		58		69		60		69		64	>77			65	>82				
3	95	71	62		74		59		72		54		78		53		74		54		72			
4	>95	>85	80	>86			79	>84			83	>84		>84	>86		82	>86						
5	>96	>85	>85	>85			84	>84			80		85		79		86		82	>86				
6	>94	>84	>84	>85			>84	>84			84		87	>85		>85			85	>84				
7	>94	>85	>85	>84			>83	>85			>84	>85		>84	>84	>85			>83					
8	>95	>84	84	>84			>85	>85			>85	>84		>85	>84	>85			>84					
9	>95	>84	>84		85	>85			>84	>85		>85		85	>84		>84							
10	>94	>84	>84		>83	>84			>84	>83		>84		>85	>84		>85		>84					

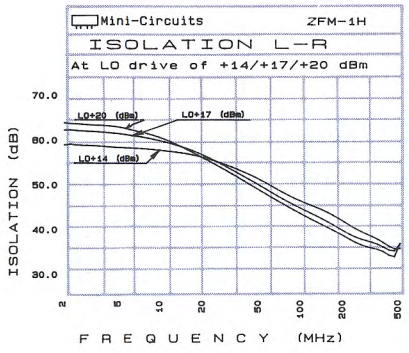
Harmonic LO Order

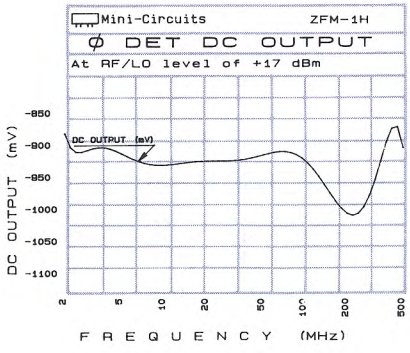
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE –4.95 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE +16.91 DBM
IF=MEASURED: FREQ.30.09 AMP. –10.85 DBM

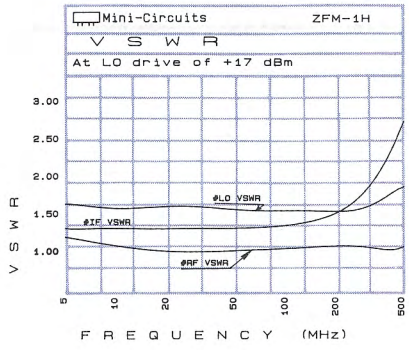
typical performance curves

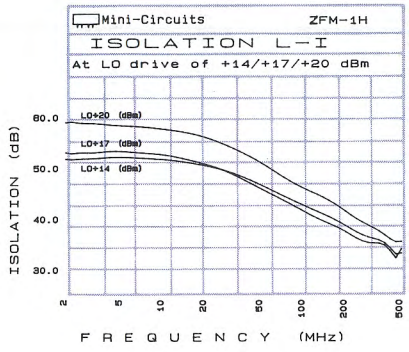
(production unit)

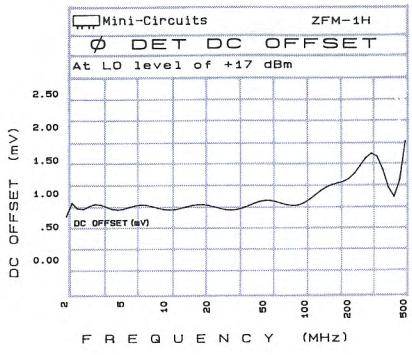












very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models

TFM-2H
TUF-2H
ZFM-2H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-I (dB) LO +14dBm	LO +17dBm	LO +20dBm
5.000	35.00	6.20	5.75	5.56	>74.00	73.03	70.67	67.29	64.57	63.07
35.152	65.15	6.28	5.75	5.54	54.22	53.95	53.39	51.18	50.91	50.42
65.304	95.30	6.51	5.78	5.55	48.20	47.75	46.75	45.62	44.94	44.11
125.610	95.61	6.40	5.83	5.54	46.20	45.94	44.83	43.25	42.85	42.09
185.910	155.91	6.56	5.88	5.63	43.09	41.73	40.19	39.67	38.74	37.98
216.060	186.06	6.55	5.87	5.68	41.78	40.07	38.85	38.01	37.26	36.64
276.370	246.37	6.22	5.70	5.55	38.57	37.49	36.91	35.45	34.59	34.48
336.670	306.67	5.97	5.62	5.52	35.95	35.70	36.13	33.67	32.97	33.08
396.980	366.98	6.09	5.78	5.59	35.04	35.50	35.59	32.50	32.29	32.34
457.280	427.28	6.48	6.15	5.93	33.88	33.92	33.86	30.42	30.55	30.59
517.580	487.58	6.37	5.88	5.61	33.96	34.70	34.90	29.63	29.07	29.34
547.740	517.74	6.24	5.91	5.66	33.82	35.38	35.32	29.51	29.45	29.80
608.040	578.04	6.57	6.36	6.18	32.52	34.75	34.17	28.25	28.29	28.63
668.340	638.34	6.78	6.50	6.10	32.38	34.53	32.34	27.59	27.06	26.63
728.650	698.65	7.19	6.30	5.86	32.32	33.69	32.40	26.83	25.41	24.95
788.950	758.95	8.18	6.43	5.84	32.44	32.39	31.62	26.20	25.21	23.50
849.260	819.26	9.23	7.56	6.21	32.91	32.23	31.42	25.91	24.28	23.11
909.560	879.56	9.88	8.59	7.12	33.24	32.46	31.95	25.89	23.91	22.92
969.860	939.86	9.62	8.55	7.56	32.85	32.66	32.72	25.75	24.30	23.22
1000.000	970.00	9.60	8.57	7.71	32.43	32.20	32.53	25.10	24.05	22.04

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.000	1.37	1.24	1.21	1.27	1.51	2.45	2.28	2.05	1.80
35.121	1.24	1.10	1.03	1.11	1.53	2.39	2.22	2.01	1.77
65.242	1.24	1.10	1.03	1.13	1.52	2.48	2.27	2.04	1.80
95.364	1.23	1.09	1.03	1.16	1.44	2.26	2.28	2.06	1.80
155.610	1.23	1.09	1.04	1.17	1.43	2.30	2.33	2.10	1.83
185.730	1.23	1.10	1.04	1.16	1.39	2.08	2.34	2.10	1.82
245.970	1.24	1.11	1.05	1.21	1.38	2.10	2.47	2.20	1.90
306.210	1.25	1.11	1.06	1.23	1.40	2.16	2.61	2.28	1.95
366.450	1.26	1.12	1.07	1.21	1.37	2.14	2.64	2.30	1.97
426.700	1.27	1.13	1.08	1.21	1.36	2.04	2.68	2.34	2.00
486.940	1.29	1.15	1.09	1.18	1.37	2.00	2.84	2.44	2.07
517.060	1.29	1.15	1.08	1.16	1.39	2.03	2.94	2.51	2.09
577.300	1.30	1.16	1.08	1.17	1.38	2.00	2.93	2.52	2.11
637.550	1.33	1.17	1.10	1.17	1.38	1.93	2.91	2.50	2.13
697.790	1.36	1.20	1.12	1.20	1.36	1.93	2.89	2.48	2.14
758.030	1.38	1.22	1.15	1.13	1.45	1.94	2.69	2.35	2.06
818.270	1.42	1.26	1.20	1.06	1.49	2.01	2.60	2.25	1.99
878.520	1.51	1.34	1.29	1.03	1.52	2.05	2.62	2.25	1.97
938.760	1.64	1.46	1.41	1.06	1.54	2.03	2.69	2.26	1.96
1000.000	1.80	1.62	1.55	1.09	1.53	1.99	2.63	2.22	1.92

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
5.000	-946.00	-.04
35.152	-938.10	-.02
65.304	-949.90	+0.00
95.456	-985.50	+.09
155.760	-936.30	-.06
185.910	-950.60	+.23
246.220	-990.70	+.93
306.520	-1007.30	+.88
366.820	-905.20	+1.17
427.130	-847.70	+2.27
487.430	-867.60	+2.06
517.580	-892.00	+1.26
577.890	-927.80	+1.97
638.190	-867.70	+4.69
698.500	-753.40	+4.48
758.800	-693.90	+5.71
819.100	-667.60	+4.22
879.410	-684.00	+5.20
939.710	-675.30	+6.68
1000.000	-664.10	+7.63

Measurements at RF & LO Power +17 dBm

Mini-Circuits™
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	21	41	17	41	21	48	35	44	50	60
1	-	18	-	35	15	33	36	40	32	37	44	43
2	63	50	45	51	45	51	42	54	>83	>63	55	>64
3	73	49	42	52	41	50	38	>86	43	64	48	66
4	>94	73	67	83	69	74	69	69	63	72	71	78
5	>96	81	82	71	69	69	61	66	58	>91	61	79
6	>94	88	83	>94	82	79	>89	78	80	78	72	77
7	>96	>93	83	>93	>92	>90	78	84	79	78	77	74
8	>96	>94	>94	>94	>94	>93	>95	>90	>91	88	>89	87
9	>95	>94	>94	>95	>93	>93	>94	>93	87	>89	86	87
10	>95	>94	>94	>94	>93	>93	>94	>93	>94	>93	>94	>93

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 5.02 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 16.96 DBM
IF = MEASURED: FREQ.30.092 MHZ AMP. -1.67 DBM

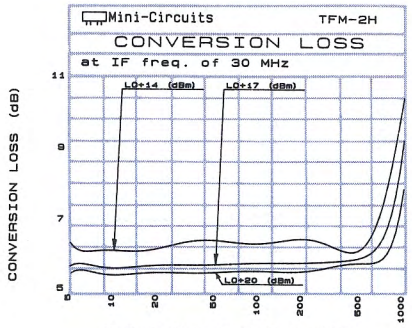
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	12	34	6	29	9	43	24	37	40	55
1	-	17	-	41	16	33	44	37	29	36	40	40
2	82	61	53	61	54	61	53	67	54	>83	60	72
3	>95	69	64	71	60	71	55	67	61	77	67	79
4	>94	>82	84	>85	>83	>83	>84	>83	>84	>83	>83	83
5	>95	>85	>84	>85	>84	>85	>84	>83	>85	>84	>83	>82
6	>96	>83	85	>83	>83	>83	>83	>84	>84	>84	>83	85
7	>95	>85	>84	>84	>83	>83	>84	>83	>83	>84	>85	>83
8	>95	>85	>85	>84	>84	>83	>83	>84	>84	>85	>85	>83
8	>94	>84	>84	>84	>85	>83	>83	>84	>83	>83	>83	>84
10	98	>84	>83	>84	>84	>84	>84	>82	>84	>84	>84	>84

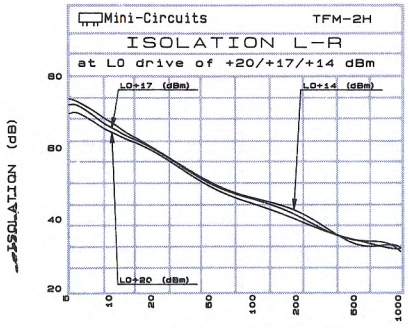
Harmonic LO Order

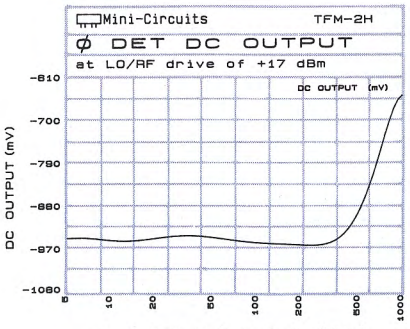
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE -4.99 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 16.99 DBM
IF = MEASURED: FREQ.30.092 MHZ AMP. -11.7 DBM

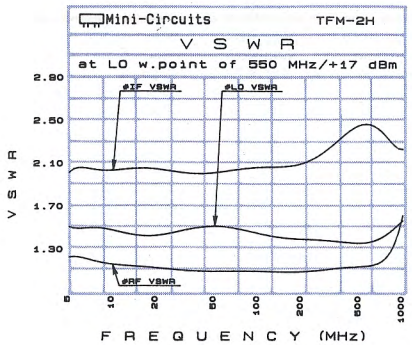
typical performance curves

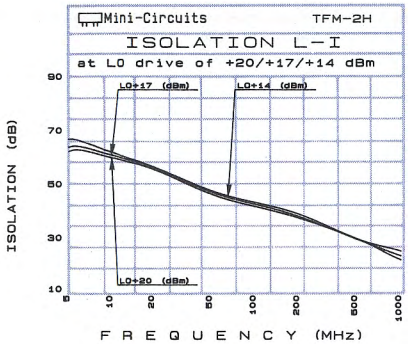
(production unit)

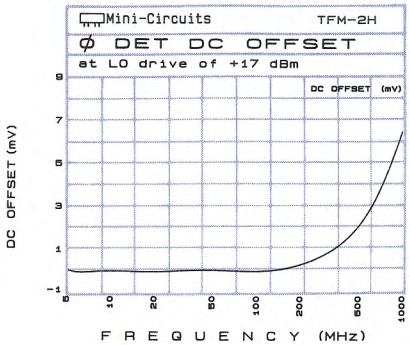












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models

TAK-1WH
ZAD-1WSH
ZLW-1WSH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
5.000	35.00	6.44	5.75	5.40	63.21	63.53	63.16	62.44	62.84	61.66
10.000	40.00	6.71	5.93	5.59	60.61	59.56	58.73	58.61	57.61	56.43
20.000	50.00	6.82	5.97	5.63	53.05	51.08	49.78	50.79	48.85	47.53
50.000	80.00	6.65	5.91	5.58	48.56	46.53	45.24	46.69	44.54	43.10
100.000	70.00	6.42	5.77	5.50	44.90	42.94	41.66	43.39	41.21	39.71
125.840	95.84	6.37	5.75	5.50	42.70	40.60	39.29	41.34	39.07	37.47
175.770	145.77	6.52	5.75	5.62	39.41	37.40	36.36	38.36	36.16	34.68
225.700	195.70	6.23	5.81	5.70	37.49	35.63	34.38	36.43	34.27	32.56
250.670	220.67	6.05	5.69	5.57	36.98	35.33	34.09	35.78	33.54	31.82
300.600	270.60	5.90	5.68	5.62	35.68	34.13	32.77	33.89	32.33	30.98
350.540	320.54	6.35	6.07	5.86	35.68	33.75	32.20	32.12	30.78	28.82
400.470	370.47	6.52	6.22	6.09	36.84	33.94	31.64	30.75	29.35	29.06
450.410	420.41	6.67	6.24	6.03	37.12	33.76	30.28	30.47	28.19	27.53
500.000	470.00	6.57	6.26	6.13	38.12	35.44	30.87	29.58	29.36	28.25
525.310	495.31	6.76	6.57	6.49	34.09	33.37	31.19	27.93	28.37	27.67
550.270	520.27	7.00	6.80	6.59	32.10	31.48	30.06	25.43	26.00	26.48
600.210	570.21	7.76	6.81	6.15	30.58	29.25	28.48	22.32	22.84	23.46
650.140	620.14	8.29	6.95	6.32	33.79	29.21	28.09	24.38	20.68	21.00
700.080	670.08	9.21	7.41	6.49	34.07	32.78	28.16	25.57	22.79	20.71
750.000	720.00	9.92	7.73	6.59	32.38	31.78	29.59	24.04	24.62	22.77

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.25	1.14	1.17	1.32	1.53	2.59	2.14	1.81	1.60
10.000	1.22	1.06	1.11	1.21	1.52	2.59	2.14	1.81	1.60
27.576	1.19	1.03	1.10	1.21	1.41	2.48	2.14	1.80	1.59
50.000	1.16	1.04	1.12	1.12	1.54	2.54	2.15	1.81	1.60
72.727	1.14	1.05	1.13	1.15	1.48	2.42	2.16	1.82	1.62
100.000	1.13	1.05	1.13	1.17	1.48	2.27	2.20	1.85	1.63
140.450	1.12	1.06	1.15	1.19	1.43	2.41	2.27	1.90	1.69
185.610	1.09	1.08	1.16	1.14	1.45	2.30	2.38	1.97	1.72
230.760	1.07	1.10	1.18	1.20	1.40	2.28	2.48	2.08	1.81
275.910	1.04	1.14	1.23	1.10	1.51	2.37	2.60	2.16	1.89
321.060	1.05	1.19	1.27	1.15	1.44	2.28	2.71	2.26	1.96
366.210	1.09	1.24	1.32	1.08	1.56	2.39	2.84	2.39	2.10
411.360	1.14	1.28	1.39	1.09	1.60	2.38	2.92	2.42	2.16
456.520	1.18	1.32	1.42	1.11	1.59	2.39	2.95	2.45	2.20
500.000	1.23	1.35	1.44	1.17	1.68	2.43	2.95	2.42	2.26
524.240	1.25	1.37	1.46	1.22	1.74	2.44	3.05	2.57	2.23
591.970	1.29	1.39	1.47	1.29	1.68	2.37	2.99	2.48	2.23
637.120	1.31	1.38	1.46	1.37	1.89	2.57	3.03	2.49	2.24
682.270	1.32	1.35	1.42	1.38	1.94	2.67	3.02	2.44	2.16
750.000	1.34	1.29	1.36	1.45	1.96	2.78	3.07	2.42	2.07

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
5.000	−934.50	+.56
10.000	−946.60	+.58
29.032	−949.30	+.56
50.000	−936.20	+.54
77.096	−951.20	+.66
101.130	−960.40	+.65
149.190	−1004.00	+.13
197.260	−1025.80	−.05
221.290	−1036.10	−.27
269.350	−1051.70	+.22
317.420	−977.90	+1.56
365.480	−856.90	+1.94
413.540	−832.00	+4.02
461.610	−832.90	+3.98
500.000	−865.80	+3.28
533.700	−839.60	+3.16
581.770	−732.70	+5.11
629.830	−642.50	+7.28
677.900	−567.50	+6.01
750.000	−626.30	+.68

Measurements at RF & LO Power +17 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers / NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0		1		2		3		4		5		6		7		8		9		10	
0	–	–	17	49	16	43	23	43	33	71	37	59										
1	–	25	–	41	18	44	31	40	26	44	22	52										
2	75	65	54	68	52	62	50	62	52	66	52	65										
3	85	63	52	66	47	67	43	70	44	>89	45	71										
4	97	>89	71	83	70	78	67	77	65	83	65	83										
5	>97	83	75	82	67	82	61	79	62	79	68	80										
6	>95	86	80	>88	79	87	77	86	81	85	80	85										
7	>96	87	76	87	78	89	76	88	73	86	74	86										
8	>96	>89	87	>88	88	>89	>89	>90	90	>89	86	>88										
9	>95	>88	>89	>89	85	>89	88	>90	88	>90	86	>90										
10	>94	>90	>88	>89	>90	>88	>90	>90	>91	>90	>90	>90										
		0		1		2		3		4		5		6		7		8		9		10

Harmonic LO Order

test conditions: RF. IN: FREQ.185.1003 MHZ DRIVE 0 DBM
LO. IN: FREQ.155.0097 MHZ DRIVE 16.98 DBM
IF MEASURED: FREQ.30.0909 MHZ AMP. −6.11 DBM

RF CAL

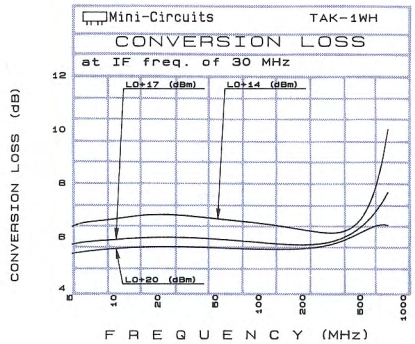
RF ORDER HARMONIC	0		1		2		3		4		5		6		7		8		9		10	
0	–	–	7	36	6	33	13	34	22	48	23	43										
1	–	25	–	41	19	44	28	39	23	42	19	45										
2	93	71	58	69	56	66	57	67	59	69	57	68										
3	>95	78	69	79	61	76	59	79	61	>80	64	79										
4	>97	>80	>79	>81	>81	>80	81	>79	>80	>80	>79	>80										
5	>95	>80	>81	>80	>81	>79	>80	>81	>80	>80	>79	>80										
6	>96	>80	>81	>79	>81	>81	>80	>79	>79	>82	>80	>80										
7	>96	>80	>81	>80	>81	>81	>80	>79	>80	>80	>81	>81										
8	>96	>78	>80	>80	>80	>80	>80	>79	>79	>81	>80	>80										
9	>95	>79	>79	>79	>80	>79	80	>79	>79	>81	81	>80										
10	>97	>78	>78	>80	>80	>79	>80	>80	>79	81	80	>81										
		0		1		2		3		4		5		6		7		8		9		10

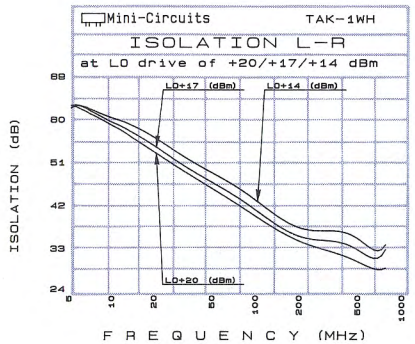
Harmonic LO Order

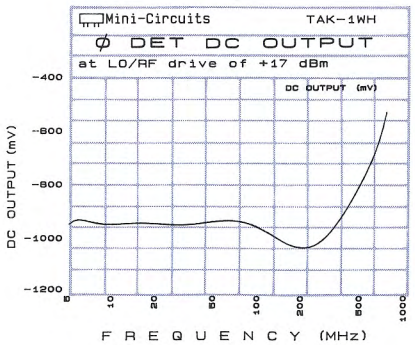
test conditions: RF. IN: FREQ.185.1003 MHZ DRIVE −9.94 DBM
LO. IN: FREQ.155.0097 MHZ DRIVE 16.98 DBM
IF MEASURED: FREQ.30.0908 MHZ AMP. −16.04 DBM

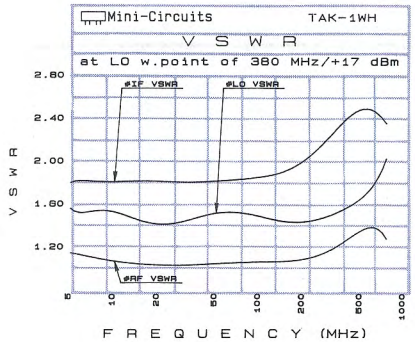
typical performance curves

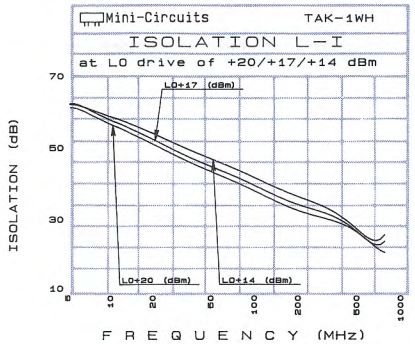
(production unit)

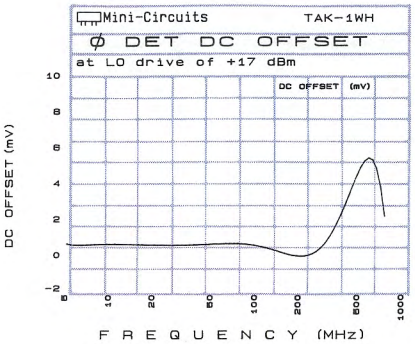












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models
TFM-3H
TUF-3H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L-I (dB) LO +14dBm	LO +17dBm	LO +20dBm
.100	30.10	5.71	5.43	5.26	64.78	66.42	66.35	68.59	66.28	63.03
5.000	35.00	5.24	4.99	4.92	60.18	61.64	63.09	64.99	64.07	62.71
10.000	40.00	5.17	4.91	4.78	59.08	60.33	61.40	61.56	61.62	60.74
20.000	50.00	5.21	4.94	4.81	60.69	61.22	61.67	60.52	60.51	59.92
34.569	64.57	5.16	4.92	4.80	56.53	57.23	57.15	55.92	56.07	55.64
50.000	80.00	5.17	4.92	4.80	53.58	53.98	54.04	52.40	52.73	52.09
60.420	90.42	5.16	4.92	4.80	51.84	52.33	52.03	50.56	50.92	49.90
69.038	99.04	5.11	4.87	4.77	50.53	51.05	50.49	49.22	49.22	48.53
86.272	56.27	5.03	4.80	4.72	48.43	48.52	47.80	46.65	46.16	46.07
100.000	70.00	5.00	4.79	4.68	46.90	46.72	46.00	44.62	44.44	44.60
103.510	73.51	5.18	4.84	4.72	46.59	46.41	45.79	44.11	44.07	44.42
129.360	99.36	5.17	4.89	4.79	43.56	43.29	43.30	40.81	41.27	42.21
146.590	116.59	5.18	4.91	4.82	41.98	41.82	41.73	39.42	40.17	40.89
155.210	125.21	5.13	4.90	4.83	41.30	41.17	41.39	38.71	39.68	40.93
172.440	142.44	5.21	5.00	4.93	40.29	39.95	39.91	37.82	38.86	39.95
189.680	159.68	5.27	5.08	5.03	39.44	39.60	39.03	36.95	38.24	39.21
224.150	194.15	5.40	5.21	5.10	36.93	37.56	37.61	35.74	36.93	38.22
232.760	202.76	5.45	5.26	5.14	36.40	36.71	36.55	35.59	36.82	37.49
241.380	211.38	5.44	5.24	5.13	36.06	35.87	35.81	35.28	36.43	37.36
250.000	220.00	5.45	5.23	5.11	35.77	35.64	35.46	34.98	36.00	37.11

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.66	1.40	1.24	1.32	1.51	2.55	1.78	1.56	1.47
26.618	1.66	1.40	1.25	1.21	1.46	2.33	1.77	1.55	1.46
33.824	1.64	1.38	1.24	1.14	1.52	2.43	1.75	1.55	1.46
41.029	1.64	1.39	1.24	1.12	1.51	2.39	1.75	1.54	1.46
50.000	1.64	1.39	1.24	1.15	1.52	2.41	1.77	1.55	1.46
69.853	1.66	1.39	1.23	1.21	1.48	2.46	1.81	1.59	1.50
77.059	1.65	1.38	1.23	1.24	1.45	2.43	1.82	1.60	1.50
84.265	1.65	1.38	1.22	1.24	1.47	2.38	1.83	1.61	1.51
98.676	1.60	1.35	1.20	1.22	1.43	2.21	1.81	1.60	1.50
100.000	1.60	1.35	1.20	1.23	1.41	2.22	1.82	1.60	1.50
113.090	1.58	1.33	1.19	1.22	1.44	2.24	1.83	1.61	1.51
127.500	1.56	1.31	1.17	1.23	1.45	2.29	1.84	1.63	1.53
149.120	1.56	1.30	1.16	1.23	1.50	2.37	1.93	1.70	1.59
163.530	1.53	1.29	1.15	1.23	1.46	2.27	1.95	1.72	1.62
185.150	1.46	1.24	1.11	1.23	1.46	2.15	1.97	1.74	1.64
199.560	1.44	1.22	1.10	1.25	1.45	2.18	2.01	1.77	1.68
206.760	1.43	1.21	1.09	1.28	1.47	2.24	2.04	1.80	1.69
228.380	1.40	1.18	1.06	1.29	1.52	2.28	2.16	1.91	1.79
242.790	1.37	1.16	1.04	1.28	1.53	2.19	2.22	1.94	1.82
250.000	1.34	1.14	1.03	1.27	1.52	2.22	2.22	1.95	1.83

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.100	-950.35	+.18
25.952	-979.20	+.49
34.569	-971.30	+.48
43.186	-970.40	+.47
51.803	-975.40	+.49
69.038	-988.00	+.42
77.655	-992.80	+.37
86.272	-1001.90	+.26
94.889	-1013.60	+.26
100.000	-1026.60	+.14
112.120	-991.10	+.10
129.360	-996.80	-.04
146.590	-981.40	+.19
163.830	-994.90	+.45
181.060	-993.70	+.36
198.300	-1000.70	+.65
206.910	-1008.60	+.66
224.150	-1013.10	+1.34
241.380	-996.10	+2.09
250.000	-979.20	+2.54

Measurements at RF & LO Power +17 dBm

Mini-Circuits™
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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	40	47	48	63	52	67	64	59	67	65
1	–	37	–	43	13	43	22	42	44	40	32	41
2	75	>81	>69	>90	68	>81	67	>81	>69	>77	>76	>74
3	78	58	68	59	55	62	48	59	44	56	42	55
4	>86	>96	>92	>96	>85	>94	>82	>95	>81	>92	80	>89
5	>85	78	73	79	66	>81	62	77	60	75	59	72
6	>85	>96	>92	>96	>91	>96	>87	>95	>86	>97	>86	>95
7	>85	>94	>86	>93	76	>92	72	>89	71	>91	73	>86
8	>86	>95	>91	>96	>91	>95	>95	>95	>95	>96	>95	>96
9	>85	>96	>85	>95	>80	>95	76	>94	76	>96	77	>95
10	>86	>96	>93	>95	>94	>95	>93	>96	>95	>94	>95	>96

Harmonic LO Order

test conditions: RF. =IN: FREQ.10.1 MHZ DRIVE 5.01 DBM
LO. IN: FREQ.40.01 MHZ DRIVE 17 DBM
IF=MEASURED: FREQ.29.91 MHZ AMP. -.41 DBM

RF ORDER HARMONIC

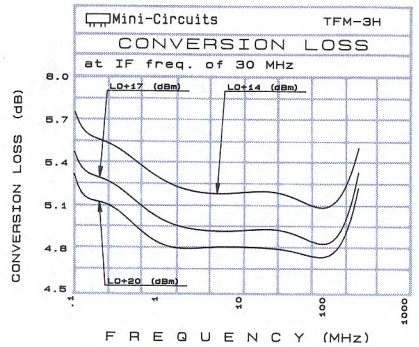
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	30	38	38	52	41	59	50	49	53	52
1	–	36	–	40	13	40	23	39	32	37	26	37
2	86	>86	77	>85	76	>84	76	>86	>83	>86	76	>85
3	88	75	73	75	59	76	55	72	53	70	53	71
4	>96	>86	>85	>86	>86	>86	>85	>86	>85	>85	>85	>86
5	>96	>83	82	>81	77	>85	74	>86	73	>86	74	>86
6	>95	>87	>86	>86	>86	>87	>87	>86	>87	>87	>86	>86
7	>96	>87	>84	>85	>84	>86	>85	>86	>85	>88	>86	>86
8	>94	>86	>85	>85	>86	>86	>86	>87	>87	>85	87	>86
9	>96	>86	>82	>86	>83	>86	>86	>85	>86	>87	>86	>86
10	>96	>88	>87	>86	>87	>86	>86	>85	>87	>86	>86	>85

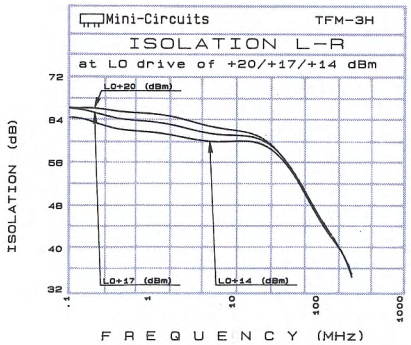
Harmonic LO Order

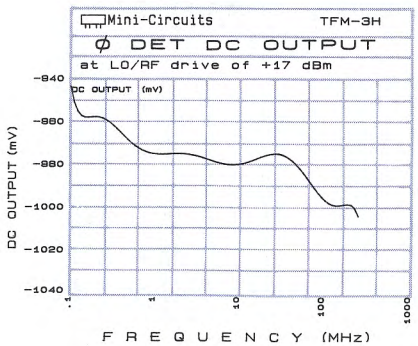
test conditions: RF. =IN: FREQ.10.1 MHZ DRIVE -5.04 DBM
LO. =IN: FREQ.40.01 MHZ DRIVE 17.03 DBM
IF=MEASURED: FREQ.29.91 MHZ AMP. -9.64 DBM

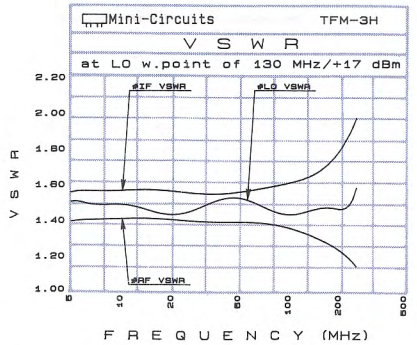
typical performance curves

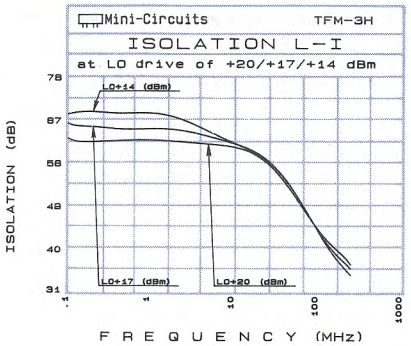
(production unit)

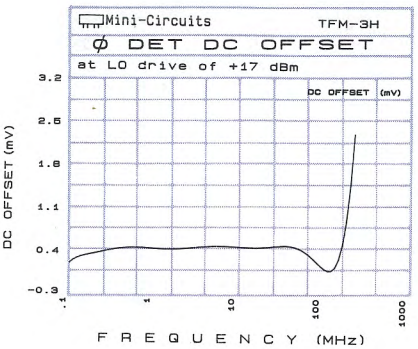












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models

TAK-3H
ZAD-3SH
ZFM-3H
ZLW-3SH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
.050	30.05	6.39	5.81	5.56	63.69	65.01	66.59	58.11	59.81	61.05
1.000	31.00	5.32	4.70	4.51	61.00	61.51	62.33	54.94	56.17	57.68
2.000	32.00	5.23	4.63	4.45	61.43	62.05	62.47	54.78	56.05	57.65
10.000	40.00	5.24	4.79	4.59	63.25	64.41	64.74	54.73	56.12	57.68
20.000	50.00	5.50	5.00	4.75	58.64	57.00	56.32	52.32	52.66	53.50
29.936	59.94	5.19	4.75	4.57	52.39	51.03	48.68	48.80	48.60	48.00
49.226	79.23	5.04	4.69	4.55	50.05	47.42	45.05	47.16	46.33	45.28
68.516	98.52	5.02	4.67	4.52	44.61	42.12	40.93	43.48	42.25	41.79
87.807	57.81	5.03	4.57	4.42	40.31	38.18	37.95	39.98	38.54	38.70
100.000	70.00	4.92	4.50	4.40	38.58	36.56	35.82	39.01	37.81	37.67
136.030	106.03	4.75	4.45	4.42	35.94	35.70	36.46	36.10	36.26	37.11
155.320	125.32	4.90	4.61	4.58	33.80	33.06	33.18	34.36	33.98	34.30
174.610	144.61	5.11	4.84	4.76	32.08	32.15	32.32	32.95	32.92	33.04
193.900	163.90	5.14	4.96	4.89	30.94	31.48	32.05	32.66	32.48	32.87
213.190	183.19	5.17	4.98	4.91	29.34	29.23	29.75	32.48	30.80	30.26
232.480	202.48	5.45	5.17	5.12	28.86	27.78	29.33	32.59	29.94	29.36
242.130	212.13	5.62	5.27	5.15	31.05	28.94	29.46	33.54	32.37	30.09
261.420	231.42	6.11	5.60	5.23	32.89	31.41	29.46	33.17	33.19	32.56
280.710	250.71	6.22	6.03	5.47	36.46	34.81	32.12	33.23	33.60	33.61
300.000	270.00	6.77	6.64	6.40	38.55	36.67	33.19	31.17	31.62	31.71

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.001	1.90	1.63	1.53	1.20	1.53	2.48	1.70	1.54	1.61
10.000	1.91	1.64	1.55	1.15	1.52	2.46	1.72	1.54	1.62
20.000	1.90	1.64	1.55	1.30	1.39	2.33	1.73	1.56	1.64
31.029	1.88	1.61	1.53	1.23	1.53	2.40	1.74	1.57	1.67
48.382	1.87	1.61	1.53	1.22	1.46	2.43	1.79	1.63	1.75
57.059	1.86	1.60	1.52	1.20	1.56	2.57	1.84	1.67	1.80
83.088	1.79	1.56	1.50	1.30	1.51	2.37	1.96	1.78	2.03
100.000	1.75	1.53	1.48	1.37	1.51	2.35	2.12	1.91	2.26
109.120	1.73	1.51	1.46	1.36	1.54	2.33	2.23	1.99	2.40
126.470	1.66	1.46	1.40	1.40	1.59	2.30	2.40	2.16	2.69
143.820	1.59	1.40	1.33	1.46	1.60	2.28	2.55	2.32	3.02
169.850	1.49	1.31	1.23	1.52	1.59	2.35	2.91	2.63	3.73
178.530	1.46	1.28	1.19	1.59	1.59	2.27	3.00	2.73	4.06
195.880	1.39	1.22	1.12	1.70	1.65	2.21	3.17	2.91	4.56
213.240	1.32	1.17	1.07	1.77	1.75	2.27	3.38	3.15	5.17
230.590	1.27	1.11	1.09	1.68	1.87	2.44	3.57	3.29	6.11
256.620	1.19	1.05	1.17	1.56	1.81	2.43	3.60	3.36	6.53
273.970	1.16	1.03	1.20	1.58	1.76	2.39	3.67	3.43	6.66
282.650	1.14	1.02	1.21	1.59	1.78	2.43	3.76	3.50	7.05
300.000	1.13	1.02	1.22	1.61	1.72	2.28	3.71	3.45	7.11

ϕ detection

max. output/DC offset vs. freq. freq. (MHz)	max. DC output mV	DC offset mv
.500	−1124.00	+.27
1.000	−1014.90	+.16
8.868	−986.30	+.19
32.474	−970.10	+.10
48.210	−976.90	+.02
56.079	−983.60	−.06
79.684	−1003.20	−.16
95.421	−997.20	+.55
111.160	−1008.40	−.04
126.890	−1015.40	+.75
142.630	−1016.00	+2.82
166.240	−1011.80	+3.13
181.970	−988.40	+1.39
197.710	−930.00	−.04
213.450	−859.60	−.91
229.180	−809.40	+.53
252.790	−752.40	+1.47
268.530	−740.00	+1.74
284.260	−728.90	+.94
300.000	−716.90	+4.87

Measurements at RF & LO Power +17 dBm

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EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	>86	–	19	24	16	36	17	44	38	48	43	59
1	>86	17	–	32	16	26	29	39	29	51	34	58
2	73	48	48	50	55	49	49	67	45	58	54	62
3	81	53	44	52	64	49	41	49	43	58	49	62
4	>86	>79	>79	72	69	>78	>78	68	73	72	71	78
5	>86	64	61	67	69	62	63	62	55	61	57	69
6	>86	>81	>80	>80	>79	>78	>78	>78	>78	>78	>78	77
7	>86	>82	78	78	79	78	77	73	71	74	70	72
8	>86	>82	>82	>81	>81	>80	>79	>79	>78	>78	>78	>78
9	>86	>81	>81	>82	>81	>81	>80	>79	>79	>78	>78	>78
10	>87	>81	>81	>81	>82	>81	>81	>80	>80	>79	>78	>78

Harmonic LO Order

test conditions: RF = 185.100 MHZ INPUT P. +.05DBM
LO 155.010 MHZ INPUT P. +17.05DBM
IF = 30.090MHZ IF AMPLIT. −5.37

RF CAL

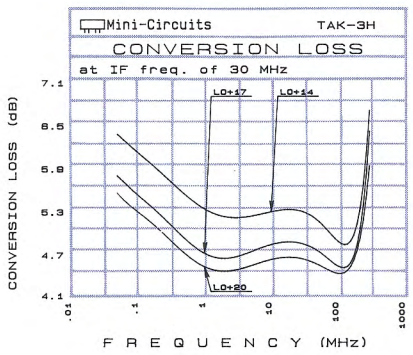
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	>76	–	8	14	6	26	6	33	27	36	30	47
1	>76	16	–	35	18	25	26	35	26	41	31	47
2	>76	62	58	65	>69	58	59	>69	54	66	58	69
3	>76	64	60	63	63	62	54	58	56	68	65	68
4	>76	>69	>69	>70	>70	>69	>69	>69	>70	>70	>69	>69
5	>76	>69	>69	>69	>70	>70	>69	>69	>69	>70	>70	>69
6	>76	>71	>69	>69	>69	>70	>70	>69	>69	>69	>70	>70
7	>76	>72	>71	>69	>69	>69	>69	>70	>69	>69	>69	>70
8	>76	>72	>72	>71	>71	>69	>69	>69	>70	>69	>69	>69
9	>76	>71	>71	>72	>71	>71	>69	>69	>69	>70	>70	>69
10	>76	>70	>71	>71	>72	>71	>71	>69	>69	>69	>70	>70

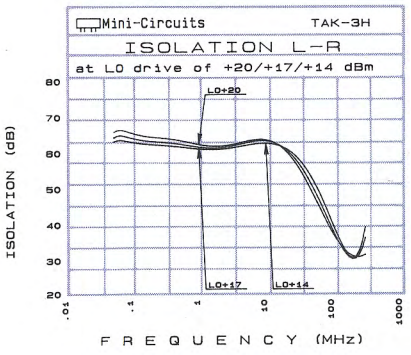
Harmonic LO Order

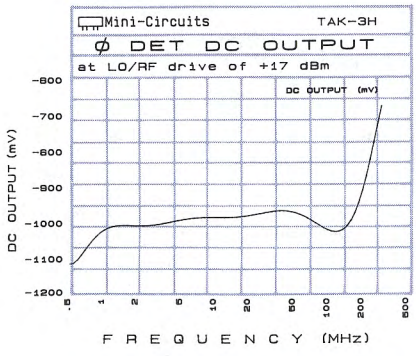
test conditions: RF = 185.100 MHZ INPUT P. −10.02DBM
LO 155.010 MHZ INPUT P. +17.05DBM
IF = 30.090MHZ
IF AMPLIT. −15.43 DBM

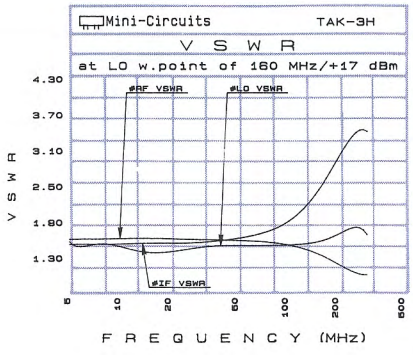
typical performance curves

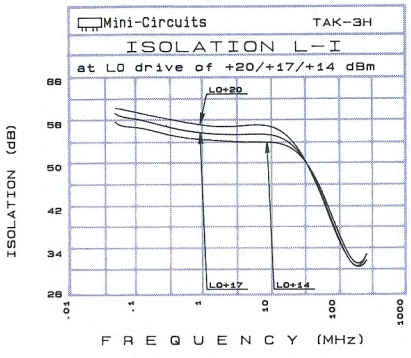
(production unit)

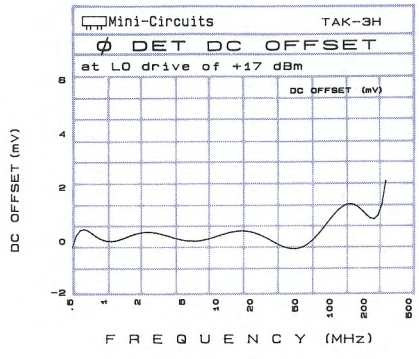












very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models
TFM-4H
ZFM-4H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–R (dB) LO +14dBm	LO +17dBm	LO +20dBm	Isolation L–I (dB) LO +14dBm	LO +17dBm	LO +20dBm
5.000	35.00	8.06	7.19	6.80	68.63	65.11	62.26	63.08	62.77	59.58
10.000	40.00	8.27	7.34	6.84	52.02	49.72	47.88	49.04	47.93	45.88
20.000	50.00	8.25	7.32	6.79	51.05	48.38	46.32	47.83	46.60	44.47
50.000	80.00	8.03	7.13	6.72	47.24	44.27	43.43	43.95	42.64	41.20
154.380	124.38	7.64	6.85	6.49	42.29	40.79	39.71	40.95	39.44	38.24
191.720	161.72	7.73	6.90	6.50	39.82	38.36	37.03	38.68	37.21	35.58
229.060	199.06	7.86	6.87	6.51	37.84	36.06	34.45	36.88	35.14	33.13
341.100	311.10	7.12	6.47	6.28	33.49	32.01	30.69	32.68	30.52	29.33
415.780	385.78	7.11	6.56	6.34	31.45	29.63	28.54	30.17	28.83	28.04
490.470	460.47	7.52	6.83	6.58	30.48	28.12	26.51	28.42	27.66	26.78
527.820	497.82	7.38	6.71	6.44	30.41	28.92	27.09	27.56	27.02	27.57
602.500	572.50	7.11	6.70	6.46	30.75	28.97	26.77	26.64	26.56	25.89
677.190	647.19	7.39	6.93	6.70	31.64	29.95	27.57	24.97	26.49	26.14
751.880	721.88	8.09	7.28	6.84	30.06	28.70	25.66	25.73	28.04	27.37
826.570	796.57	8.85	7.85	7.11	29.06	27.71	25.25	28.36	29.57	27.42
901.260	871.26	9.77	8.86	7.63	28.40	28.43	26.42	28.85	30.98	27.89
975.940	945.94	9.25	7.94	6.20	27.82	27.50	26.58	26.15	26.48	25.48
1050.600	1020.60	10.52	9.15	8.07	27.31	26.59	25.44	24.18	22.84	21.76
1088.000	1058.00	10.42	8.97	7.81	26.86	25.61	24.18	21.02	21.90	19.82
1200.000	1170.00	9.67	8.13	7.03	25.93	24.40	23.17	19.92	21.18	17.96

mixer VSWR

freq. MHz	VSWR, RF port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, LO port LO +14dBm	LO +17dBm	LO +20dBm	VSWR, IF port LO +14dBm	LO +17dBm	LO +20dBm
5.002	1.29	1.36	1.45	1.32	1.55	2.55	1.93	1.55	1.27
42.344	1.04	1.15	1.25	1.07	1.50	2.37	1.92	1.54	1.27
50.000	1.03	1.14	1.25	1.07	1.52	2.44	1.92	1.54	1.27
79.688	1.02	1.13	1.24	1.15	1.41	2.22	1.93	1.55	1.28
117.030	1.03	1.12	1.23	1.17	1.40	2.22	1.96	1.56	1.29
154.380	1.05	1.11	1.22	1.15	1.34	2.04	1.98	1.58	1.31
191.720	1.06	1.10	1.21	1.15	1.36	1.94	2.01	1.60	1.33
303.750	1.10	1.08	1.18	1.26	1.23	1.85	2.16	1.72	1.41
378.440	1.13	1.07	1.16	1.32	1.24	1.83	2.31	1.81	1.49
453.130	1.15	1.04	1.13	1.35	1.22	1.81	2.48	1.92	1.58
500.000	1.16	1.03	1.12	1.38	1.17	1.69	2.56	1.99	1.63
602.500	1.18	1.01	1.10	1.48	1.13	1.60	2.70	2.11	1.75
639.840	1.18	1.03	1.10	1.46	1.08	1.57	2.70	2.11	1.75
751.880	1.19	1.10	1.14	1.42	1.04	1.45	2.82	2.21	1.90
826.560	1.19	1.14	1.19	1.31	1.09	1.46	2.84	2.23	1.92
863.910	1.21	1.17	1.21	1.33	1.13	1.47	2.86	2.25	1.94
938.590	1.22	1.22	1.24	1.32	1.24	1.56	2.83	2.22	1.93
1000.000	1.24	1.24	1.25	1.36	1.33	1.61	2.80	2.19	1.89
1125.300	1.21	1.22	1.22	1.36	1.52	1.75	2.62	2.03	1.74
1200.000	1.15	1.18	1.21	1.40	1.61	1.86	2.50	1.94	1.66

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
5.000	+862.70	+.98
43.548	+873.80	+.96
50.000	+862.90	+.94
82.096	+872.90	+.95
120.640	+866.80	+1.14
159.190	+892.40	+1.15
197.740	+896.30	+1.20
313.380	+1011.70	+.35
390.480	+899.10	+.75
467.580	+861.20	−3.01
500.000	+866.50	−2.85
583.220	+943.90	−3.59
621.770	+936.90	−.37
737.410	+753.50	−2.26
814.510	+693.50	−1.41
853.060	+709.20	−1.65
930.150	+685.80	−2.43
1000.000	+632.60	−3.22
1122.900	+641.30	−.21
1200.000	+711.10	−4.22

Measurements at RF & LO Power +17 dBm

Mini-Circuits™
Distribution Centers/NORTH AMERICA P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	34	19	37	39	46	39	48	54	54
1	–	21	–	39	16	42	26	42	38	49	44	49
2	57	>53	33	50	31	>59	32	48	42	>62	45	>63
3	77	50	41	55	46	52	38	60	44	54	44	55
4	>84	54	49	53	49	52	51	58	48	58	54	60
5	>85	73	59	64	50	63	48	63	48	69	47	71
6	>85	71	67	67	61	63	64	65	59	66	54	67
7	>84	70	>83	73	71	69	69	70	65	71	62	72
8	>84	>88	>81	75	>78	75	77	68	71	68	66	67
9	>84	>86	>87	>86	>81	>85	>77	75	70	75	68	74
10	>84	>89	>86	>87	>88	>85	>86	>83	76	73	72	75

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 10.04 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 17.01 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. 3.02 DBM

RF ORDER HARMONIC

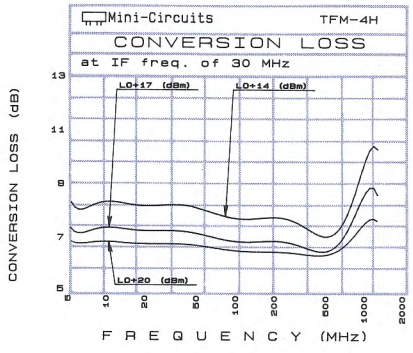
RF CAL	0	1	2	3	4	5	6	7	8	9	10
U	–	–	39	26	6	22	24	32	21	37	61	36
1	–	21	–	38	17	38	29	36	30	39	34	43
2	78	47	38	45	38	49	39	46	53	52	55	54
3	>85	66	56	67	55	61	49	69	49	>77	52	69
4	>86	73	69	69	>80	70	69	68	65	67	68	70
5	>85	>78	>79	>78	>78	78	75	78	72	77	70	>77
6	>84	77	>78	>78	>78	>78	>79	>79	>78	>78	>79	77
7	>85	>77	>77	>76	>78	>78	>80	>77	>79	>78	>78	>78
8	>85	>77	>77	>77	>77	>78	>79	>78	>79	>78	>79	>78
9	>84	>77	>77	>78	>79	>77	>77	>78	>79	>79	>78	>78
10	>85	>77	>77	>77	>77	>77	>76	>77	>79	>80	>78	>79

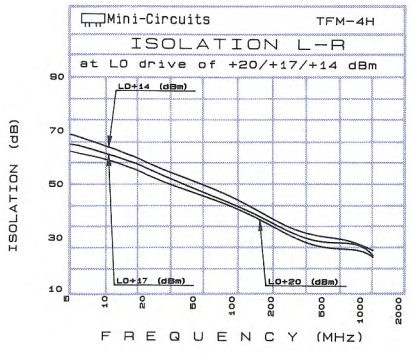
Harmonic LO Order

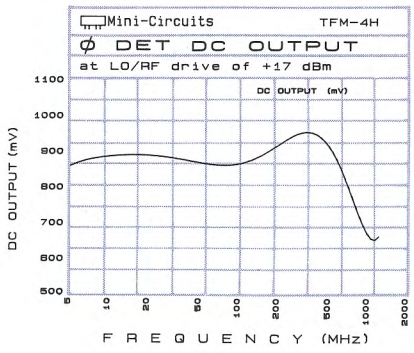
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE −.02 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 17.01 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. −6.99 DBM

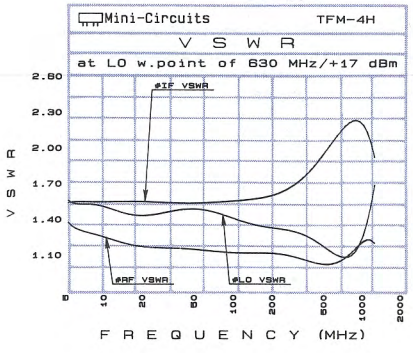
typical performance curves

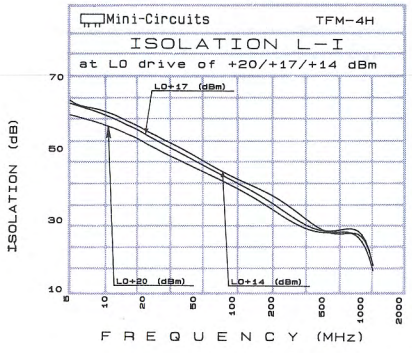
(production unit)

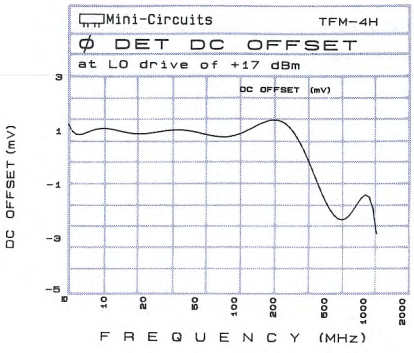












In Stock...immediate Delivery

ultra low distortion

Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

Models
RAY-1
ZAY-1
ZMY-1

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
5.000	35.00	6.50	6.52	6.53	61.85	57.02	53.70	79.05	82.02	>86.00
10.000	40.00	6.43	6.40	6.48	60.36	56.72	53.82	79.25	82.32	>86.00
20.000	50.00	6.40	6.40	6.49	56.74	54.48	52.00	79.36	81.28	81.01
35.938	65.94	6.43	6.43	6.53	52.88	51.51	49.99	76.65	75.99	75.33
50.000	80.00	6.38	6.40	6.51	50.10	48.82	47.85	72.70	72.57	68.82
82.345	52.35	6.37	6.39	6.59	45.91	45.62	45.16	66.35	62.91	60.22
100.000	70.00	6.33	6.36	6.56	44.28	44.05	43.27	61.72	58.66	56.52
144.220	114.22	6.45	6.53	6.64	41.58	41.60	41.21	54.43	53.71	54.55
175.160	145.16	6.63	6.68	6.77	39.88	40.04	39.24	51.26	51.38	50.90
200.000	170.00	6.68	6.69	6.76	39.60	39.45	38.48	50.04	50.73	50.65
221.570	191.57	6.49	6.52	6.62	36.79	36.41	37.51	45.90	46.45	49.56
252.500	222.50	6.51	6.52	6.61	36.84	36.33	36.92	47.05	47.23	49.54
283.440	253.44	6.62	6.64	6.77	37.32	36.36	36.25	47.30	47.98	49.23
314.380	284.38	6.70	6.74	6.84	37.11	36.35	36.04	46.09	46.73	48.01
345.320	315.32	6.67	6.62	6.75	34.44	33.85	34.16	42.98	44.99	48.25
376.260	346.26	6.57	6.50	6.57	30.62	30.50	31.71	40.13	41.75	42.64
407.190	377.19	6.63	6.43	6.39	32.30	32.89	32.68	41.52	42.28	41.96
438.130	408.13	6.83	6.50	6.32	34.18	33.81	34.16	42.37	42.66	43.08
469.070	439.07	7.31	6.81	6.64	34.59	33.63	34.33	42.39	41.41	40.68
500.000	470.00	7.15	6.62	6.62	34.79	34.24	34.04	40.74	40.42	39.86

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	VSWR, LO port LO +20dBm	LO +23dBm	VSWR, IF port LO +20dBm	LO +23dBm
5.001	1.26	1.29	1.88	2.50	1.47	1.33
10.000	1.12	1.14	1.80	2.37	1.47	1.33
20.000	1.03	1.06	1.85	2.33	1.48	1.33
35.938	1.01	1.05	1.82	2.31	1.48	1.33
50.000	1.03	1.07	1.85	2.37	1.47	1.34
82.345	1.06	1.08	1.76	2.20	1.51	1.36
100.000	1.07	1.10	1.77	2.25	1.53	1.39
144.220	1.11	1.12	1.72	2.11	1.62	1.45
175.160	1.13	1.14	1.80	2.25	1.66	1.51
200.000	1.15	1.16	1.68	2.06	1.74	1.56
221.570	1.17	1.18	1.76	2.17	1.78	1.61
252.500	1.19	1.20	1.67	2.04	1.87	1.67
283.440	1.21	1.22	1.74	2.10	1.82	1.66
314.380	1.24	1.24	1.68	1.96	1.98	1.79
345.320	1.26	1.26	1.75	2.04	2.06	1.87
376.260	1.29	1.29	1.70	1.96	2.13	1.91
407.190	1.31	1.31	1.69	1.95	2.18	1.96
438.130	1.34	1.35	1.67	1.90	2.23	2.01
469.070	1.37	1.38	1.63	1.87	2.25	2.04
500.000	1.43	1.44	1.60	1.83	2.26	2.05

ϕ detection

Freq. (MHz)	max. DC output mV	DC offset mV
5.000	−1385.80	−1.23
10.000	−1409.30	−1.23
20.000	−1383.10	−1.25
36.344	−1343.30	−1.31
50.000	−1331.10	−1.34
70.688	−1336.80	−1.35
87.860	−1376.40	−1.51
100.000	−1386.40	−1.35
139.380	−1311.20	−1.32
173.720	−1328.90	−1.90
200.000	−1376.10	−1.77
242.410	−1327.70	−1.60
276.750	−1361.20	−2.85
300.000	−1342.10	−2.44
345.440	−1273.10	−3.00
379.780	−1214.40	−.53
400.000	−1216.90	−1.82
431.300	−1282.30	+.07
465.640	−1220.50	+.70
500.000	−1228.50	−2.86

Measurements at RF & LO Power +23 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	19	37	32	44	30	50	34	58	46	61
1	–	21	–	33	11	39	18	49	24	43	36	49
2	63	56	42	>66	47	>65	49	>64	47	>67	46	>61
3	73	53	42	52	56	57	49	57	42	57	42	64
4	>85	71	61	77	60	77	59	70	63	69	58	69
5	>86	64	56	64	59	70	53	67	53	70	53	76
6	>86	75	62	>82	70	>80	70	78	66	>84	72	>82
7	>86	69	65	>80	62	74	64	75	69	77	67	>80
8	>86	>83	78	>89	75	>87	>81	>85	>79	>88	>79	>87
9	>85	>86	74	>83	>81	>88	>84	>81	76	>85	73	>88
10	>85	>88	>80	>88	>88	>88	>85	>89	>88	>88	>79	>89
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE +9.98 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE +22.98 DBM
IF=MEASURED: FREQ.30.09 AMP. +3.07 DBM

RF ORDER HARMONIC

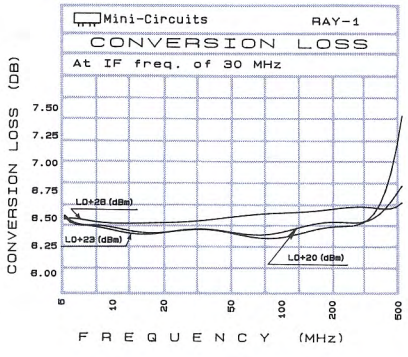
	RF CAL											
0	–	–	13	20	24	27	21	35	19	40	26	51
1	–	19	–	36	11	40	17	46	21	42	31	40
2	83	60	50	62	51	60	52	59	53	59	52	67
3	>85	72	62	68	60	69	58	71	55	72	54	76
4	>85	>78	73	>78	76	>78	>78	>77	>78	>79	>78	>78
5	>85	>78	>79	>79	>79	>78	>78	>78	77	>78	75	>79
6	>85	>77	>79	>78	>79	>79	>78	>78	>78	>79	>79	>80
7	>84	>78	>77	>79	>78	>78	>78	>79	>78	>78	>79	>79
8	>86	>78	>79	>78	>78	79	>78	>79	>79	>79	>78	>78
9	>86	>78	>77	>78	>78	>78	>79	>78	>80	>80	>78	>79
10	>85	>79	>78	>77	>77	>78	>77	>79	>78	>79	>78	>79
		0	1	2	3	4	5	6	7	8	9	10

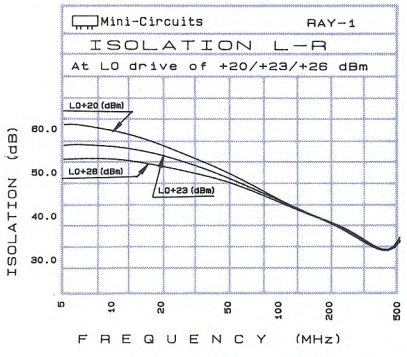
Harmonic LO Order

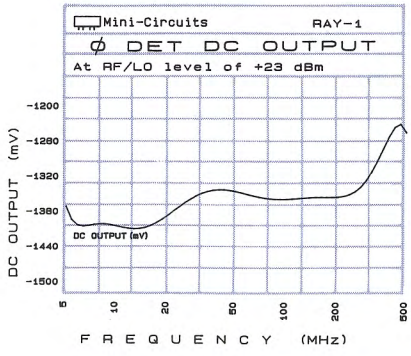
test conditions: RF.=IN: FREQ.185.1 MHZ DRIVE 0 DBM
LO.=IN: FREQ.155.01 MHZ DRIVE +22.97 DBM
IF=MEASURED: FREQ.30.09 AMP. −6.82 DBM

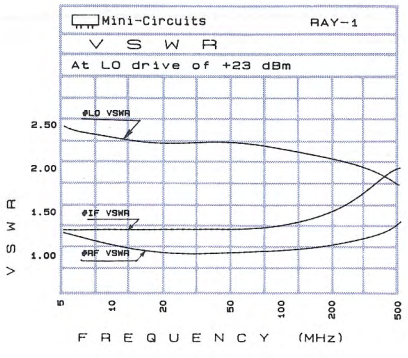
typical performance curves

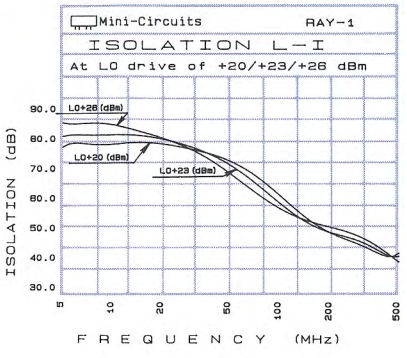
(production unit)

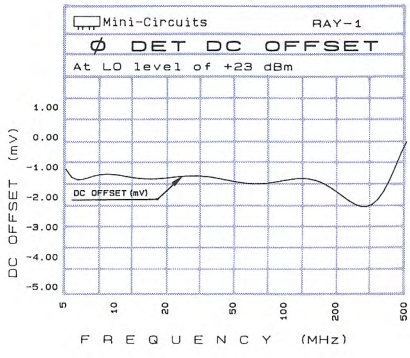












ultra low distortion

Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

Models

RAY-2
ZAY-2
ZMY-2

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
10.000	40.00	7.40	7.24	7.29	63.84	62.69	60.07	65.23	65.25	62.53
39.118	69.12	7.44	7.31	7.49	60.69	59.37	57.65	64.08	63.70	61.39
68.236	98.24	7.35	7.27	7.51	57.59	56.74	55.77	61.64	61.14	58.79
126.470	96.47	7.23	7.14	7.44	55.15	53.84	52.39	58.67	56.28	54.98
184.710	154.71	7.27	7.22	7.53	50.42	48.58	48.05	51.41	50.62	50.74
213.830	183.83	7.31	7.24	7.53	46.32	45.40	45.35	47.53	47.73	48.43
272.060	242.06	7.25	7.23	7.50	42.98	42.61	42.86	44.87	45.47	46.34
330.300	300.30	7.35	7.29	7.61	41.59	41.54	42.10	43.35	44.13	44.42
388.530	358.53	7.44	7.36	7.69	40.33	40.25	40.28	42.03	42.56	42.73
446.770	416.77	7.87	7.64	7.75	38.11	38.45	39.55	40.69	40.78	42.04
505.010	475.01	8.06	7.63	7.76	35.94	36.69	37.98	38.96	39.32	39.20
534.120	504.12	8.28	7.90	7.90	35.19	35.83	37.50	38.08	37.92	38.06
592.360	562.36	8.76	8.08	7.97	34.72	35.57	37.25	36.54	36.44	35.82
650.600	620.60	8.41	7.76	7.67	35.09	36.21	37.77	34.73	34.53	34.35
708.830	678.83	8.35	7.65	7.59	35.95	36.58	37.86	34.84	34.06	34.28
767.070	737.07	8.18	7.45	7.52	37.16	36.95	37.46	33.96	33.05	33.07
825.300	795.30	8.19	7.70	7.81	36.30	36.19	36.58	32.59	31.58	30.83
883.540	853.54	9.07	8.40	8.34	35.40	35.85	37.02	31.59	30.60	30.85
941.780	911.78	10.02	9.21	9.08	35.05	34.74	36.39	30.53	29.37	29.56
1000.000	970.00	10.52	9.87	9.86	34.37	34.25	34.54	30.87	29.56	29.15

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
10.000	1.11	1.14	1.17	1.76	2.22	2.89	1.82	1.60	1.40
39.088	1.07	1.12	1.13	1.57	1.91	2.25	1.81	1.59	1.35
68.176	1.09	1.14	1.18	1.74	2.24	2.94	1.83	1.61	1.45
100.000	1.12	1.16	1.15	1.49	1.80	2.15	1.87	1.64	1.39
155.440	1.16	1.19	1.18	1.54	1.90	2.46	1.96	1.73	1.53
200.000	1.19	1.21	1.19	1.47	1.80	2.84	2.03	1.81	1.61
242.710	1.21	1.22	1.15	1.46	1.75	2.15	2.13	1.90	1.60
300.880	1.23	1.23	1.14	1.64	1.97	2.27	2.27	2.04	1.84
359.060	1.22	1.21	1.11	1.77	2.16	2.43	2.37	2.13	2.09
417.240	1.19	1.18	1.09	1.81	2.17	2.34	2.44	2.20	2.19
475.410	1.16	1.14	1.10	1.94	2.27	2.25	2.51	2.27	2.16
504.500	1.16	1.13	1.12	1.96	2.34	2.19	2.53	2.30	2.20
562.680	1.18	1.15	1.15	1.88	2.20	2.14	2.62	2.40	2.28
620.850	1.27	1.24	1.16	1.80	2.02	2.04	2.67	2.47	2.29
679.030	1.43	1.39	1.17	1.62	1.77	1.96	2.79	2.63	2.33
737.210	1.61	1.57	1.24	1.40	1.52	2.04	2.90	2.84	2.63
795.380	1.83	1.77	1.41	1.33	1.46	2.08	3.07	3.15	3.17
853.560	2.11	1.99	1.64	1.44	1.64	2.08	3.33	3.57	3.72
911.740	2.42	2.23	1.87	1.79	2.13	2.06	3.49	3.91	3.92
1000.000	2.96	2.65	2.40	3.35	4.88	2.26	3.89	4.59	4.52

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
10.000	−1425.30	+2.54
39.970	−1373.80	+2.65
69.940	−1401.00	+2.91
100.000	−1397.40	+3.15
159.850	−1430.40	+3.67
200.000	−1394.60	+3.29
249.760	−1458.90	+3.27
309.700	−1395.70	+3.32
369.640	−1261.90	+3.03
429.580	−1207.40	+3.43
489.520	−1225.40	+3.72
519.490	−1250.90	+4.19
579.430	−1184.50	+4.97
639.370	−1096.40	+4.26
669.340	−1113.20	+5.74
729.280	−1035.70	+5.99
789.220	−983.40	+5.57
849.160	−949.00	+9.12
939.070	−915.30	10.77
1000.000	−816.10	+7.84

Measurements at RF & LO Power +23 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	23	32	30	44	35	40	50	51	50	56
1	–	11	–	36	13	39	36	44	30	42	37	54
2	57	>51	44	44	44	>64	48	>55	>60	>61	>58	47
3	76	49	37	44	35	53	41	47	53	49	41	53
4	>86	68	63	68	67	>80	69	64	59	72	61	>79
5	>86	67	64	71	52	59	45	59	53	60	71	68
6	>83	66	74	74	>79	65	63	65	61	65	>77	>80
7	>85	68	60	76	58	73	68	66	53	64	71	70
8	>86	>86	75	75	74	72	75	>81	65	74	62	>82
9	>85	>84	>82	>79	68	72	62	>82	63	74	61	65
10	>84	>86	>85	>87	>86	>86	>78	>80	>83	>80	>79	74
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 10 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.93 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. 2.27 DBM

RF ORDER HARMONIC

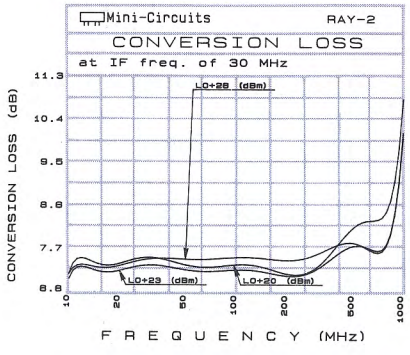
	RF CAL											
0	–	–	14	22	18	33	21	26	35	30	33	37
1	–	12	–	35	12	35	39	36	26	40	32	46
2	78	55	57	58	64	59	57	>71	62	60	65	54
3	>86	77	59	67	59	66	63	67	66	64	58	>77
4	>84	>77	>78	76	>79	73	>78	>78	>78	>79	>78	>76
5	>84	>78	>77	>77	>78	>79	>79	>79	>79	>79	>77	>77
6	>84	>77	>77	>78	>78	>80	>80	>79	>79	>78	>78	>78
7	>85	>77	>76	>76	>78	>79	>78	>79	>78	>80	>78	>78
8	>83	>77	>76	>77	>77	>79	>78	>80	>80	>78	>78	>79
9	>84	>77	>77	>78	>77	>76	>77	>76	>78	>79	>79	>77
10	>83	>77	>77	>77	>78	>78	>77	>78	>77	>79	>79	>78
		0	1	2	3	4	5	6	7	8	9	10

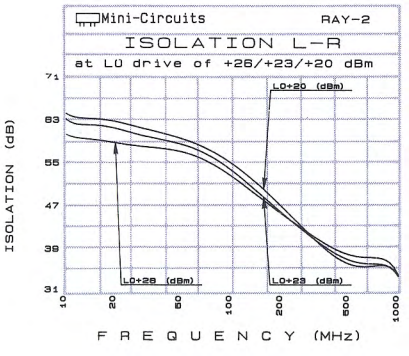
Harmonic LO Order

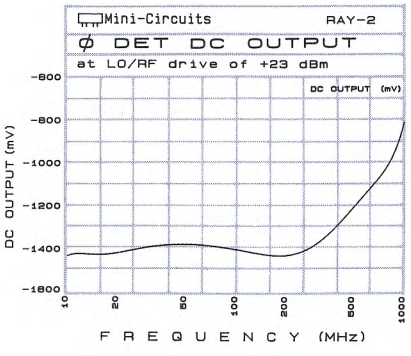
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE .07 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.93 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. –7.31 DBM

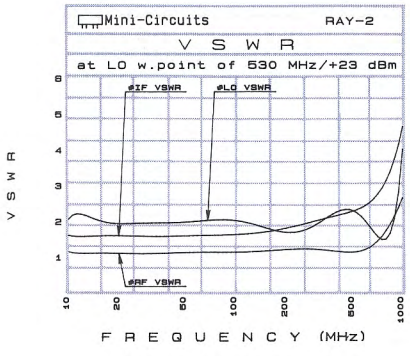
typical performance curves

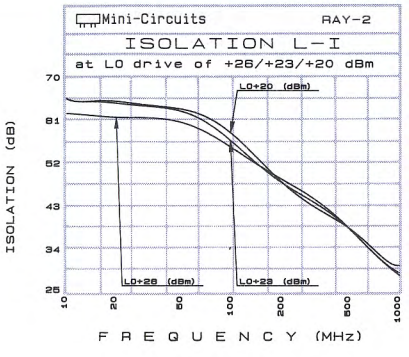
(production unit)

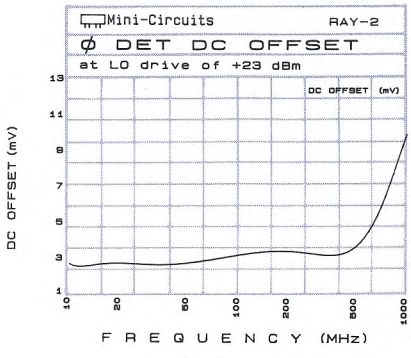












ultra low distortion

Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

Models

RAY-3
ZAY-3
ZMY-3

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
.070	30.07	5.89	5.77	5.83	55.50	55.55	56.16	56.70	56.68	56.98
.200	30.20	5.65	5.58	5.67	53.87	53.15	52.66	56.88	57.09	57.21
1.000	31.00	5.40	5.29	5.40	53.43	52.74	52.25	56.80	57.07	57.32
5.000	35.00	5.13	5.23	5.19	53.20	52.57	51.95	56.66	56.88	57.11
20.000	50.00	5.33	5.27	5.40	52.95	52.28	51.68	56.46	56.59	56.74
34.541	64.54	5.30	5.24	5.39	51.98	51.27	50.53	54.99	54.69	54.37
48.329	78.33	5.34	5.26	5.41	49.40	48.91	48.22	51.20	51.06	50.65
62.117	92.12	5.31	5.28	5.37	46.32	46.28	46.09	47.64	47.85	48.12
69.011	99.01	5.32	5.29	5.39	44.36	44.38	44.13	45.53	45.65	45.21
82.799	52.80	5.29	5.28	5.38	42.44	42.67	42.34	43.68	43.88	42.27
96.587	66.59	5.32	5.28	5.42	40.76	41.29	40.93	41.18	41.90	41.18
103.480	73.48	5.26	5.25	5.40	39.57	39.95	39.53	40.65	40.89	39.21
117.270	87.27	5.30	5.28	5.36	38.97	39.22	39.59	40.47	39.90	39.33
131.060	101.06	5.32	5.29	5.44	38.64	39.37	40.10	40.71	39.78	37.65
144.850	114.85	5.40	5.34	5.48	36.94	38.04	39.29	38.19	37.10	35.27
158.630	128.63	5.49	5.43	5.51	35.34	36.70	37.68	35.06	33.79	31.67
165.530	135.53	5.51	5.47	5.56	34.47	36.49	37.97	32.66	31.41	29.74
179.320	149.32	5.54	5.47	5.59	34.00	36.22	37.89	31.97	30.50	28.81
193.100	163.10	5.56	5.54	5.64	33.89	36.47	36.66	31.76	29.43	27.79
200.000	170.00	5.56	5.51	5.61	34.35	36.43	35.76	31.75	29.00	27.46

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
5.001	1.25	1.17	1.15	1.79	2.42	3.01	1.49	1.40	1.32
10.000	1.25	1.18	1.15	1.79	2.40	3.09	1.49	1.41	1.33
20.000	1.25	1.18	1.15	1.69	2.23	2.58	1.51	1.42	1.34
27.286	1.24	1.17	1.15	1.73	2.21	2.38	1.51	1.42	1.35
32.857	1.23	1.17	1.15	1.73	2.19	2.31	1.51	1.43	1.36
44.000	1.23	1.16	1.14	1.74	2.20	2.36	1.53	1.45	1.37
50.000	1.22	1.15	1.13	1.74	2.20	2.46	1.54	1.46	1.39
60.714	1.21	1.15	1.13	1.75	2.27	2.74	1.58	1.50	1.42
66.286	1.21	1.14	1.13	1.76	2.27	2.89	1.60	1.52	1.44
83.000	1.20	1.13	1.11	1.78	2.28	2.67	1.67	1.58	1.50
88.571	1.19	1.13	1.11	1.76	2.25	2.48	1.70	1.61	1.52
100.000	1.19	1.13	1.11	1.72	2.14	2.21	1.74	1.65	1.57
110.860	1.18	1.12	1.11	1.68	2.10	2.11	1.77	1.67	1.57
127.570	1.17	1.12	1.11	1.74	2.17	2.35	1.89	1.79	1.69
138.710	1.17	1.12	1.11	1.79	2.25	2.57	1.96	1.85	1.74
149.860	1.17	1.12	1.12	1.80	2.29	2.56	2.02	1.91	1.79
161.000	1.17	1.13	1.13	1.78	2.22	2.38	2.09	1.98	1.85
177.710	1.18	1.14	1.14	1.75	2.16	2.15	2.19	2.06	1.94
194.430	1.19	1.16	1.16	1.74	2.18	2.28	2.30	2.16	2.03
200.000	1.19	1.16	1.17	1.77	2.21	2.41	2.35	2.20	2.06

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.070	−1448.00	−4.44
.200	−1471.50	−7.26
1.000	−1503.30	−7.40
5.000	−1446.10	−7.35
10.000	−1472.00	−7.56
20.000	−1446.20	−7.34
35.000	−1433.90	−7.13
50.000	−1418.30	−6.85
65.000	−1419.40	−6.82
80.000	−1422.70	−6.49
87.500	−1422.10	−6.46
100.000	−1416.90	−5.75
110.000	−1408.10	−5.96
125.000	−1381.90	−5.08
140.000	−1377.90	−3.26
147.500	−1390.00	−3.09
162.500	−1398.60	−3.92
177.500	−1390.50	−3.70
192.500	−1366.50	−1.40
200.000	−1339.30	+.58

Measurements at RF & LO Power +23 dBm

Mini-Circuits™
Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	17	28	23	39	32	56	60	55	53	66
1	–	16	–	25	11	33	24	38	39	52	47	57
2	64	52	46	49	46	49	51	58	51	>61	55	>66
3	73	42	40	47	41	59	42	51	44	51	>69	56
4	>87	67	61	61	68	79	67	67	66	65	72	75
5	>87	69	66	66	64	58	55	55	55	61	56	64
6	>87	77	70	81	75	69	73	70	69	72	75	75
7	>84	69	66	68	69	76	62	74	68	69	71	65
8	>86	>82	69	76	78	80	>82	79	75	78	74	73
9	>85	77	>81	69	75	>88	>88	>83	>87	78	77	75
10	>85	>87	>81	>82	>81	77	>81	76	>83	>82	>90	>89

Harmonic LO Order

test conditions: RF. = IN: FREQ.185.1 MHZ DRIVE 10.05 DBM
LO. IN: FREQ.155.01 MHZ DRIVE 22.92 DBM
IF MEASURED: FREQ.30.09 MHZ AMP. 4.17 DBM

RF ORDER HARMONIC

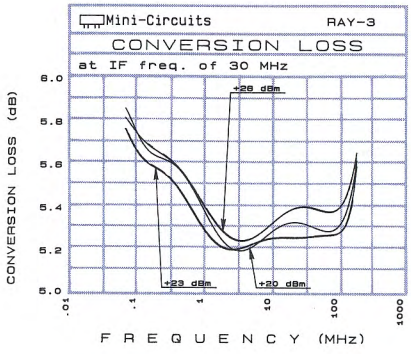
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	8	18	11	27	22	47	44	51	39	53
1	–	15	–	26	10	30	23	35	38	50	42	66
2	84	59	63	60	64	61	61	74	64	74	73	74
3	>86	63	69	67	64	68	63	70	63	78	67	73
4	>86	>80	>80	78	75	79	78	>80	80	>79	>80	>80
5	>86	>80	>80	>80	>80	>80	>80	>80	>80	>79	>79	>80
6	>86	>80	>81	>80	>80	>81	>80	>80	>80	>79	>80	>80
7	>85	>80	>80	>79	>79	>80	>80	>80	>80	>80	>80	>80
8	>87	>80	>80	>79	>81	>80	>80	>79	>80	>80	>80	>79
9	>85	>79	>79	>80	>80	>80	>80	>79	>81	>79	>81	>79
10	>84	>79	>80	>79	>79	>80	>80	>80	>80	>79	>80	>81

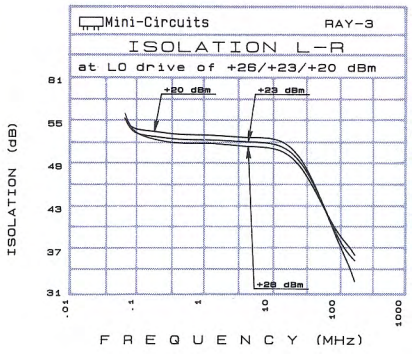
Harmonic LO Order

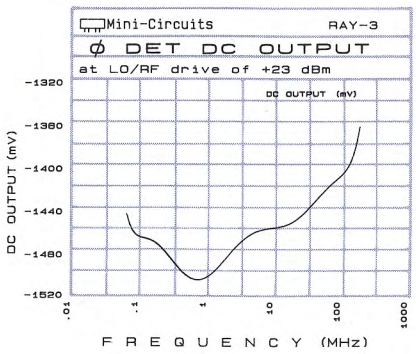
test conditions: RF. = IN: FREQ.185.1 MHZ DRIVE –.07 DBM
LO. = IN: FREQ.155.01 MHZ DRIVE 22.92 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. –5.93 DBM

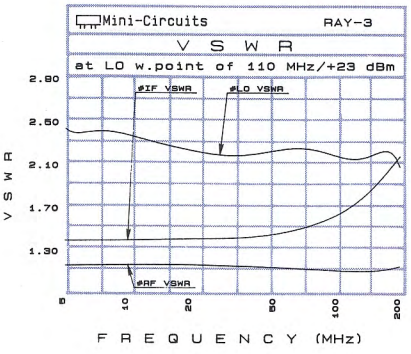
typical performance curves

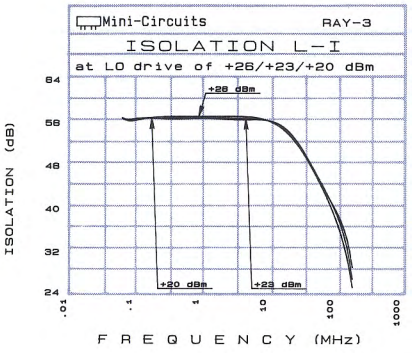
(production unit)

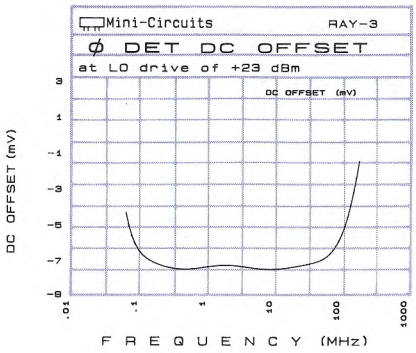












ultra low distortion

Frequency Mixers

Model RAY-6

LEVEL 23 (+23dBm LO, up to +15dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
.010	10.01	6.00	6.00	5.98	60.88	56.94	56.57	57.28	56.32	56.05
.050	10.05	4.80	4.76	4.73	59.08	55.89	53.94	56.52	52.80	50.68
.200	10.20	4.59	4.58	4.53	60.44	56.55	53.59	57.32	52.97	50.17
1.000	11.00	4.54	4.60	4.66	61.74	57.41	53.98	58.45	53.59	50.84
2.000	12.00	4.74	4.76	4.83	62.28	58.18	54.57	59.79	54.59	51.44
5.000	15.00	4.74	4.78	4.85	58.99	57.29	54.86	57.30	54.20	52.27
8.629	18.63	4.84	4.82	4.92	50.26	50.26	49.44	48.24	46.35	44.99
10.000	20.00	4.78	4.82	4.85	46.67	45.31	44.07	46.40	44.58	42.73
12.077	22.08	4.88	4.88	4.92	44.39	42.42	40.16	44.20	41.76	39.35
15.524	25.52	4.80	4.81	4.88	40.51	39.77	40.47	42.76	40.39	36.55
20.000	30.00	4.51	4.50	4.56	40.90	41.36	42.40	43.14	41.11	36.97
22.419	32.42	4.89	4.87	4.98	41.52	42.26	42.14	43.53	41.73	38.57
24.143	34.14	4.90	4.91	4.99	39.04	39.78	41.84	41.73	39.46	36.87
29.315	19.32	4.85	4.86	4.92	40.26	38.11	34.34	40.42	37.99	35.70
32.762	22.76	4.84	4.82	4.90	38.52	36.32	33.36	39.55	37.00	34.56
37.934	27.93	4.85	4.84	4.94	37.02	34.95	33.22	37.69	35.33	33.54
41.381	31.38	4.89	4.84	4.97	32.88	31.36	31.03	36.04	34.43	33.15
44.829	34.83	4.88	4.88	4.98	34.76	33.56	34.32	36.37	33.46	30.10
48.276	38.28	4.89	4.92	5.00	30.01	28.56	28.80	33.07	30.10	26.02
50.000	40.00	4.91	4.89	5.01	28.52	27.47	27.69	32.60	30.74	26.67

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
5.001	1.37	1.32	1.28	1.84	2.47	3.12	1.47	1.42	1.39
6.217	1.37	1.32	1.28	1.83	2.48	3.17	1.47	1.41	1.39
7.434	1.37	1.32	1.28	1.82	2.48	3.21	1.47	1.42	1.40
10.000	1.39	1.33	1.29	1.80	2.43	3.14	1.51	1.44	1.40
12.297	1.39	1.33	1.29	1.79	2.39	3.03	1.52	1.45	1.41
15.946	1.39	1.32	1.29	1.76	2.32	2.84	1.53	1.46	1.42
19.595	1.38	1.31	1.28	1.73	2.26	2.63	1.52	1.46	1.42
20.000	1.38	1.31	1.28	1.76	2.25	2.62	1.52	1.46	1.43
22.027	1.38	1.31	1.27	1.74	2.24	2.53	1.54	1.47	1.43
24.459	1.36	1.30	1.26	1.73	2.23	2.45	1.53	1.47	1.43
26.892	1.36	1.30	1.26	1.76	2.20	2.41	1.54	1.48	1.44
29.324	1.35	1.29	1.25	1.75	2.22	2.36	1.54	1.48	1.45
32.973	1.33	1.27	1.23	1.76	2.20	2.33	1.56	1.49	1.46
36.622	1.32	1.26	1.23	1.77	2.21	2.34	1.58	1.52	1.48
39.054	1.31	1.25	1.22	1.77	2.20	2.36	1.59	1.53	1.49
41.486	1.30	1.24	1.21	1.78	2.20	2.39	1.60	1.53	1.50
43.919	1.29	1.23	1.20	1.78	2.21	2.41	1.61	1.55	1.51
46.351	1.28	1.22	1.19	1.79	2.22	2.45	1.63	1.56	1.52
48.784	1.28	1.21	1.19	1.78	2.22	2.48	1.65	1.58	1.54
50.000	1.27	1.21	1.18	1.78	2.23	2.51	1.65	1.59	1.55

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.020	−1477.00	−4.10
.050	−1408.00	−4.17
.200	−1477.00	−4.10
1.000	−1476.80	−3.86
2.000	−1479.00	−3.70
5.000	−1484.60	−5.90
10.000	−1487.00	−6.11
12.286	−1490.20	−6.37
15.714	−1487.10	−6.48
19.143	−1483.10	−6.31
20.000	−1477.30	−6.23
22.572	−1470.30	−5.95
26.000	−1471.00	−5.36
29.429	−1462.10	−4.70
32.857	−1451.90	−4.29
36.286	−1438.30	−3.88
39.715	−1432.70	−3.92
43.143	−1416.10	−3.24
46.572	−1404.60	−2.13
50.000	−1407.60	−2.66

Measurements at RF & LO Power +23 dBm

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS
5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	20	40	41	34	29	39	29	48	40	50
1	–	23	–	28	10	37	16	38	21	33	32	43
2	67	>72	59	>79	>66	>73	>62	>79	57	>67	61	>68
3	81	63	51	63	53	56	51	55	58	58	62	65
4	>86	81	69	77	68	>83	69	>81	67	76	70	79
5	>87	81	78	>82	70	77	67	78	65	>85	65	79
6	>86	>84	>83	>83	>82	>84	>85	>85	>84	>84	>84	>85
7	>85	>85	>81	>85	>83	>84	>83	>82	>83	>83	80	>85
8	>86	>82	>82	>83	>85	>84	>83	>85	>84	>84	>84	>85
9	>86	>85	>84	>86	>84	>85	>84	>87	>84	>86	>86	>87
10	>86	>82	>82	>83	>83	>84	>83	>84	>84	>84	>84	>85
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test conditions: RF. =IN: FREQ.10.1 MHZ DRIVE 4.99 DBM
LO. IN: FREQ.40.01 MHZ DRIVE 23 DBM
IF MEASURED: FREQ.29.91 MHZ AMP. –.35 DBM

RF ORDER HARMONIC

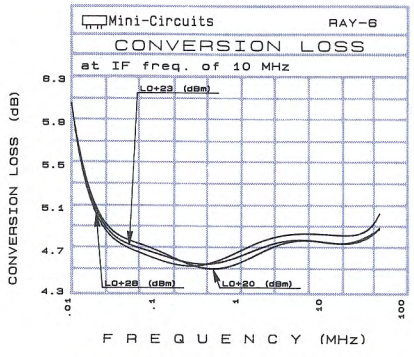
	RF CAL											
0	–	–	10	29	30	24	20	29	18	39	29	39
1	–	23	–	28	11	36	16	38	21	32	33	41
2	84	>75	59	>75	61	>75	62	71	60	67	63	72
3	>86	>75	67	>75	66	71	65	68	69	75	67	>75
4	>86	>74	>73	>75	>77	>76	>76	>76	>76	>74	>76	>76
5	>86	>77	>75	76	>76	>75	>76	>75	>74	>76	>75	>76
6	>86	>76	>76	>75	>76	>75	>75	>75	>76	>76	75	>75
7	>85	>76	>75	>75	>74	>76	>75	>74	>76	>76	>76	>76
8	>86	>76	>77	>75	>75	>75	>77	>76	>75	>76	>76	>75
9	>87	>75	>74	>76	>75	>77	>75	>74	>75	>74	>75	>75
10	>85	>76	>76	>76	>76	>76	>76	>75	>76	>77	>76	>75
		0	1	2	3	4	5	6	7	8	9	10

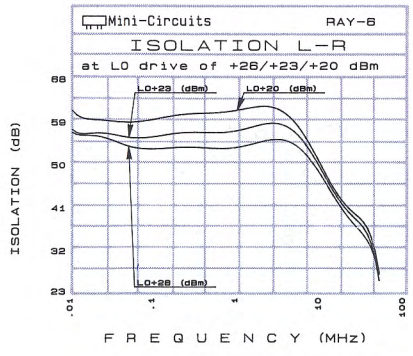
Harmonic LO Order

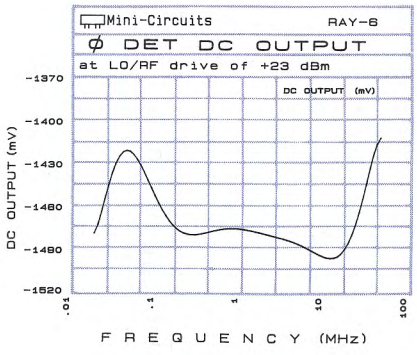
test conditions: RF. =IN: FREQ.10.1 MHZ DRIVE –5.05 DBM
LO. IN: FREQ.40.01 MHZ DRIVE 23 DBM
IF MEASURED: FREQ.29.91 MHZ AMP. –10.42 DBM

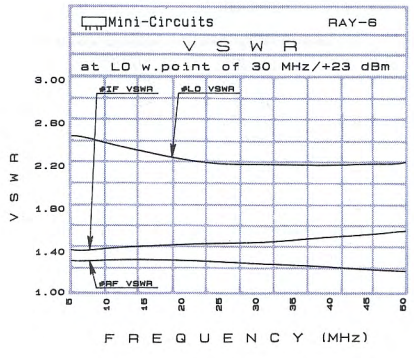
typical performance curves

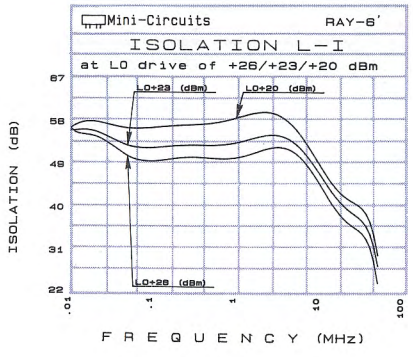
(production unit)

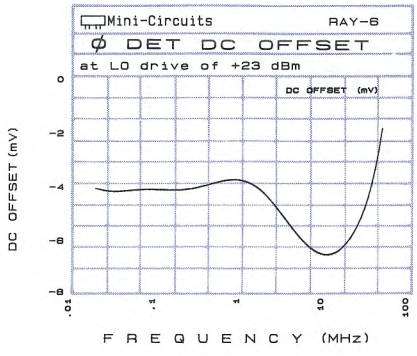












super-low distortion

Frequency Mixers

LEVEL 23S (+23dBm LO, up to +20dBm RF)

Models
SAY-1
ZFY-1

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
.100	30.10	6.28	5.89	5.76	22.66	25.02	26.96	23.83	25.81	26.67
1.000	31.00	6.16	5.82	5.76	43.67	46.68	49.99	43.91	47.33	50.38
10.000	40.00	5.92	5.59	5.69	43.93	47.08	50.18	44.24	47.94	50.52
20.000	50.00	5.96	5.60	5.70	43.87	46.71	49.57	44.41	47.64	49.53
34.576	64.58	5.93	5.59	5.70	43.35	45.97	48.44	44.21	46.92	48.10
69.052	99.05	5.89	5.57	5.69	42.78	45.02	46.84	43.90	46.05	46.59
100.000	70.00	5.83	5.52	5.64	42.07	43.63	44.27	43.31	44.10	43.58
120.770	90.77	5.86	5.58	5.71	41.19	42.68	43.09	42.55	43.10	42.49
155.240	125.24	5.99	5.68	5.71	39.81	40.68	41.13	41.13	41.09	39.43
189.720	159.72	6.22	5.73	5.82	38.49	39.25	40.38	40.04	39.09	38.16
224.190	194.19	6.43	5.85	5.87	38.26	39.09	40.58	39.65	38.89	38.15
241.430	211.43	6.58	5.95	5.93	37.51	38.42	40.04	38.32	38.05	37.91
258.670	228.67	6.59	6.00	6.01	35.85	37.01	38.48	36.00	36.93	36.61
293.150	263.15	6.45	5.91	6.01	35.24	36.97	37.82	34.03	35.23	34.94
327.620	297.62	6.31	5.81	5.90	35.25	37.56	37.85	32.69	34.01	33.27
362.100	332.10	6.32	5.87	5.94	37.64	40.25	39.64	32.79	33.42	32.92
396.570	366.57	6.50	5.96	6.00	38.48	41.18	40.23	33.96	33.85	33.56
431.050	401.05	6.80	6.22	6.21	38.46	41.74	40.20	35.73	36.25	34.92
465.530	435.53	7.10	6.39	6.79	39.62	43.60	42.81	38.44	37.76	36.93
500.000	470.00	7.31	6.56	6.95	39.64	42.79	41.46	37.31	37.30	36.50

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
5.003	1.70	1.35	1.14	1.31	1.41	2.36	1.63	1.29	1.08
10.000	1.72	1.37	1.14	1.28	1.45	2.43	1.65	1.30	1.08
20.000	1.75	1.37	1.15	1.32	1.35	2.10	1.65	1.31	1.09
34.118	1.74	1.37	1.16	1.21	1.42	1.96	1.63	1.30	1.08
50.000	1.73	1.37	1.16	1.21	1.46	2.05	1.63	1.30	1.09
63.235	1.75	1.38	1.18	1.29	1.42	2.38	1.64	1.30	1.09
100.000	1.78	1.42	1.21	1.38	1.37	1.82	1.64	1.30	1.11
121.470	1.83	1.45	1.24	1.39	1.34	1.79	1.65	1.32	1.13
150.590	1.90	1.50	1.29	1.53	1.37	1.97	1.67	1.33	1.15
194.260	2.00	1.57	1.35	1.56	1.32	1.63	1.71	1.37	1.18
200.000	2.03	1.58	1.35	1.56	1.30	1.69	1.72	1.37	1.18
223.380	2.11	1.64	1.40	1.61	1.31	1.78	1.75	1.40	1.20
252.500	2.17	1.68	1.43	1.71	1.25	1.57	1.78	1.43	1.22
296.180	2.32	1.76	1.50	1.93	1.25	1.67	1.86	1.49	1.27
325.290	2.43	1.81	1.55	1.97	1.30	1.60	1.93	1.55	1.32
354.410	2.53	1.89	1.61	2.18	1.34	1.60	2.01	1.64	1.39
398.090	2.62	1.95	1.67	2.37	1.37	1.55	2.12	1.71	1.45
427.210	2.67	1.99	1.70	2.55	1.42	1.48	2.21	1.78	1.51
470.880	2.73	2.05	1.78	2.83	1.53	1.35	2.36	1.88	1.60
500.000	2.62	2.02	1.81	2.84	1.55	1.25	2.34	1.89	1.65

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.100	+656.40	−5.40
1.000	+874.50	+4.90
10.000	+1023.10	+.85
20.000	+999.80	+.95
50.000	+965.70	+.66
62.114	+954.20	+.92
100.000	+971.40	+1.53
119.230	+964.80	+1.92
157.300	+971.70	+2.28
195.380	+995.60	+2.50
200.000	+997.80	+2.10
233.460	+959.80	+1.38
252.490	+952.70	+2.42
290.570	+965.50	+2.50
328.650	+971.70	+1.52
366.720	+928.50	+2.39
404.800	+839.20	+5.63
442.870	+747.20	+6.19
461.910	+720.90	+7.41
500.000	+681.50	+6.95

Measurements at RF & LO Power +23 dBm

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	25	25	40	46	38	50	42	47	42
1	–	34	–	39	14	44	27	40	32	47	42	54
2	57	>58	>56	>62	>55	>57	>52	>64	>55	>60	>67	>64
3	76	51	47	52	43	59	46	54	49	>72	49	>74
4	>84	71	63	65	61	67	68	68	69	68	75	68
5	>85	70	>81	70	73	68	66	71	67	>79	73	74
6	>84	>80	>83	75	>78	76	77	71	77	74	77	>78
7	>85	>86	>80	77	76	>81	74	74	68	73	70	77
8	>85	>87	>88	>88	>88	>84	>85	>87	>89	>84	>86	>85
9	>85	>90	>89	>89	>90	>88	>87	>88	>89	>88	>84	>85
10	>85	>87	>87	>88	>90	>89	>89	>90	>90	>91	>89	>87

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 10.08 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.97 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. 4.08 DBM

RF ORDER HARMONIC

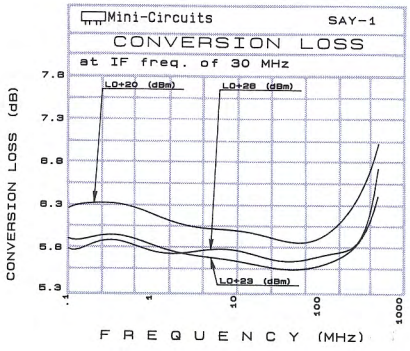
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	17	14	15	28	28	27	38	29	35	29
1	–	30	–	40	14	39	26	41	30	46	39	56
2	76	>77	65	67	61	59	57	61	>72	61	>79	64
3	>86	67	69	69	67	72	68	70	68	78	70	>80
4	>85	>79	>79	>79	>79	>80	>82	>82	>80	>80	>78	>77
5	>86	>79	>78	>79	>80	>79	>81	>81	>80	>80	>81	>79
6	>84	>78	>79	>79	>81	>81	>81	>81	>80	>80	>80	>80
7	>85	>80	>79	>77	>79	>79	>80	>79	>82	>80	>82	>80
8	>85	>80	>78	>79	>78	>79	>79	>80	>80	>82	>81	>80
9	>84	>78	>79	>78	>80	>79	>79	>79	>79	>79	>80	>80
10	>84	>79	>79	>79	>79	>78	>79	>80	>81	>80	>80	>80

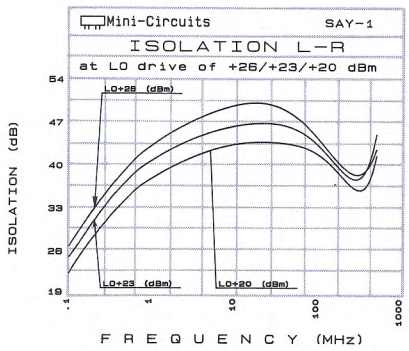
Harmonic LO Order

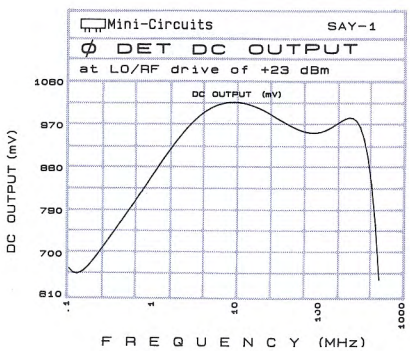
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE .05 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.96 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -5.86 DBM

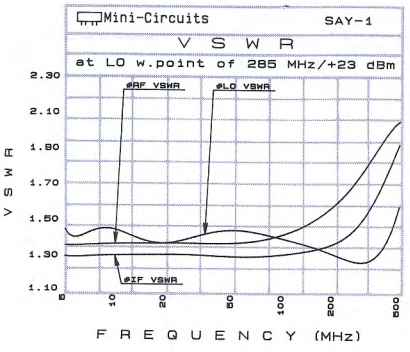
typical performance curves

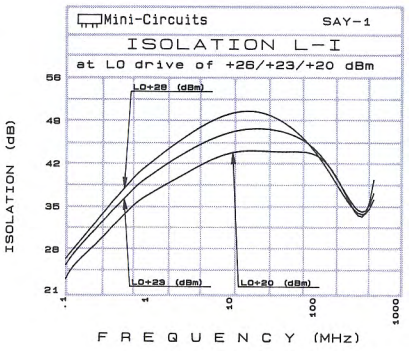
(production unit)

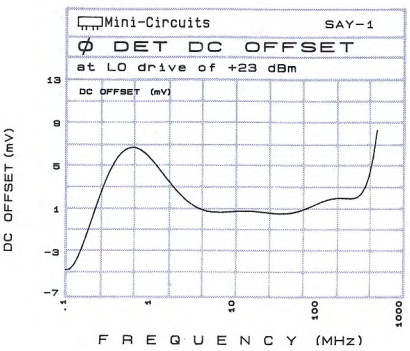












super-low distortion

Frequency Mixers

LEVEL 23S (+23dBm LO, up to +20dBm RF)

Models
SAY-2
ZFY-2

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L–I (dB) LO +20dBm	LO +23dBm	LO +26dBm
.100	30.10	6.43	6.00	5.73	22.68	24.85	27.10	22.66	23.85	24.69
.500	30.50	6.48	6.04	5.80	33.97	36.68	39.29	33.35	35.77	37.61
5.000	35.00	6.24	5.85	5.72	39.61	41.65	44.65	39.03	42.30	45.57
20.000	50.00	6.12	5.68	5.58	42.60	44.97	47.41	42.20	46.33	51.35
50.000	80.00	6.08	5.70	5.59	43.67	45.99	48.16	42.93	47.10	52.03
100.000	70.00	5.99	5.65	5.57	43.59	45.52	46.71	42.36	45.79	48.00
142.940	112.94	5.99	5.66	5.58	42.99	44.24	44.70	41.66	44.02	44.50
214.370	184.37	6.39	5.79	5.68	40.65	40.93	41.24	39.73	39.85	39.81
250.080	220.08	6.40	5.86	5.76	39.08	39.52	40.83	38.70	38.88	40.02
321.500	291.50	6.19	5.81	5.73	36.98	37.74	38.78	34.43	35.22	36.15
392.920	362.92	6.38	5.91	5.81	37.27	38.90	38.49	32.68	33.06	33.70
464.340	434.34	7.11	6.50	6.34	41.43	42.47	38.21	34.90	34.07	33.94
535.770	505.77	7.83	7.03	6.82	41.41	40.44	37.24	39.49	35.52	33.05
571.480	541.48	8.28	7.34	7.19	40.02	39.42	36.86	37.60	34.94	32.37
642.900	612.90	8.88	7.88	7.48	36.96	36.98	34.29	31.92	31.33	29.44
714.320	684.32	9.67	8.27	7.70	33.82	34.35	33.56	28.97	29.91	29.10
785.740	755.74	9.90	8.37	7.68	31.59	32.57	32.28	27.23	29.06	28.95
857.160	827.16	9.75	8.53	8.01	28.78	30.10	30.63	24.92	26.12	26.78
928.590	898.59	10.17	9.10	8.58	26.70	27.93	29.25	23.20	23.81	24.21
1000.000	970.00	10.62	9.35	8.68	24.38	25.45	26.82	21.56	21.46	20.95

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
5.001	1.57	1.20	1.17	1.43	1.25	2.31	1.61	1.20	1.07
10.000	1.58	1.21	1.17	1.41	1.28	2.24	1.61	1.21	1.06
20.000	1.59	1.22	1.17	1.39	1.21	1.87	1.62	1.21	1.05
35.121	1.57	1.21	1.16	1.29	1.25	1.87	1.62	1.21	1.04
50.000	1.59	1.22	1.18	1.33	1.30	2.00	1.62	1.21	1.05
95.364	1.63	1.26	1.22	1.49	1.22	1.69	1.68	1.26	1.04
125.480	1.69	1.30	1.27	1.66	1.23	2.01	1.73	1.29	1.07
155.610	1.75	1.35	1.34	1.73	1.19	1.73	1.79	1.34	1.08
200.000	1.86	1.43	1.43	1.79	1.14	1.76	1.91	1.43	1.13
276.090	2.06	1.60	1.68	1.75	1.11	1.49	2.13	1.60	1.26
366.450	2.32	1.83	1.95	2.16	1.31	1.27	2.46	1.86	1.47
456.820	2.51	2.10	2.16	2.72	1.51	1.07	2.78	2.13	1.68
500.000	2.57	2.21	2.37	2.94	1.70	1.15	2.87	2.24	1.92
517.060	2.60	2.26	2.34	3.15	1.73	1.19	2.89	2.26	1.92
607.420	2.73	2.49	2.30	3.62	2.06	1.44	2.90	2.40	2.13
667.670	2.81	2.62	2.25	3.54	2.20	1.51	2.88	2.45	2.24
758.030	2.89	2.73	2.05	2.73	1.95	1.57	2.77	2.39	2.03
848.390	2.87	2.72	2.03	1.86	1.37	1.57	2.62	2.27	1.94
938.760	2.75	2.59	2.03	2.05	1.19	1.48	2.55	2.11	1.60
1000.000	2.55	2.40	2.03	2.74	1.57	2.44	1.97	1.41	1.40

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mv
.100	+700.50	+1.60
.500	+772.40	18.40
2.000	+914.80	+5.40
10.000	+1040.80	+.10
49.560	+993.30	−.33
89.120	+1008.60	−.64
128.680	+1006.40	−1.10
168.240	+1030.80	−3.68
207.800	+1004.70	−4.93
286.920	+1000.50	−5.44
366.040	+956.70	−4.94
445.160	+758.00	15.46
500.000	+663.90	13.91
524.280	+685.50	12.14
603.400	+839.20	10.41
682.520	+829.10	10.67
761.640	+666.30	−4.57
840.760	+579.70	15.09
880.320	+601.70	18.82
1000.000	+548.90	11.33

Measurements at RF & LO Power +23 dBm

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Distribution Centers/NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	24	17	34	39	35	47	55	48	46
1	-	26	-	47	16	33	28	39	29	60	37	57
2	58	>57	44	50	45	>61	42	>56	50	>57	>53	>69
3	77	55	43	53	38	64	43	56	46	60	45	70
4	>85	70	67	77	63	>81	62	74	70	73	72	70
5	>84	77	76	68	67	68	58	71	59	69	69	73
6	>83	>77	75	>78	76	77	67	74	65	76	69	>84
7	>85	>88	78	>86	>80	>83	>78	>89	68	>87	69	>85
8	>84	>87	>86	>83	>81	>88	>79	>80	71	74	71	>78
9	>85	>88	>87	>89	>84	>87	>87	>89	>80	>87	76	>84
10	>85	>86	>87	>89	>88	>88	>88	>87	>86	>86	77	>81

Harmonic LO Order

test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE 9.99 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.93 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. 3.46 DBM

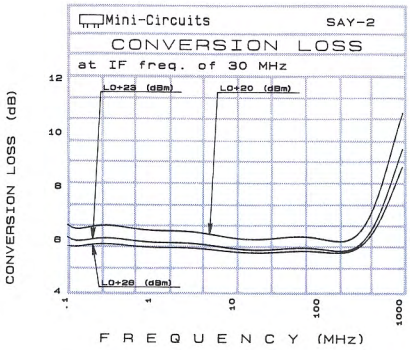
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	9	16	7	22	27	22	36	40	47	32
1	-	27	-	44	15	31	28	36	26	51	33	57
2	78	64	54	>73	59	68	56	>78	64	>75	63	66
3	>86	69	65	69	60	75	62	76	64	77	64	>78
4	>84	>78	>78	>80	>80	>78	77	>78	>78	>78	>78	>77
5	>84	>77	>78	>79	>80	>81	>79	>80	>79	>79	>78	>78
6	>84	>77	>78	>78	>78	>79	>79	>79	>79	>81	>79	>78
7	>85	>78	>77	>76	>78	>79	>79	>79	>81	>80	>79	>79
8	>83	>78	>79	>78	>77	>78	>80	>80	>79	>80	>79	>79
9	>84	>77	>77	>78	>79	>77	>78	>78	>78	>78	>79	>81
10	>83	>79	>77	>78	>79	>77	>78	>78	>78	>79	>79	>79

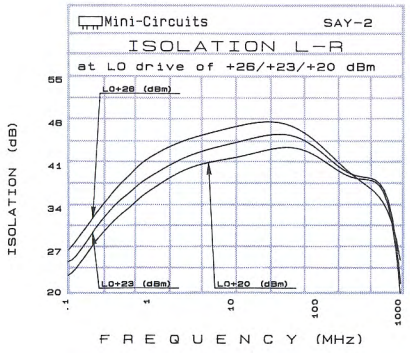
Harmonic LO Order

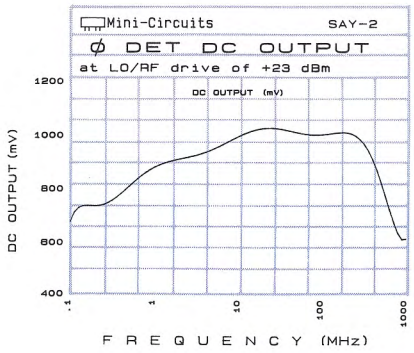
test conditions: RF. = IN: FREQ.500.1 MHZ DRIVE .07 DBM
LO. = IN: FREQ.470.01 MHZ DRIVE 22.93 DBM
IF = MEASURED: FREQ.30.09 MHZ AMP. -6.56 DBM

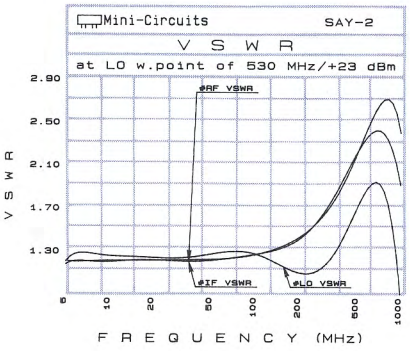
typical performance curves

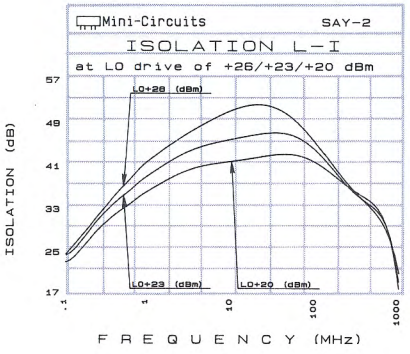
(production unit)

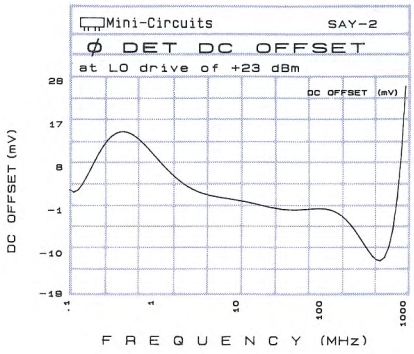












ultra-low distortion

Frequency Mixers

LEVEL 23S (+23dBm LO, up to +20dBm RF)

Models
SAY-11
ZFY-11



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	freq. (MHz)	Isolation L-R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L-I (dB) LO +20dBm	LO +23dBm	LO +26dBm
10.000	40.000	8.13	7.46	7.12	10.000	37.80	41.65	47.32	26.90	30.72	34.62
20.000	50.000	8.26	7.51	7.25	20.000	39.88	43.95	49.92	27.09	31.06	35.15
50.000	80.000	8.51	7.74	7.36	50.000	40.17	44.45	50.10	27.03	30.74	34.46
87.097	57.097	8.63	7.81	7.37	87.097	40.41	44.86	49.18	26.49	29.91	33.48
100.000	70.000	8.43	7.66	7.34	100.000	40.09	44.68	48.76	26.28	29.62	33.14
200.000	170.000	8.39	7.59	7.33	200.000	41.85	46.21	43.14	25.41	28.67	32.24
318.387	288.387	8.86	8.03	7.71	318.387	45.76	41.22	37.41	24.96	28.91	31.61
500.000	470.000	8.40	7.47	7.61	500.000	46.38	37.07	35.32	26.20	29.62	31.27
626.774	596.774	8.87	7.57	7.58	626.774	39.83	33.58	31.89	26.57	30.05	31.22
780.968	750.968	8.64	7.27	7.41	780.968	36.31	33.54	31.90	28.57	31.66	31.47
1000.000	970.000	7.93	7.77	7.43	1000.000	35.39	33.08	31.41	32.23	33.53	30.92
1089.355	1059.355	8.15	7.84	7.47	1089.355	34.21	33.62	31.86	34.60	34.45	30.41
1243.548	1213.548	8.71	8.04	7.73	1243.548	34.01	34.16	33.36	35.83	36.92	31.46
1397.742	1367.742	8.60	8.31	7.91	1397.742	34.55	33.51	31.91	37.62	37.46	30.44
1500.000	1470.000	8.95	8.18	7.89	1500.000	35.54	34.49	32.28	38.92	39.38	31.51
1706.129	1676.129	9.51	8.31	7.72	1706.129	36.23	34.41	32.30	36.16	45.70	33.84
2000.000	1970.000	9.66	8.17	7.69	2000.000	38.87	37.07	36.45	34.19	38.82	36.82
2091.613	2061.613	9.79	8.07	7.49	2091.613	40.04	37.89	37.23	33.22	36.35	35.13
2245.807	2215.807	9.22	7.59	7.36	2245.807	43.18	37.54	36.60	32.57	34.57	33.18
2400.000	2370.000	8.54	7.11	6.63	2400.000	37.57	35.91	36.18	31.78	33.44	31.57

mixer VSWR

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	freq. (MHz)	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm
10.000	1.67	1.55	1.46	1.30	1.24	1.76	5.000	1.47	1.25	1.16
20.000	1.65	1.54	1.45	1.28	1.22	1.75	10.000	1.49	1.25	1.14
50.000	1.63	1.51	1.42	1.23	1.31	1.79	20.000	1.51	1.25	1.13
84.688	1.61	1.50	1.41	1.25	1.26	1.77	35.152	1.48	1.23	1.12
100.000	1.60	1.49	1.41	1.27	1.25	1.77	50.000	1.46	1.22	1.11
200.000	1.59	1.47	1.39	1.30	1.22	1.79	65.303	1.47	1.23	1.11
308.750	1.56	1.45	1.36	1.29	1.23	1.73	100.000	1.47	1.22	1.11
383.438	1.55	1.43	1.34	1.28	1.28	1.72	155.758	1.46	1.21	1.10
500.000	1.51	1.38	1.30	1.25	1.34	1.77	200.000	1.45	1.21	1.10
607.500	1.47	1.34	1.27	1.24	1.29	1.73	246.212	1.44	1.20	1.10
756.875	1.50	1.38	1.32	1.32	1.23	1.73	306.515	1.39	1.17	1.09
906.250	1.62	1.49	1.44	1.50	1.33	1.64	366.818	1.39	1.16	1.09
1000.000	1.73	1.59	1.53	1.70	1.35	1.60	427.121	1.33	1.12	1.09
1205.000	2.02	1.82	1.72	2.40	1.48	1.49	500.000	1.30	1.10	1.12
1354.375	2.22	1.99	1.86	2.98	1.58	1.46	547.727	1.26	1.10	1.15
1503.750	2.45	2.18	2.03	3.35	1.69	1.51	608.030	1.20	1.11	1.21
1727.812	2.65	2.32	2.16	3.43	1.71	1.56	758.788	1.13	1.21	1.35
2000.000	2.62	2.32	2.15	3.29	1.68	1.44	819.091	1.09	1.27	1.42
2175.938	2.55	2.28	2.13	2.94	1.74	1.78	909.545	1.10	1.34	1.51
2400.000	2.34	2.15	2.01	2.61	1.77	1.72	1000.000	1.12	1.40	1.58

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	9	16	6	15	16	33	27	37	35	54
1	–	26	+0	32	20	34	32	44	46	40	39	38
2	94	54	47	53	54	60	51	55	58	62	53	61
3	86	73	64	67	60	82	61	71	72	74	73	72
4	>91	>83	>81	>87	>86	86	84	85	>81	81	>82	>77
5	>91	>83	>82	>82	>87	>85	>86	>85	86	>82	>82	>82
6	>90	80	>82	>82	87	>86	84	>85	84	>86	>81	>82
7	>85	>77	80	81	>82	>87	>86	82	82	>84	84	>81
8	85	>78	76	>81	>82	81	>87	85	>83	83	83	>87
9	>84	>76	77	>77	>83	>82	>82	>86	>85	>84	>85	>85
10	>80	>72	75	>78	>77	>82	>83	81	86	>86	>85	>85

LO Harmonic Order

test conditions: RF IN: 2000.10 MHZ; −.01 DBM
LO IN: 2100.01 MHZ; +23.04 DBM
IF OUT: 99.91 MHZ; −7.92 DBM

RF ORDER HARMONIC

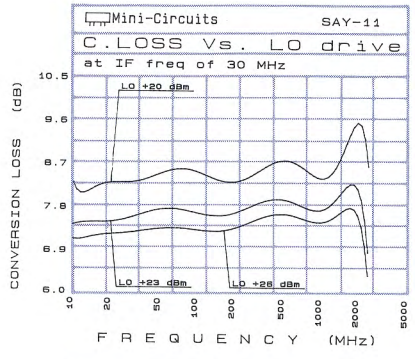
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	17	30	17	25	28	44	49	46	48	63
1	–	31	+0	30.	19	34	34	43	49	44	40	44
2	95	45	37	44	42	47	42	45	52	59	48	58
3	>90	58	48	52	42	60	43	55	53	61	63	55
4	>91	82	71	73	66	70	62	63	65	67	68	67
5	>91	84	85	73	71	67	63	73	64	69	72	69
6	89	89	84	90	85	88	76	81	80	82	78	83
7	>85	>87	88	91	>92	88	90	85	83	89	81	85
8	84	87	>86	90	>92	>92	>94	92	>88	90	90	94
9	84	86	>87	85	91	>91	>92	>93	92	>89	>91	>92
10	>81	>83	>87	84	85	>92	>92	>92	>94	92	>91	>91

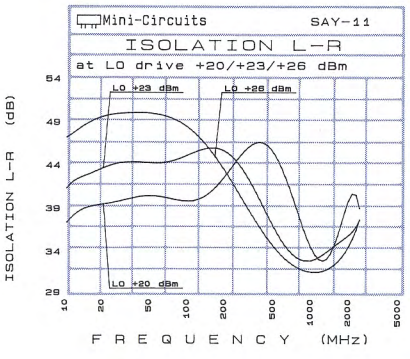
LO Harmonic Order

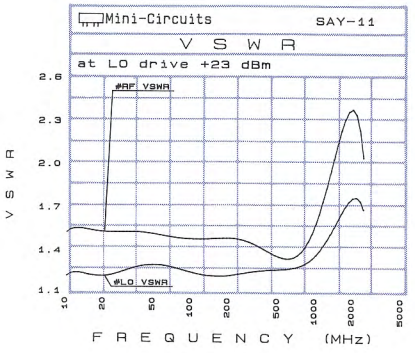
test conditions: RF IN: 2000.10 MHZ; +10.01 DBM
LO IN: 2100.01 MHZ; +23.04 DBM
IF OUT: 99.91 MHZ; +1.95 DBM

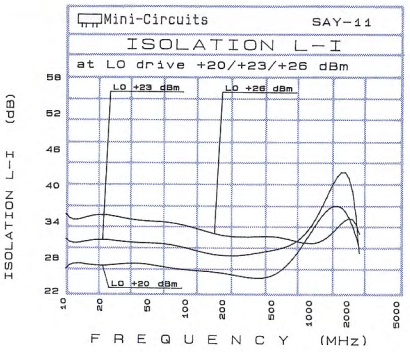
typical performance curves

(production unit)









In Stock...Immediate Delivery

lowest distortion available

Frequency Mixers

Model
VAY-1

LEVEL 27 (+27dBm LO, up to +24dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +23dBm	LO +27dBm	LO +30dBm	Isolation L–R (dB) LO +23dBm	LO +27dBm	LO +30dBm	Isolation L–I (dB) LO +23dBm	LO +27dBm	LO +30dBm
.050	30.05	7.65	6.73	6.43	43.01	45.06	48.21	41.02	44.77	47.90
.100	30.10	6.76	5.90	5.71	44.26	46.53	49.77	42.32	46.31	49.47
.200	30.20	6.63	5.71	5.53	44.70	46.84	50.03	42.42	46.41	49.42
.500	30.50	6.42	5.47	5.15	44.77	46.89	49.86	42.45	46.31	49.14
1.000	31.00	6.45	5.47	5.01	44.52	46.31	48.58	42.20	45.50	47.93
17.905	47.91	5.87	5.34	5.23	43.81	45.35	46.91	41.27	44.81	46.67
35.760	65.76	5.86	5.35	5.34	43.18	44.40	44.78	41.06	44.31	44.93
53.615	83.62	5.84	5.37	5.34	42.40	43.31	43.54	40.94	43.11	42.67
125.040	95.04	6.48	6.02	5.90	41.94	42.44	42.46	40.54	41.42	41.53
142.890	112.89	6.51	6.06	5.94	40.76	40.80	40.64	38.88	39.25	39.31
196.460	166.46	6.72	6.19	6.10	39.84	39.78	40.08	37.83	38.66	38.73
232.170	202.17	6.83	6.31	6.09	40.02	40.08	40.09	37.43	38.07	38.43
250.020	220.02	6.95	6.42	6.14	41.14	40.67	39.70	37.23	37.72	38.04
285.730	255.73	6.94	6.42	6.22	42.09	40.68	39.68	36.81	36.54	35.61
321.440	291.44	6.79	6.30	6.19	40.95	41.05	39.67	35.95	34.78	34.56
357.150	327.15	6.79	6.37	6.20	39.34	41.32	39.35	35.79	34.37	33.14
392.860	362.86	6.83	6.31	6.18	36.75	38.74	38.90	37.43	35.82	33.51
446.430	416.43	7.29	6.72	6.52	34.41	35.92	36.07	39.92	36.76	34.66
464.280	434.28	7.45	6.85	6.62	32.47	34.39	35.61	40.51	38.34	34.54
500.000	470.00	7.74	7.04	6.83	31.98	33.75	35.07	38.55	35.90	33.07

mixer VSWR

freq. MHz	VSWR, RF port LO +23dBm	LO +27dBm	LO +30dBm	VSWR, LO port LO +23dBm	LO +27dBm	LO +30dBm	VSWR, IF port LO +23dBm	LO +27dBm	LO +30dBm
5.001	1.87	1.46	1.22	1.63	1.14	2.06	1.78	1.37	1.13
10.000	1.87	1.46	1.24	1.60	1.14	2.23	1.78	1.38	1.14
20.000	1.88	1.47	1.24	1.56	1.11	2.19	1.79	1.38	1.15
48.676	1.87	1.47	1.25	1.46	1.19	1.96	1.76	1.37	1.14
63.235	1.88	1.48	1.26	1.67	1.23	1.78	1.77	1.37	1.14
77.794	1.90	1.49	1.27	1.76	1.22	1.72	1.77	1.36	1.13
100.000	1.92	1.51	1.27	1.66	1.18	1.66	1.77	1.37	1.13
121.470	1.96	1.54	1.29	1.71	1.20	1.61	1.78	1.37	1.14
150.590	2.04	1.59	1.36	1.95	1.23	1.73	1.81	1.38	1.16
194.260	2.13	1.65	1.57	1.85	1.18	1.81	1.82	1.39	1.18
208.820	2.16	1.68	1.64	2.03	1.25	1.71	1.84	1.40	1.19
237.940	2.25	1.75	1.71	2.00	1.22	1.53	1.88	1.43	1.18
252.500	2.29	1.77	1.70	1.89	1.21	1.51	1.89	1.43	1.18
296.180	2.44	1.86	1.60	2.12	1.25	1.31	1.97	1.48	1.19
325.290	2.52	1.92	1.73	2.08	1.29	1.30	2.04	1.53	1.23
368.970	2.68	2.02	2.02	2.47	1.47	1.23	2.11	1.61	1.30
398.090	2.72	2.09	2.02	2.53	1.52	1.16	2.17	1.66	1.34
441.760	2.82	2.17	2.16	2.80	1.70	1.13	2.26	1.76	1.47
485.440	2.90	2.27	2.35	3.40	1.96	1.08	2.36	1.86	1.65
500.000	2.88	2.27	2.21	3.17	1.95	1.11	2.36	1.87	1.64

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mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	26	24	39	34	37	41	46	57	53	57
1	–	21	–	33	21	28	23	36	29	45	41	53
2	47	>56	>43	>47	>50	>47	>44	>53	>54	>50	>56	>54
3	63	46	41	43	39	48	51	50	43	>58	44	>60
4	>84	65	57	63	54	60	58	58	64	59	64	59
5	>86	71	68	60	61	59	58	60	60	60	66	68
6	>84	70	76	69	>77	66	>80	66	74	70	68	75
7	>85	>79	74	76	73	74	69	67	75	68	>85	>80
8	>85	>89	>90	>80	>90	>81	>85	>83	77	74	>78	74
9	>84	>87	>81	>84	>78	>81	>78	>87	76	>78	74	76
10	>85	>92	>91	>92	>93	>88	>89	>91	>82	>85	>79	77

Harmonic LO Order

test conditions: RF. =IN: FREQ.500.1 MHZ DRIVE 14.94 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 26.97 DBM
IF MEASURED: FREQ.30.091 MHZ AMP. 7.71 DBM

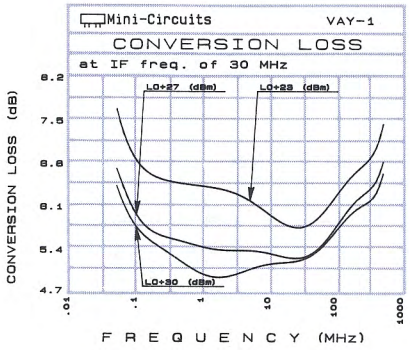
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	14	15	14	27	27	29	33	44	35	52
1	–	24	–	33	17	25	24	32	27	44	32	46
2	67	52	52	56	59	58	49	53	52	57	>62	55
3	>87	62	65	61	60	66	66	71	69	76	66	>82
4	>84	>82	>79	>83	>79	>81	>84	>82	>83	>82	>83	>81
5	>85	>82	>83	>84	>84	>85	>84	>84	>84	>83	>83	>84
6	>84	>82	>82	>83	>84	>83	>83	>85	>83	>83	>84	>82
7	>84	>82	>82	>82	>82	>84	>84	>86	>84	>83	>83	>83
8	>84	>82	>83	>82	>82	>83	>83	>83	>83	>85	>84	>85
9	>83	>82	>83	>83	>82	>83	>83	>82	>83	>84	>84	>85
10	>85	>83	>83	>82	>83	>83	>82	>83	>83	>83	>83	>84

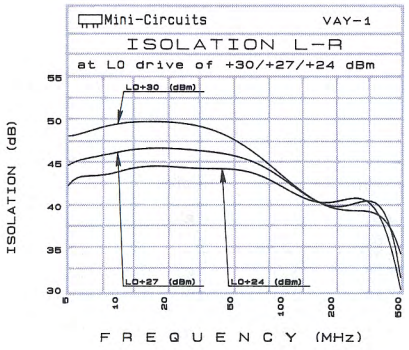
Harmonic LO Order

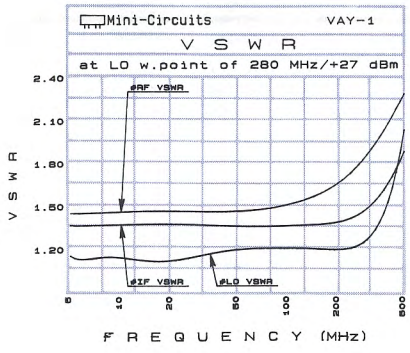
test conditions: RF. =IN: FREQ.500.1 MHZ DRIVE 4.94 DBM
LO. IN: FREQ.470.01 MHZ DRIVE 27.02 DBM
IF MEASURED: FREQ.30.09 MHZ AMP. –2.03 DBM

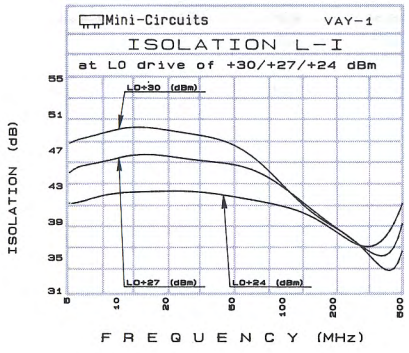
typical performance curves

(production unit)









plug-in, surface-mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
TUF-1
TUF-1SM



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO + 4 dBm	LO + 7 dBm	LO +10 dBm	Isolation L-R (dB) LO + 4 dBm	LO + 7 dBm	LO +10 dBm	Isolation L-I (dB) LO + 4 dBm	LO + 7 dBm	LO +10 dBm
2.000	32.000	7.09	6.81	6.58	87.30	81.85	77.21	68.80	72.15	73.61
4.000	34.000	6.68	6.40	6.19	78.00	76.35	73.81	66.70	68.25	68.21
5.000	35.000	6.62	6.34	6.12	75.70	74.35	72.61	65.80	66.65	66.71
10.000	40.000	6.54	6.25	6.02	69.63	69.58	68.44	62.53	62.18	61.74
20.000	50.000	6.46	6.21	5.98	64.30	64.25	64.03	58.40	57.65	56.43
50.000	80.000	6.36	6.13	5.95	57.56	57.73	57.67	52.41	50.60	49.26
81.733	51.733	6.44	6.16	5.95	53.47	53.89	54.19	48.78	46.89	45.69
100.000	70.000	6.48	6.18	5.96	51.89	52.31	52.63	47.30	45.35	44.00
161.467	131.467	6.34	6.08	5.91	48.63	49.28	49.54	43.72	42.03	40.89
200.000	170.000	6.15	6.03	5.89	47.02	47.46	47.65	41.84	40.24	39.02
241.200	211.200	6.17	6.04	5.90	46.01	46.41	46.63	40.25	38.76	37.49
281.067	251.067	6.18	6.04	5.90	44.63	45.16	45.38	38.53	37.18	36.02
300.000	270.000	6.35	6.09	5.92	44.31	44.55	44.64	38.08	36.84	35.72
320.933	290.933	6.31	6.08	5.92	43.71	44.04	43.87	37.13	35.94	34.79
400.667	370.667	6.18	5.99	5.86	42.32	42.93	42.99	33.91	33.45	32.72
480.400	450.400	6.28	6.06	5.90	40.18	40.46	40.80	31.33	30.91	30.51
500.000	470.000	6.33	6.11	5.95	39.89	40.16	40.42	31.07	30.63	30.27
560.133	530.133	6.35	6.15	5.99	39.63	39.99	40.02	29.59	29.30	28.68
580.067	550.067	6.41	6.19	6.02	39.64	40.02	40.17	29.36	29.24	28.71
600.000	570.000	6.45	6.26	6.10	39.55	39.76	39.73	28.83	28.69	28.09

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO + 4 dBm	LO + 7 dBm	LO +10 dBm	VSWR LO port LO + 4 dBm	LO + 7 dBm	LO +10 dBm	VSWR IF port LO + 4 dBm	LO + 7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
2.000	1.53	1.56	1.58	1.90	2.71	3.80	1.34	1.19	1.09	2.000	-230.82	-0.05
4.000	1.28	1.31	1.34	1.82	2.64	3.73	1.34	1.19	1.10	4.000	-231.66	-0.01
5.000	1.22	1.25	1.29	1.81	2.62	3.70	1.34	1.19	1.09	5.000	-230.98	-0.07
10.000	1.10	1.15	1.20	1.67	2.47	3.54	1.35	1.19	1.10	10.000	-230.48	0.02
20.000	1.04	1.11	1.17	1.71	2.51	3.57	1.35	1.19	1.10	20.000	-225.17	0.02
50.000	1.02	1.10	1.16	1.67	2.46	3.50	1.36	1.20	1.12	50.000	-238.30	0.02
100.000	1.09	1.13	1.17	1.64	2.41	3.42	1.39	1.24	1.16	81.733	-244.03	-0.01
109.640	1.11	1.14	1.18	1.62	2.37	3.36	1.39	1.25	1.17	100.000	-251.23	0.04
169.440	1.19	1.20	1.24	1.61	2.31	3.24	1.44	1.31	1.24	161.467	-233.45	0.06
217.280	1.25	1.27	1.29	1.60	2.29	3.19	1.49	1.36	1.30	200.000	-234.93	0.03
265.120	1.32	1.33	1.36	1.61	2.26	3.14	1.55	1.43	1.37	241.200	-250.57	0.14
300.000	1.38	1.38	1.40	1.63	2.28	3.16	1.63	1.52	1.46	281.067	-248.51	0.07
324.920	1.41	1.42	1.44	1.65	2.30	3.17	1.62	1.48	1.42	300.000	-239.16	0.10
372.760	1.49	1.50	1.51	1.68	2.31	3.19	1.71	1.57	1.51	320.933	-239.97	0.14
420.600	1.58	1.58	1.59	1.71	2.32	3.16	1.80	1.66	1.59	400.667	-252.65	0.37
468.440	1.66	1.66	1.67	1.78	2.33	3.12	1.89	1.74	1.68	480.400	-232.77	0.59
500.000	1.72	1.71	1.72	1.79	2.33	3.11	1.95	1.80	1.73	500.000	-226.52	0.58
540.200	1.79	1.77	1.78	1.84	2.35	3.10	2.03	1.88	1.80	560.133	-225.65	0.94
588.040	1.88	1.86	1.86	1.86	2.36	3.12	2.12	1.97	1.89	580.067	-227.84	0.87
600.000	1.90	1.88	1.88	1.88	2.38	3.14	2.14	1.99	1.91	600.000	-231.92	0.89

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	22	13	36	36	34	23	38	57	41
1	-	21	+0	27	12	30	19	39	44	36	37	36
2	96	66	51	61	50	70	49	60	62	>74	59	59
3	>96	>75	>75	>75	>75	75	67	>75	71	>74	>74	71
4	95	74	>75	>75	72	74	>76	74	74	>75	>75	>74
5	>95	>74	73	>75	>76	>75	>75	>75	>75	>75	>74	74
6	>96	>74	>53	>74	72	>75	>75	75	>75	75	>75	>75
7	>96	>75	73	>74	>75	>75	74	>76	>75	>75	74	>76
8	>96	>75	>74	72	>74	>75	>75	>75	75	75	>76	>76
9	>95	74	>75	>74	>74	>74	>74	>74	>75	>75	74	>75
10	95	>76	>75	>75	>75	73	>74	73	>75	>75	>76	>75

Harmonic LO Order

test condition: RF IN: 490.10 MHZ; -14.94 DBM
LO IN: 460.01 MHZ; +7.01 DBM
IF OUT: 30.09 MHZ; -20.78 DBM

RF ORDER HARMONIC

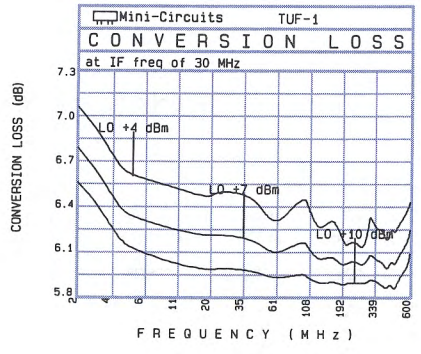
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	13	34	26	54	48	43	36	60	65	58
1	-	16	+0	28	11	31	25	42	44	40	42	40
2	95	61	40	52	41	58	41	59	54	66	51	56
3	95	55	49	50	45	52	47	58	50	56	62	53
4	>96	73	62	62	59	64	57	74	60	68	65	80
5	>95	79	76	67	65	63	64	67	60	72	59	75
6	>95	84	73	83	75	77	76	81	73	75	72	83
7	>95	>84	>84	84	84	82	79	>85	>85	82	84	84
8	>97	>85	>85	>84	>84	>85	>85	>85	>85	84	>85	82
9	>96	>84	>84	>84	>84	80	>84	>85	>85	82	>86	84
10	>96	84	82	82	83	>85	>84	>82	>85	82	>85	85

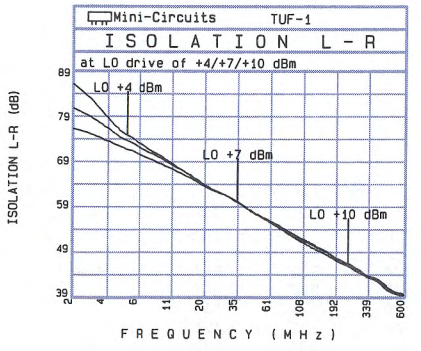
Harmonic LO Order

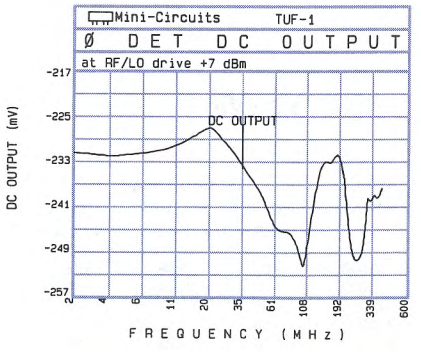
test condition: RF IN: 490.10 MHZ; -5.03 DBM
LO IN: 460.01 MHZ; +7.01 DBM
IF OUT: 30.09 MHZ; -10.93 DBM

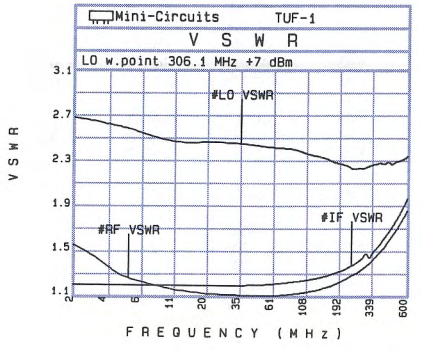
typical performance curves

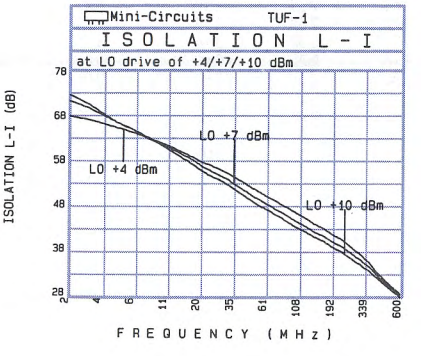
(production unit)

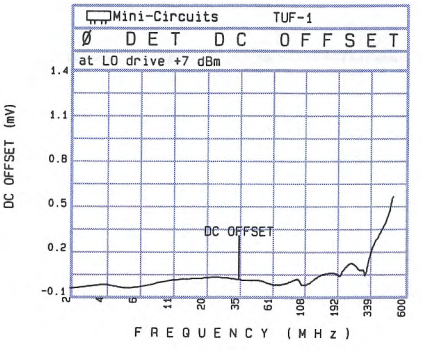












In Stock...Immediate Delivery

plug-in, surface-mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
TUF-2
TUF-2SM



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
50.000	80.000	6.51	6.03	5.83	60.07	61.24	61.91	62.57	62.94	62.41
100.000	70.000	6.66	6.12	5.88	54.20	55.20	55.87	59.27	58.22	56.88
129.167	99.167	6.55	6.03	5.82	52.12	53.19	53.99	58.02	56.36	55.21
200.000	170.000	6.34	5.94	5.79	48.54	49.63	50.34	55.06	53.04	51.66
208.333	178.333	6.44	5.97	5.80	48.33	49.40	50.10	55.05	52.95	51.62
287.500	257.500	6.40	5.98	5.81	45.90	46.76	47.52	51.28	49.61	48.05
340.278	310.278	6.33	5.94	5.79	44.50	45.51	46.16	48.97	47.70	46.65
366.667	336.667	6.30	5.91	5.76	44.03	45.07	45.72	47.78	46.56	45.82
445.833	415.833	6.23	5.88	5.72	42.62	43.51	44.19	44.52	43.99	43.72
498.611	468.611	6.35	5.96	5.81	42.00	42.80	43.42	43.31	42.71	42.05
500.000	470.000	6.37	5.98	5.82	42.01	42.81	43.43	43.31	42.75	42.09
551.389	521.389	6.41	6.04	5.87	41.60	42.43	42.87	42.09	42.00	41.59
630.556	600.556	6.56	6.27	6.00	41.07	41.96	42.40	39.80	39.82	39.98
683.333	653.333	6.75	6.36	6.13	40.40	41.15	41.84	38.94	38.97	38.72
709.722	679.722	6.82	6.45	6.21	39.93	40.66	41.36	38.17	38.42	38.14
788.889	758.889	6.92	6.59	6.41	39.16	39.89	40.44	36.74	37.39	37.67
868.056	838.056	7.28	6.81	6.62	38.76	39.69	40.25	35.45	36.49	37.33
947.222	917.222	7.54	7.04	6.85	38.55	39.66	40.23	34.36	34.99	35.77
973.611	943.611	7.88	7.23	6.99	38.69	39.91	40.57	34.48	34.80	35.50
1000.000	970.000	8.07	7.37	7.03	38.50	39.73	40.41	34.50	34.65	35.19

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
50.000	1.02	1.08	1.16	1.76	2.52	3.54	1.69	1.49	1.28	50.000	-235.28	-0.11
100.000	1.06	1.10	1.17	1.72	2.47	3.47	1.70	1.51	1.32	100.000	-246.85	0.00
145.000	1.09	1.12	1.19	1.70	2.42	3.38	1.73	1.55	1.36	129.167	-229.93	-0.02
200.000	1.14	1.17	1.23	1.68	2.35	3.27	1.77	1.61	1.44	200.000	-230.78	-0.04
259.000	1.19	1.22	1.27	1.66	2.31	3.17	1.83	1.68	1.53	208.333	-237.03	-0.04
316.000	1.25	1.27	1.32	1.68	2.32	3.19	1.90	1.76	1.62	287.500	-241.18	0.17
373.000	1.30	1.33	1.37	1.72	2.34	3.19	1.94	1.82	1.71	340.278	-229.30	0.17
400.000	1.34	1.36	1.40	1.72	2.32	3.14	1.96	1.85	1.74	366.667	-233.22	0.23
468.000	1.41	1.43	1.47	1.76	2.32	3.10	2.03	1.92	1.83	445.833	-244.79	0.44
500.000	1.45	1.47	1.50	1.80	2.34	3.10	2.06	1.95	1.86	498.611	-217.91	0.63
525.000	1.48	1.50	1.53	1.82	2.33	3.06	2.09	1.98	1.89	500.000	-217.41	0.68
601.000	1.58	1.58	1.61	1.90	2.37	3.07	2.13	2.02	1.95	551.389	-212.58	0.75
677.000	1.69	1.68	1.69	1.96	2.38	3.01	2.15	2.03	1.96	630.556	-215.80	1.06
734.000	1.79	1.76	1.77	1.99	2.35	2.94	2.23	2.08	2.02	683.333	-193.57	1.04
753.000	1.83	1.79	1.80	1.99	2.33	2.89	2.17	2.00	1.92	709.722	-200.21	1.09
829.000	1.99	1.94	1.93	2.06	2.34	2.86	2.20	2.02	1.93	788.889	-217.86	1.21
905.000	2.18	2.11	2.10	2.13	2.38	2.84	2.19	1.99	1.89	868.056	-168.57	1.41
962.000	2.39	2.31	2.28	2.17	2.42	2.84	2.20	1.97	1.86	947.222	-190.84	1.45
981.000	2.45	2.37	2.34	2.17	2.42	2.84	2.20	1.97	1.85	973.611	-183.66	1.49
1000.000	2.52	2.44	2.40	2.17	2.41	2.83	2.20	1.97	1.83	1000.000	-175.78	1.32

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	15	28	25	29	27	51	29	47	30	43
1	-	21	+0	29	12	34	18	39	39	45	44	38
2	96	71	66	71	64	69	62	67	72	> 74	66	72
3	> 96	> 75	75	> 75	72	72	67	> 75	69	> 74	70	> 75
4	95	> 75	> 74	> 75	> 75	> 75	> 76	> 75	> 75	> 74	> 74	> 74
5	> 95	> 74	> 74	> 74	> 75	> 75	> 76	> 75	> 75	> 75	> 75	> 75
6	> 96	> 75	> 54	> 74	> 75	> 75	73	> 75	> 76	75	75	> 76
7	> 96	> 74	74	> 74	73	74	75	71	> 76	> 76	> 75	> 75
8	> 96	73	> 74	> 74	72	74	> 75	> 76	> 75	> 76	74	72
9	> 95	> 75	74	> 74	> 73	> 74	> 74	74	> 75	> 75	> 75	73
10	95	> 75	> 75	> 75	> 75	> 75	> 74	> 74	> 74	> 76	> 76	> 75

Harmonic LO Order

test condition: RF IN: 490.10 MHZ; -14.94 DBM
LO IN: 460.01 MHZ; +7.01 DBM
IF OUT: 30.09 MHZ; -20.78 DBM

RF ORDER HARMONIC

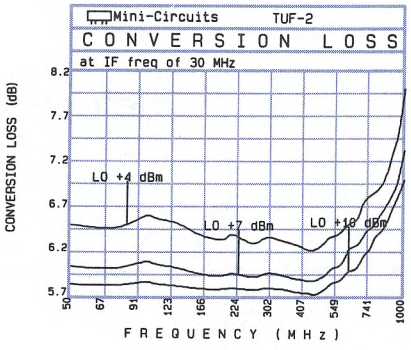
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	26	38	36	41	37	61	42	60	45	58
1	-	21	+0	29	12	34	19	42	38	50	50	43
2	95	64	55	65	54	67	56	59	63	72	58	67
3	95	60	55	60	55	59	48	72	52	57	55	62
4	> 96	82	> 85	76	84	80	76	80	71	83	78	84
5	> 95	80	77	82	66	76	59	71	58	77	57	71
6	> 95	> 85	> 74	80	82	85	82	85	81	85	81	> 85
7	> 95	> 85	81	> 85	84	84	85	> 85	84	82	82	83
8	> 97	> 85	83	> 85	> 84	> 85	> 85	> 85	> 86	> 86	85	> 86
9	> 96	> 86	> 86	> 85	83	> 83	> 85	> 86	> 85	> 86	> 86	> 86
10	> 96	> 86	> 85	84	> 85	82	> 85	> 85	81	> 84	85	> 86

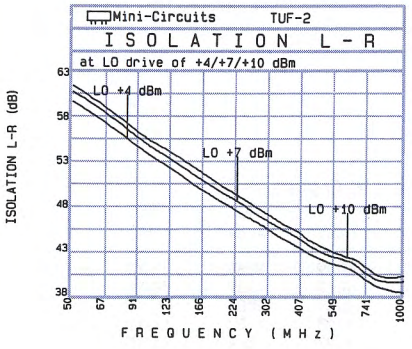
Harmonic LO Order

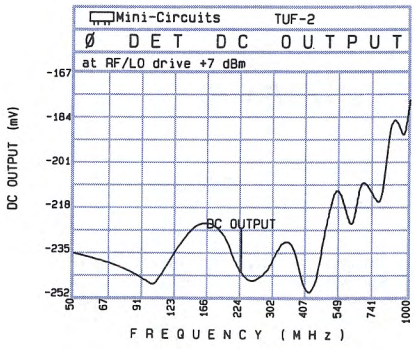
test condition: RF IN: 490.10 MHZ; -5.03 DBM
LO IN: 460.01 MHZ; +7.01 DBM
IF OUT: 30.09 MHZ; -10.59 DBM

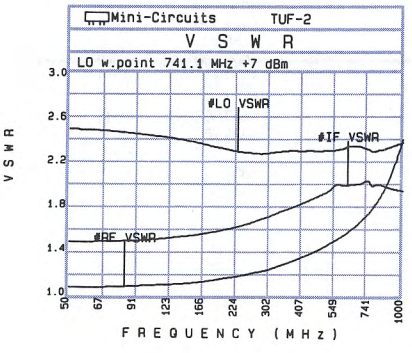
typical performance curves

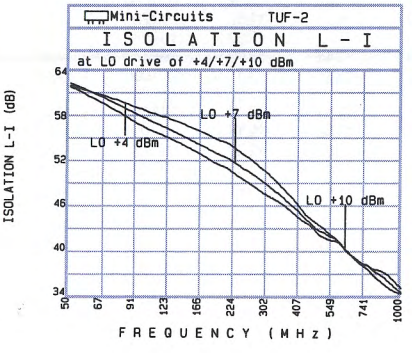
(production unit)

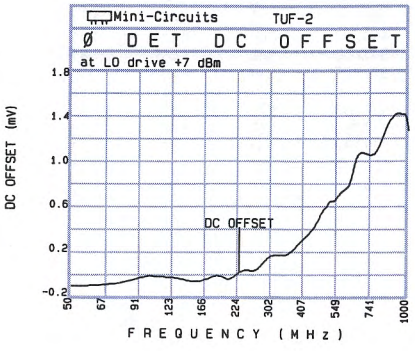












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

Model SCM-5

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
1250.000	1280.000	7.07	6.32	5.90	24.73	24.82	25.00	17.29	18.89	19.99
1298.529	1328.529	6.96	6.19	5.82	24.46	24.60	24.78	16.69	18.27	19.16
1330.882	1300.882	6.34	5.58	5.17	25.05	25.12	25.23	15.81	17.54	18.54
1347.059	1317.059	6.36	5.60	5.14	25.33	25.48	25.50	15.35	17.09	18.06
1379.412	1349.412	6.12	5.45	5.33	25.38	25.75	25.93	14.87	16.59	17.71
1411.765	1381.765	5.91	5.33	5.36	25.11	25.62	25.92	14.46	15.98	16.91
1444.118	1414.118	5.86	5.31	5.67	25.58	26.16	26.43	14.18	15.43	16.17
1460.294	1430.294	5.81	5.31	5.86	26.17	26.70	27.07	14.00	15.15	15.85
1500.000	1470.000	5.87	5.26	5.76	26.80	27.09	26.85	13.22	14.04	14.70
1541.177	1511.177	5.85	5.26	5.77	27.11	27.63	27.24	13.61	13.76	14.08
1557.353	1527.353	6.01	5.31	5.73	27.16	27.57	26.81	13.41	13.24	13.45
1589.706	1559.706	6.04	5.36	5.92	27.56	28.19	27.27	13.70	13.05	12.95
1622.059	1592.059	6.23	5.54	5.94	27.61	28.01	26.74	13.26	12.44	12.01
1654.412	1624.412	6.32	5.70	6.08	27.21	27.36	26.20	13.10	12.21	11.64
1670.588	1640.588	6.37	5.76	6.05	27.01	27.10	26.22	13.39	12.39	11.68
1702.941	1672.941	6.59	5.96	6.01	25.95	25.84	24.95	12.75	11.54	10.75
1751.471	1721.471	6.61	6.00	5.96	26.00	25.71	24.84	12.80	11.30	10.18
1767.647	1737.647	6.55	5.95	5.91	26.11	25.76	24.78	12.87	11.27	10.11
1783.824	1753.824	6.61	5.97	5.87	25.53	25.07	23.95	12.39	10.72	9.68
1800.000	1770.000	6.63	5.94	5.84	25.20	24.75	23.76	12.43	10.73	9.67

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
1250.000	3.60	2.97	2.47	8.72	10.89	12.80	5.000	2.29	1.92	1.68	1250.000	-106.06	10.73
1298.529	3.14	2.57	2.16	8.95	10.62	12.09	10.000	2.32	1.94	1.69	1298.529	-96.80	10.24
1330.882	2.80	2.31	1.93	9.23	10.69	12.09	20.000	2.34	1.95	1.70	1330.882	-90.34	10.32
1347.059	2.71	2.24	1.86	9.63	11.03	12.52	50.000	2.35	1.95	1.70	1347.059	-89.28	10.73
1379.412	2.47	2.00	1.67	10.69	11.77	13.09	52.903	2.36	1.95	1.70	1379.412	-79.96	10.62
1411.765	2.25	1.84	1.51	11.24	11.85	13.09	100.000	2.39	1.97	1.71	1411.765	-72.91	11.49
1444.118	2.09	1.69	1.38	11.24	11.69	12.52	100.807	2.39	1.97	1.71	1444.118	-65.61	12.83
1460.294	2.02	1.61	1.31	11.53	11.77	12.52	148.710	2.43	1.99	1.73	1460.294	-65.12	14.16
1500.000	1.88	1.51	1.21	12.44	12.44	12.80	196.613	2.43	1.98	1.72	1500.000	-59.72	16.09
1541.177	1.74	1.43	1.16	12.61	12.71	12.61	200.000	2.43	1.98	1.72	1541.177	-45.03	17.30
1557.353	1.72	1.42	1.16	12.35	12.52	12.44	244.516	2.41	1.97	1.71	1557.353	-41.41	17.69
1589.706	1.67	1.43	1.22	12.35	12.52	12.18	250.000	2.41	1.96	1.71	1589.706	-38.21	18.47
1622.059	1.67	1.47	1.30	12.35	12.52	12.09	260.484	2.39	1.96	1.71	1622.059	-33.29	18.99
1654.412	1.68	1.52	1.39	12.26	12.44	11.85	292.419	2.36	1.95	1.70	1654.412	-29.68	18.70
1670.588	1.70	1.56	1.44	12.18	12.26	11.77	324.355	2.32	1.92	1.68	1670.588	-32.21	19.75
1702.941	1.74	1.64	1.54	11.93	11.85	11.53	372.258	2.23	1.88	1.66	1702.941	-35.58	20.08
1751.471	1.85	1.78	1.71	11.61	11.31	11.09	404.194	2.18	1.87	1.64	1751.471	-34.03	17.75
1767.647	1.88	1.85	1.77	11.53	11.31	10.89	452.097	2.12	1.85	1.63	1767.647	-33.43	16.69
1783.824	1.93	1.90	1.82	11.46	11.17	10.19	484.032	2.08	1.83	1.63	1783.824	-34.51	16.04
1800.000	1.97	1.97	1.90	11.61	11.03	10.50	500.000	2.08	1.83	1.63	1800.000	-38.13	15.67

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Mini-Circuits

ULTRA•REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+17	14	2	40	33	37	29	60	58	53
1	-	12	0	29	27	37	31	37	43	48	> 63	61
2	> 96	45	28	34	26	51	35	45	46	52	43	62
3	> 96	52	55	45	41	47	65	57	50	54	62	55
4	88	> 68	71	69	54	55	58	74	62	65	63	> 68
5	90	> 70	> 69	74	> 76	70	69	65	73	71	67	> 69
6	> 89	> 68	68	> 69	> 75	> 75	74	73	71	71	> 76	> 68
7	> 90	> 69	67	> 69	67	> 75	> 75	> 75	> 75	> 75	> 75	> 74
8	> 84	> 63	> 68	> 68	68	67	> 75	> 75	> 75	> 76	> 76	> 75
9	> 84	> 63	> 63	67	> 68	> 69	> 68	> 76	> 75	> 75	71	> 75
10	> 84	> 64	> 63	> 63	> 68	66	> 68	67	> 75	> 76	> 75	> 76

Harmonic LO Order

test condition: RF IN:1700.10 MHZ; -15.05 DBM
LO IN:1670.01 MHZ; +6.94 DBM
IF OUT: 30.09 MHZ; -21.04 DBM

RF ORDER HARMONIC

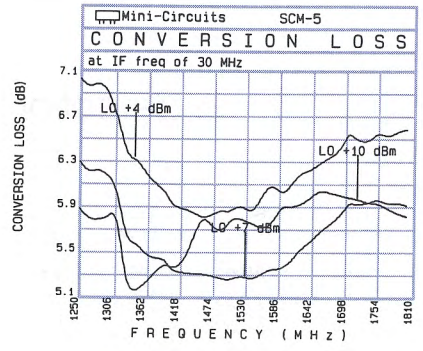
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+7	21	16	47	45	54	46	> 72	71	67
1	-	11	0	35	25	32	45	64	57	55	69	> 73
2	95	32	20	29	21	57	35	54	61	59	55	> 73
3	> 96	32	36	35	28	44	53	49	50	70	63	61
4	> 90	57	45	51	40	46	37	71	49	67	69	68
5	> 91	73	68	56	55	44	44	53	60	66	61	72
6	> 89	57	64	70	54	62	47	72	49	68	58	> 78
7	88	65	61	74	> 77	68	67	63	56	61	68	83
8	83	69	70	71	> 78	76	67	75	59	69	58	71
9	83	> 72	> 72	76	74	75	> 77	79	80	67	62	66
10	> 85	> 72	> 72	> 72	> 78	78	76	> 77	74	> 84	67	74

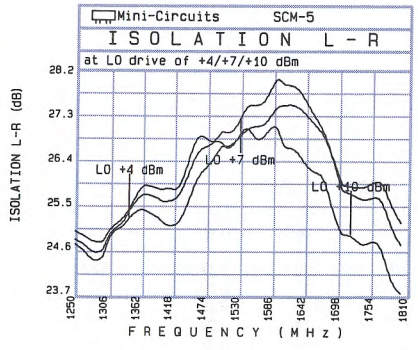
Harmonic LO Order

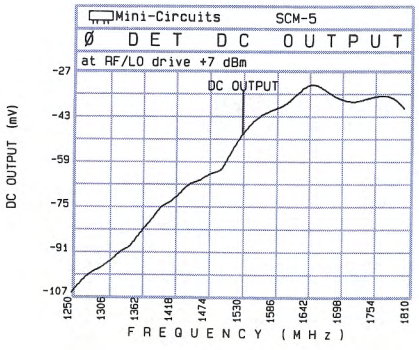
test condition: RF IN:1700.10 MHZ; -5.01 DBM
LO IN:1670.01 MHZ; +6.94 DBM
IF OUT: 30.09 MHZ; -11.57 DBM

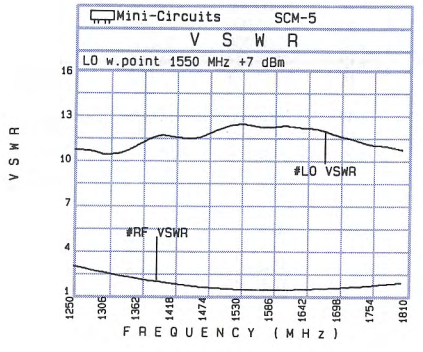
typical performance curves

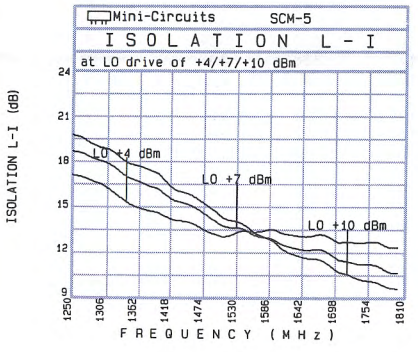
(production unit)

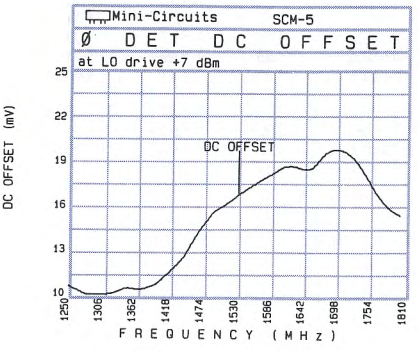












In Stock...Immediate Delivery

most widely-used

Frequency Mixers

Model SIMA-5

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
2.000	32.000	7.47	7.18	7.04	66.17	71.44	80.12	71.67	75.64	80.12
4.000	34.000	7.12	6.83	6.69	65.57	70.85	78.74	71.47	75.65	79.24
5.000	35.000	7.06	6.76	6.63	65.37	70.64	77.71	71.67	75.44	78.61
10.000	40.000	6.90	6.63	6.51	64.98	69.77	74.75	71.48	74.07	74.55
20.000	50.000	6.91	6.62	6.49	64.75	68.32	70.51	70.25	70.32	69.91
50.000	80.000	6.98	6.68	6.54	62.25	63.23	62.82	64.95	63.43	62.22
100.000	70.000	6.97	6.70	6.58	58.40	57.80	57.24	59.50	57.80	56.70
162.500	132.500	7.03	6.76	6.63	54.96	54.25	53.71	55.46	53.86	52.75
200.000	170.000	7.14	6.84	6.67	53.68	52.95	52.32	53.40	52.03	50.71
376.500	346.500	7.34	6.93	6.70	49.55	48.36	47.12	44.47	43.30	41.84
500.000	470.000	7.55	7.09	6.84	47.88	47.44	46.23	40.03	38.45	37.16
590.500	560.500	7.89	7.36	6.90	44.62	44.40	43.91	36.97	35.71	34.52
750.000	720.000	7.05	6.59	6.41	41.04	40.26	39.47	31.68	30.46	29.45
804.500	774.500	6.92	6.51	6.34	40.14	39.27	38.37	29.99	28.96	28.23
1000.000	970.000	6.82	6.55	6.51	37.81	36.88	35.60	25.61	24.67	24.06
1018.500	988.500	6.82	6.54	6.49	37.64	36.77	35.51	25.30	24.36	23.77
1232.500	1202.500	7.15	6.91	6.86	35.73	34.61	33.46	22.68	22.20	21.67
1393.000	1363.000	7.57	7.31	7.25	34.85	33.73	32.62	23.08	22.25	21.58
1446.500	1416.500	7.62	7.31	7.21	34.32	33.18	32.06	23.09	22.20	21.48
1500.000	1470.000	7.90	7.48	7.30	34.36	33.10	31.93	23.66	22.45	21.60

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.27	1.31	1.34	1.62	2.40	3.37	1.32	1.16	1.07	2.000	-232.95	-0.29
10.000	1.15	1.20	1.23	1.57	2.35	3.29	1.33	1.17	1.07	4.000	-234.52	-0.28
20.000	1.09	1.15	1.19	1.66	2.43	3.45	1.33	1.17	1.07	5.000	-233.65	-0.28
50.000	1.08	1.14	1.19	1.56	2.31	3.24	1.33	1.16	1.07	10.000	-233.60	-0.27
100.000	1.06	1.12	1.17	1.62	2.37	3.27	1.34	1.17	1.08	20.000	-230.71	-0.27
149.677	1.04	1.10	1.14	1.64	2.34	3.20	1.35	1.18	1.09	50.000	-249.38	-0.26
200.000	1.02	1.07	1.11	1.63	2.34	3.19	1.36	1.20	1.10	100.000	-237.65	-0.25
294.355	1.09	1.07	1.08	1.69	2.30	3.09	1.39	1.22	1.12	200.000	-250.36	-0.20
439.032	1.33	1.29	1.28	1.77	2.38	3.17	1.39	1.22	1.12	208.621	-246.95	-0.21
500.000	1.45	1.41	1.40	1.72	2.19	2.77	1.37	1.21	1.11	415.241	-221.16	0.09
583.710	1.63	1.59	1.59	1.78	2.25	2.83	1.31	1.16	1.07	500.000	-216.29	0.15
728.387	1.92	1.90	1.91	1.80	2.20	2.80	1.15	1.09	1.14	621.862	-211.78	0.40
750.000	1.96	1.96	1.95	1.85	2.32	3.03	1.11	1.08	1.16	750.000	-209.23	1.70
873.065	2.14	2.15	2.15	1.92	2.23	2.79	1.20	1.32	1.44	828.483	-205.28	2.97
1000.000	2.34	2.36	2.36	1.98	2.17	2.65	1.65	1.82	1.94	1000.000	-230.69	5.27
1017.742	2.38	2.40	2.40	1.99	2.16	2.62	1.74	1.92	2.05	1035.103	-220.81	5.94
1162.419	2.56	2.60	2.63	2.14	2.09	2.43	3.01	3.22	3.34	1241.724	-233.23	9.04
1307.097	2.60	2.64	2.68	2.15	1.95	2.16	5.07	5.22	5.36	1396.690	-214.06	10.27
1451.774	2.60	2.63	2.68	2.04	1.78	1.92	6.97	6.97	6.89	1448.345	-205.44	10.02
1500.000	2.65	2.64	2.69	1.95	1.71	1.89	7.31	7.25	7.17	1500.000	-218.56	9.39

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+3	16	14	27	51	53	40	55	36	57
1	-	12	+0	34	18	29	25	24	50	54	53	57
2	> 94	63	60	55	61	63	57	61	62	72	> 68	> 69
3	> 94	68	62	> 76	56	> 76	66	69	62	60	74	66
4	> 96	72	> 74	73	> 75	> 75	> 76	> 75	> 75	> 75	74	73
5	95	> 75	> 76	> 76	> 74	> 75	75	> 75	> 75	> 74	> 75	> 76
6	> 90	> 68	> 75	72	> 75	73	> 75	74	> 75	> 75	74	> 75
7	86	> 68	68	> 75	> 76	> 75	70	> 76	> 75	> 75	> 75	73
8	> 90	> 69	> 68	> 68	71	> 75	> 74	73	75	> 76	72	74
9	> 89	> 70	69	> 69	67	> 75	> 75	> 75	> 74	> 75	75	> 76
10	> 90	> 69	68	> 69	> 69	> 68	> 75	> 75	> 74	> 74	> 75	> 76

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -14.05 DBM
LO IN: 970.01 MHZ; +6.95 DBM
IF OUT: 30.09 MHZ; -20.53 DBM

RF ORDER HARMONIC

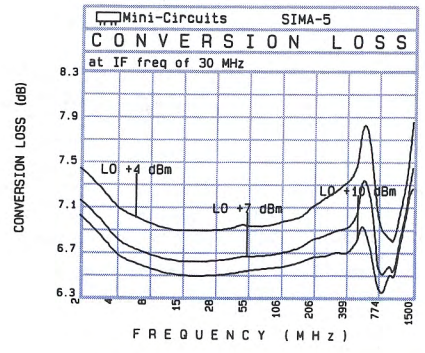
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	7	27	25	39	46	61	54	72	54	71
1	-	11	0	34	19	30	27	28	55	59	61	66
2	91	58	48	50	50	57	49	54	56	71	68	75
3	94	49	42	58	36	69	47	51	45	42	62	67
4	> 96	73	65	70	70	62	68	69	65	65	67	80
5	> 95	72	73	72	64	76	55	79	64	68	58	57
6	> 89	> 79	81	85	78	79	81	71	78	78	80	72
7	87	> 78	78	> 85	> 86	84	76	85	68	> 85	76	78
8	> 90	76	> 78	76	> 85	> 85	> 85	> 85	> 86	84	85	> 85
9	> 89	> 79	> 79	> 78	> 78	> 85	> 85	> 85	> 85	> 85	80	> 85
10	> 89	78	> 79	> 78	> 79	77	> 86	> 85	> 85	> 85	> 85	84

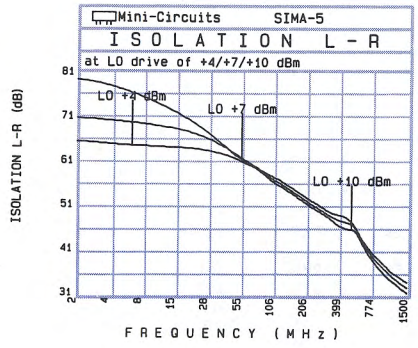
Harmonic LO Order

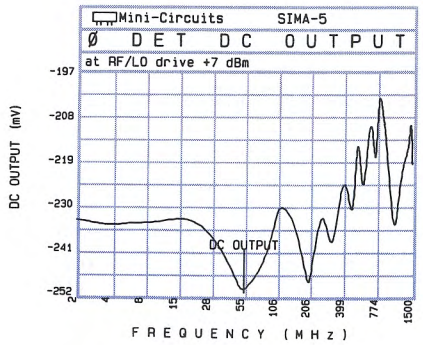
test condition: RF IN:1000.10 MHZ; -3.98 DBM
LO IN: 970.01 MHZ; +6.95 DBM
IF OUT: 30.09 MHZ; -10.50 DBM

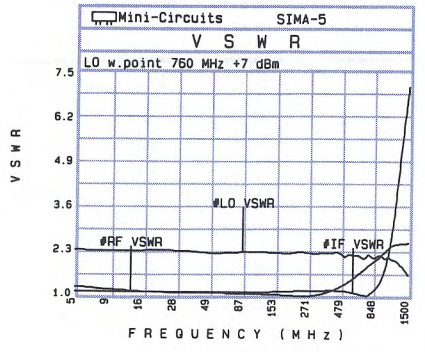
typical performance curves

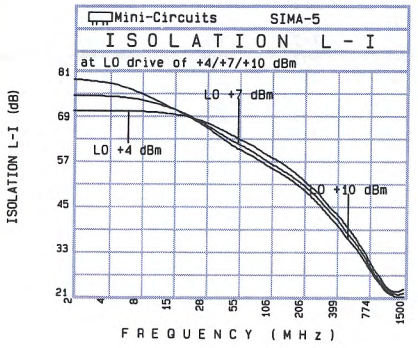
(production unit)

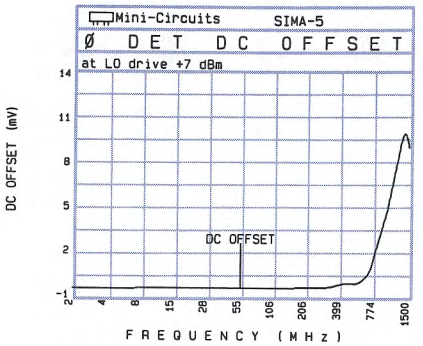












In Stock...Immediate Delivery

plug-in, surface-mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
TUF-3
TUF-3SM



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
0.150	30.150	5.84	5.60	5.46	82.59	77.37	74.58	60.69	63.67	66.98
0.200	30.200	5.75	5.52	5.39	83.04	77.64	74.35	60.44	63.64	66.75
0.300	30.300	5.69	5.47	5.33	82.49	77.00	74.12	60.19	63.40	66.52
0.500	30.500	5.64	5.41	5.28	81.86	76.78	74.01	60.36	63.48	66.51
1.000	31.000	5.54	5.31	5.20	80.26	76.45	73.66	60.46	63.55	66.86
1.500	31.500	5.47	5.25	5.14	80.37	75.88	73.40	60.37	63.58	66.40
2.000	32.000	5.44	5.22	5.10	79.14	75.76	73.07	60.34	63.46	66.57
5.000	35.000	5.44	5.19	5.06	77.84	74.18	72.40	60.54	63.18	65.20
10.000	40.000	5.46	5.21	5.07	74.42	72.35	70.36	59.32	61.65	63.66
20.000	50.000	5.44	5.19	5.07	69.83	68.26	67.08	59.13	60.76	61.68
50.000	80.000	5.39	5.19	5.08	62.13	60.65	59.84	54.30	54.03	53.94
77.044	107.044	5.40	5.20	5.10	58.01	56.86	55.86	49.93	50.29	50.76
100.000	70.000	5.52	5.26	5.13	56.31	54.74	53.67	47.96	48.45	48.86
153.939	123.939	5.44	5.27	5.18	53.29	50.70	49.21	44.86	45.02	44.64
200.000	170.000	5.50	5.33	5.24	46.94	45.62	45.07	44.33	43.77	42.57
230.833	200.833	5.58	5.38	5.26	47.41	46.53	47.19	42.19	41.53	40.76
300.000	270.000	5.79	5.57	5.45	50.32	49.67	45.53	41.24	37.33	34.73
369.242	339.242	6.25	5.94	5.74	50.19	48.35	38.52	45.32	36.42	32.36
384.621	354.621	6.31	5.93	5.68	44.96	48.35	42.68	39.40	33.54	29.97
400.000	370.000	6.44	5.93	5.62	45.50	56.18	47.40	36.15	32.89	29.89

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.27	1.21	1.22	1.81	2.60	3.64	1.67	1.41	1.23	0.150	243.74	-0.02
10.000	1.19	1.09	1.07	1.71	2.50	3.52	1.68	1.41	1.23	0.200	244.51	-0.02
20.000	1.20	1.07	1.03	1.57	2.32	3.27	1.69	1.43	1.24	0.300	245.19	-0.03
50.000	1.21	1.08	1.02	1.52	2.26	3.18	1.71	1.45	1.27	0.500	245.83	-0.03
65.557	1.21	1.08	1.02	1.51	2.24	3.17	1.73	1.46	1.29	1.000	247.57	-0.01
90.029	1.21	1.09	1.02	1.51	2.22	3.13	1.76	1.49	1.32	1.500	247.54	-0.02
100.000	1.21	1.09	1.02	1.50	2.21	3.10	1.77	1.51	1.34	2.000	247.08	-0.04
130.814	1.20	1.08	1.03	1.51	2.19	3.05	1.82	1.56	1.40	5.000	246.13	-0.03
163.443	1.20	1.08	1.02	1.52	2.17	2.98	1.88	1.63	1.48	10.000	243.89	-0.03
200.000	1.19	1.07	1.04	1.56	2.18	2.97	1.96	1.72	1.57	20.000	242.18	-0.01
204.229	1.19	1.07	1.04	1.57	2.18	2.97	1.98	1.73	1.57	50.000	256.04	-0.01
212.386	1.19	1.07	1.03	1.57	2.19	2.97	2.00	1.74	1.59	77.044	258.28	0.01
236.857	1.17	1.06	1.03	1.60	2.20	2.96	2.06	1.80	1.65	100.000	262.95	0.06
269.486	1.19	1.09	1.03	1.67	2.26	3.00	2.11	1.87	1.72	153.939	244.26	0.13
300.000	1.18	1.09	1.03	1.71	2.33	3.12	2.18	1.93	1.76	200.000	245.72	0.27
326.586	1.22	1.14	1.08	1.76	2.35	3.13	2.20	1.96	1.80	230.833	258.58	0.10
359.214	1.27	1.19	1.14	1.84	2.39	3.14	2.24	2.02	1.85	300.000	237.32	0.09
375.529	1.32	1.25	1.21	1.89	2.41	3.14	2.15	1.94	1.78	369.242	224.13	-0.05
391.843	1.39	1.31	1.28	1.95	2.45	3.15	2.20	1.99	1.82	384.621	226.89	0.29
400.000	1.40	1.32	1.29	1.98	2.49	3.18	2.21	2.01	1.83	400.000	227.14	0.78

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	15	25	15	32	17	37	22	48	29	46
1	-	14	+0	27	11	31	18	41	29	42	39	41
2	96	65	53	71	54	66	55	73	61	68	52	74
3	>96	65	63	65	64	66	58	75	58	67	61	75
4	96	75	>75	>77	75	75	>76	>76	>76	74	>77	75
5	>96	>76	75	>76	>77	>76	>76	>77	75	>77	>76	>76
6	94	>76	>56	>76	>76	>76	>76	>76	>77	75	75	>76
7	95	>76	>77	>76	>76	75	>77	>77	>76	>77	75	>76
8	>96	>76	>76	75	>76	>76	75	76	>76	>76	>76	75
9	>96	75	72	>76	>77	>76	>76	75	>74	>76	>77	>76
10	95	>76	>76	>76	72	>75	>76	>76	>76	>77	75	>76

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -15.08 DBM
LO IN: 155.01 MHZ; +7.07 DBM
IF OUT: 30.09 MHZ; -20.13 DBM

RF ORDER HARMONIC

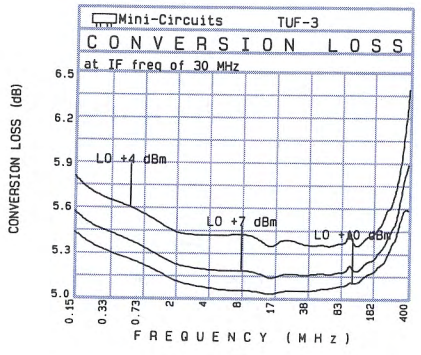
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	26	33	25	43	27	48	36	60	45	59
1	-	14	+0	27	11	33	18	39	29	46	41	47
2	81	64	54	77	54	68	57	80	69	58	46	71
3	95	51	46	49	49	54	50	54	50	54	56	57
4	>96	70	60	69	61	74	64	71	66	73	70	79
5	>96	75	64	66	68	69	59	64	55	66	53	68
6	>96	>86	>76	85	78	81	74	81	75	82	74	78
7	96	83	85	81	75	83	69	79	73	80	72	80
8	93	>86	>86	>86	>86	85	>86	85	>86	86	85	>86
9	>95	83	>85	>86	>86	>86	82	82	80	83	80	81
10	>96	>87	>85	85	>85	>86	>86	>86	85	>86	>86	85

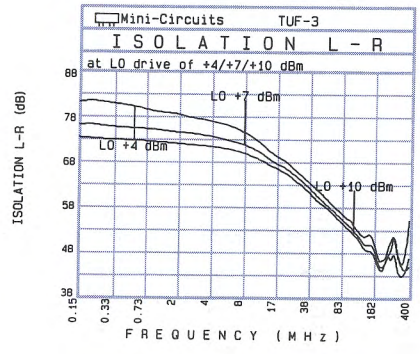
Harmonic LO Order

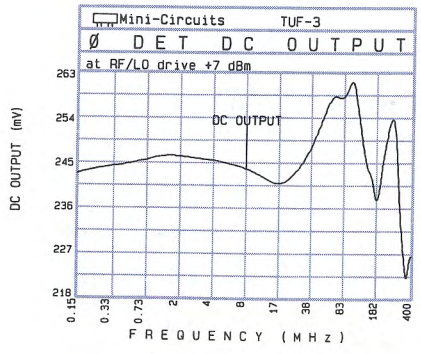
test condition: RF IN: 185.10 MHZ; -4.99 DBM
LO IN: 155.01 MHZ; +7.07 DBM
IF OUT: 30.09 MHZ; -10.07 DBM

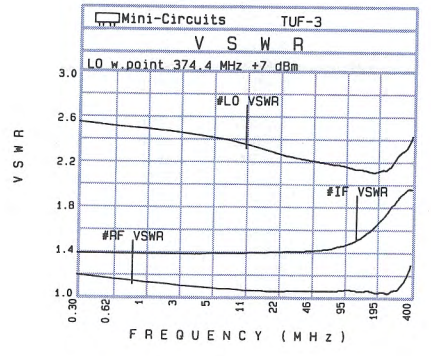
typical performance curves

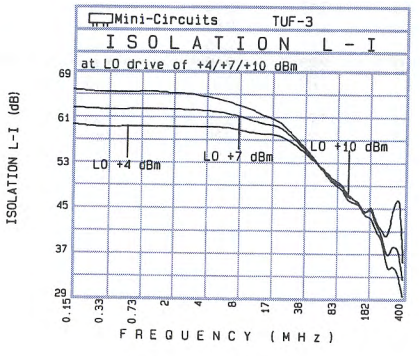
(production unit)

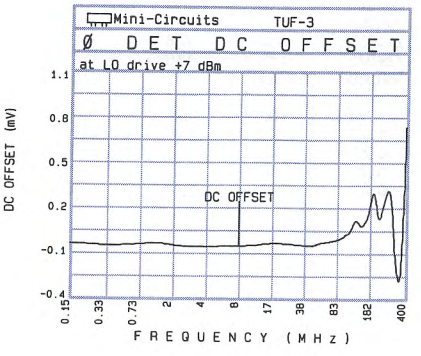












In Stock...Immediate Delivery

very high dynamic range

Frequency Mixers

Model SIMA-5H

LEVEL 17 (+17 dBm LO, up to +10 dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
2.000	32.000	7.47	7.20	7.14	78.46	78.18	78.07	74.46	71.38	68.12
4.000	34.000	7.23	6.92	6.86	77.08	76.93	76.54	73.78	70.73	67.75
5.000	35.000	7.18	6.86	6.78	76.88	75.95	75.35	73.68	70.75	67.66
10.000	40.000	6.98	6.73	6.66	73.50	72.17	71.64	72.70	69.37	66.85
20.000	50.000	7.03	6.72	6.64	68.76	67.37	67.13	69.96	67.87	66.11
50.000	80.000	7.05	6.71	6.64	60.95	59.93	59.62	63.28	62.42	61.67
100.000	70.000	7.00	6.75	6.67	54.79	54.27	53.84	56.59	56.40	55.94
162.500	132.500	7.01	6.81	6.73	51.24	50.46	50.19	52.23	52.07	52.17
200.000	170.000	7.19	6.94	6.79	49.73	48.77	48.60	50.32	50.41	50.29
376.500	346.500	7.45	7.07	6.84	45.43	43.97	43.39	44.35	43.09	42.61
500.000	470.000	7.60	7.32	7.04	43.82	42.46	41.78	41.11	39.34	38.67
590.500	560.500	8.33	7.84	7.27	42.64	41.96	41.05	38.85	38.16	37.41
750.000	720.000	7.49	7.10	6.81	39.98	38.19	37.20	35.91	34.48	33.25
804.500	774.500	7.28	6.83	6.65	39.81	37.85	36.71	35.01	33.39	32.27
1000.000	970.000	7.08	6.80	6.72	38.35	36.59	35.30	29.77	29.05	28.54
1018.500	988.500	7.04	6.78	6.71	38.19	36.20	34.97	29.44	28.58	28.11
1232.500	1202.500	7.19	6.95	6.93	35.00	33.05	31.66	27.61	26.99	26.23
1393.000	1363.000	7.53	7.26	7.22	33.93	31.84	30.44	28.50	27.40	26.62
1446.500	1416.500	7.65	7.26	7.18	32.85	31.02	29.43	27.77	27.35	26.45
1500.000	1470.000	7.70	7.31	7.16	33.07	30.42	29.14	28.05	27.05	26.58

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.26	1.30	1.33	1.54	2.25	3.07	1.32	1.16	1.05	2.000	-722.90	-0.43
10.000	1.18	1.22	1.26	1.50	2.21	3.05	1.33	1.16	1.06	4.000	-729.10	-0.42
20.000	1.13	1.19	1.22	1.60	2.27	3.11	1.33	1.17	1.06	5.000	-728.20	-0.42
50.000	1.12	1.18	1.21	1.53	2.21	3.06	1.33	1.16	1.06	10.000	-724.00	-0.41
100.000	1.11	1.17	1.20	1.55	2.22	2.97	1.35	1.18	1.08	20.000	-721.10	-0.39
149.677	1.10	1.15	1.19	1.56	2.18	2.94	1.37	1.20	1.11	50.000	-774.30	-0.34
200.000	1.09	1.13	1.16	1.56	2.17	2.80	1.39	1.22	1.13	100.000	-735.70	-0.27
294.355	1.08	1.08	1.10	1.61	2.12	2.76	1.42	1.26	1.17	200.000	-769.00	-0.11
439.032	1.15	1.10	1.07	1.60	2.03	2.60	1.43	1.28	1.21	208.621	-760.20	-0.09
500.000	1.21	1.17	1.15	1.66	2.09	2.46	1.43	1.29	1.22	415.241	-676.70	0.82
583.710	1.30	1.28	1.27	1.57	1.92	3.10	1.43	1.30	1.24	500.000	-629.20	1.04
728.387	1.45	1.46	1.47	1.64	1.97	2.88	1.41	1.33	1.30	621.862	-623.40	1.44
750.000	1.47	1.47	1.48	1.68	2.05	2.55	1.41	1.32	1.30	750.000	-636.10	4.36
873.065	1.58	1.59	1.61	1.81	2.01	2.39	1.53	1.50	1.53	828.483	-632.50	7.03
1000.000	1.70	1.73	1.74	1.89	1.91	2.27	1.83	1.90	1.97	1000.000	-701.80	10.15
1017.742	1.73	1.75	1.78	1.92	1.91	2.20	1.91	1.99	2.07	1035.103	-698.30	11.15
1162.419	1.91	1.95	1.98	2.10	1.80	1.97	3.06	3.26	3.34	1241.724	-690.30	12.70
1307.097	2.01	2.05	2.09	2.27	1.70	1.74	5.38	5.52	5.59	1396.690	-624.30	8.79
1451.774	2.05	2.09	2.13	2.30	1.58	1.48	7.17	7.08	7.00	1448.345	-611.00	7.87
1500.000	2.08	2.12	2.15	2.26	1.52	1.40	7.25	7.14	7.05	1500.000	-603.70	7.02

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	1	19	6	34	20	32	30	64	40	45
1	-	12	+0	32	16	37	26	34	41	46	50	53
2	93	62	68	56	58	61	55	63	56	64	60	> 77
3	> 95	68	58	74	53	73	60	77	64	69	70	75
4	> 96	83	76	78	83	78	76	80	76	82	80	> 84
5	> 96	> 84	81	> 84	82	> 84	81	> 84	> 84	> 83	83	> 84
6	> 90	> 78	83	> 84	> 84	> 83	83	> 86	> 85	83	> 84	83
7	> 90	> 77	> 77	> 84	83	> 83	> 84	> 84	> 84	> 85	83	> 83
8	> 90	76	> 78	> 77	> 85	84	> 84	> 84	> 85	84	> 85	83
9	89	> 78	> 78	76	76	> 85	> 84	81	83	> 85	> 85	> 85
10	> 90	> 78	> 78	> 78	> 78	76	> 86	> 84	> 84	> 83	> 85	> 85

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -5.04 DBM
LO IN: 970.01 MHZ; + 16.97 DBM
IF OUT: 30.09 MHZ; -11.54 DBM

RF ORDER HARMONIC

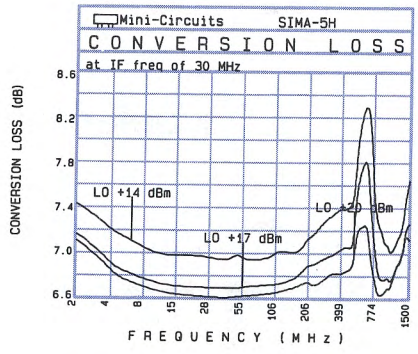
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	29	16	44	30	45	42	81	56	74
1	-	12	+0	32	16	37	27	36	45	51	57	59
2	77	59	58	57	62	63	45	62	52	58	56	80
3	87	52	44	59	38	59	46	71	48	52	57	63
4	95	78	71	70	71	65	62	69	61	70	65	75
5	95	90	72	71	63	73	56	67	62	68	63	66
6	> 89	> 87	79	86	78	80	85	74	74	79	72	77
7	87	> 87	> 87	90	82	85	75	86	70	77	77	76
8	> 91	87	> 88	> 87	88	93	86	87	> 95	83	84	91
9	> 90	87	> 88	> 88	86	> 94	91	> 94	85	94	83	86
10	88	> 88	> 88	87	> 88	> 88	> 94	> 94	90	91	94	87

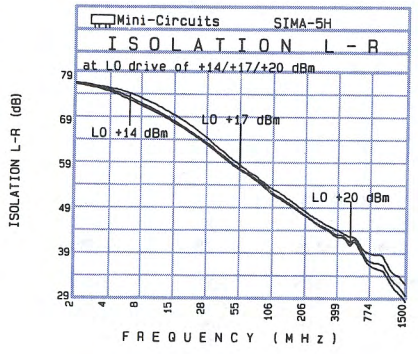
Harmonic LO Order

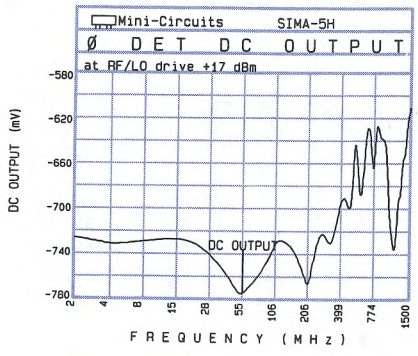
test condition: RF IN:1000.10 MHZ; +4.92 DBM
LO IN: 970.01 MHZ; + 16.97 DBM
IF OUT: 30.09 MHZ; -1.75 DBM

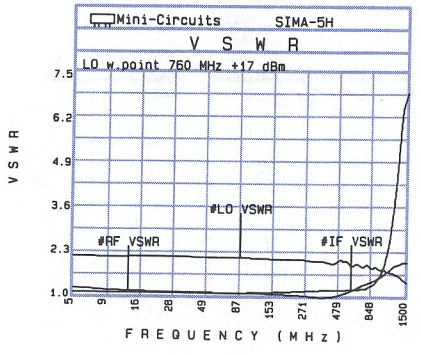
typical performance curves

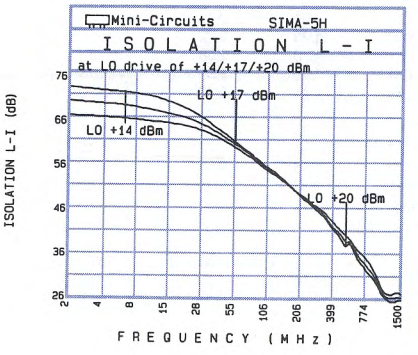
(production unit)

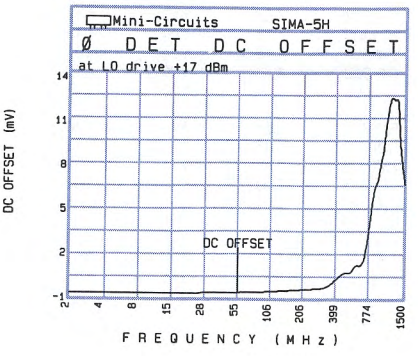












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
SIMA-5MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
2.000	32.000	7.44	7.16	6.98	67.33	67.57	67.96	74.93	70.97	69.36
4.000	34.000	7.15	6.84	6.67	66.85	66.81	67.11	73.75	70.21	68.31
5.000	35.000	7.12	6.80	6.62	66.85	66.99	67.24	73.45	69.69	68.14
10.000	40.000	6.90	6.67	6.45	66.17	66.21	66.09	70.37	67.01	64.94
20.000	50.000	7.02	6.70	6.47	66.03	65.57	64.87	65.73	62.90	60.95
50.000	80.000	7.12	6.77	6.52	62.55	61.02	59.92	57.90	55.09	53.64
100.000	70.000	6.96	6.72	6.51	57.61	55.91	54.97	51.39	48.94	47.99
162.500	132.500	7.01	6.80	6.61	55.30	53.26	51.81	47.99	45.83	44.67
200.000	170.000	7.25	6.95	6.65	54.18	52.23	50.21	46.92	44.77	43.31
376.500	346.500	7.65	7.02	6.66	51.79	49.05	46.22	41.30	39.25	37.29
500.000	470.000	7.99	7.27	6.92	50.36	47.59	46.64	35.54	35.15	34.94
590.500	560.500	8.89	7.75	6.96	46.00	44.36	43.19	33.38	33.14	33.15
750.000	720.000	7.30	6.76	6.43	42.99	39.92	37.49	29.09	29.30	28.98
804.500	774.500	7.19	6.69	6.37	41.94	39.55	37.37	27.56	28.09	27.85
1000.000	970.000	6.99	6.74	6.56	40.65	37.20	34.98	24.26	24.96	25.06
1018.500	988.500	6.98	6.77	6.62	40.55	37.06	34.57	24.07	24.73	24.82
1232.500	1202.500	7.48	7.09	7.03	37.67	34.04	31.65	23.71	24.13	24.05
1393.000	1363.000	8.00	7.65	7.55	36.17	32.16	30.02	24.88	24.40	24.49
1446.500	1416.500	8.28	7.77	7.63	34.88	31.47	29.20	24.79	24.32	24.37
1500.000	1470.000	8.52	7.94	7.75	35.41	31.37	29.37	25.48	24.68	24.92

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.62	1.30	1.33	1.39	2.06	2.89	1.62	1.36	1.23	2.000	-428.60	0.54
10.000	1.64	1.20	1.25	1.37	2.01	2.83	1.64	1.36	1.23	4.000	-432.40	0.53
20.000	1.64	1.16	1.22	1.49	2.08	2.96	1.64	1.37	1.23	5.000	-431.90	0.53
50.000	1.63	1.16	1.21	1.45	2.02	2.85	1.63	1.36	1.23	10.000	-427.90	0.52
100.000	1.66	1.14	1.20	1.46	2.02	2.82	1.66	1.38	1.25	20.000	-421.60	0.52
149.677	1.68	1.12	1.17	1.58	2.01	2.73	1.68	1.40	1.26	50.000	-454.80	0.54
200.000	1.71	1.09	1.14	1.66	1.96	2.72	1.71	1.42	1.29	100.000	-432.20	0.59
294.355	1.75	1.01	1.04	1.61	1.90	2.58	1.75	1.46	1.32	200.000	-454.50	0.82
439.032	1.73	1.19	1.18	1.74	1.95	2.49	1.73	1.48	1.33	208.621	-448.00	0.88
500.000	1.70	1.30	1.29	1.51	1.81	2.42	1.70	1.46	1.32	415.241	-405.60	2.26
583.710	1.61	1.46	1.46	1.54	1.83	2.27	1.61	1.41	1.30	500.000	-374.20	2.31
728.387	1.45	1.74	1.76	1.69	1.87	2.37	1.45	1.33	1.30	621.862	-370.10	2.91
750.000	1.42	1.78	1.80	1.70	1.83	2.55	1.42	1.31	1.30	750.000	-372.60	6.73
873.065	2.00	1.99	2.02	1.85	1.83	2.36	1.43	1.48	1.55	828.483	-377.80	9.11
1000.000	2.21	2.22	2.25	1.96	1.78	2.13	1.73	1.87	2.04	1000.000	-420.10	10.92
1017.742	2.24	2.26	2.28	1.99	1.75	2.09	1.80	1.96	2.13	1035.103	-408.70	11.06
1162.419	2.49	2.52	2.53	2.26	1.71	1.86	2.80	3.02	3.18	1241.724	-397.10	12.85
1307.097	2.61	2.65	2.70	2.25	1.58	1.60	4.11	4.24	4.23	1396.690	-355.60	8.05
1451.774	2.63	2.71	2.73	2.09	1.41	1.39	4.53	4.54	4.42	1448.345	-362.60	7.30
1500.000	2.63	2.71	2.74	2.01	1.36	1.32	4.47	4.50	4.37	1500.000	-373.60	7.62

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	0	20	12	26	21	35	34	50	39	60
1	-	12	+0	36	16	27	26	25	43	47	55	57
2	91	58	52	55	46	62	44	58	62	52	59	62
3	> 94	61	61	67	55	66	61	62	61	61	77	71
4	95	> 84	67	81	70	78	66	> 84	64	79	78	74
5	> 96	80	82	79	81	> 84	79	81	81	82	81	81
6	88	> 78	83	82	> 84	> 84	> 84	84	83	> 84	80	> 84
7	> 88	> 77	> 77	> 85	> 84	> 83	> 84	> 85	> 84	> 84	> 84	> 84
8	> 90	> 78	76	> 78	> 84	> 85	> 83	> 83	83	> 85	> 84	> 82
9	> 89	> 77	> 79	> 77	> 77	83	> 84	83	> 84	> 85	> 85	83
10	> 89	> 78	76	77	> 79	76	> 85	> 84	> 84	> 84	> 84	> 85

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -5.03 DBM
LO IN: 970.01 MHZ; +13.02 DBM
IF OUT: 30.09 MHZ; -11.67 DBM

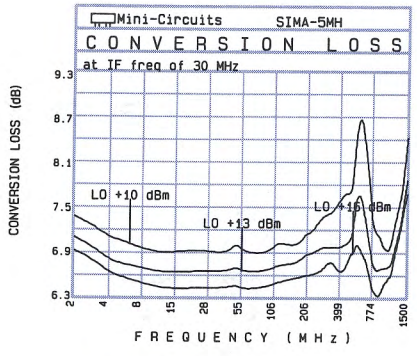
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	29	23	38	31	53	50	64	61	72
1	-	12	0	35	17	30	29	31	57	59	72	70
2	77	49	52	49	41	55	40	52	49	59	56	72
3	88	43	38	54	33	56	42	48	43	43	59	64
4	94	79	54	75	57	62	49	72	46	61	63	57
5	> 96	54	60	59	57	69	50	75	57	63	56	57
6	> 89	74	72	83	65	80	65	66	57	73	52	69
7	85	85	> 87	68	73	73	68	77	60	74	69	73
8	> 90	87	86	79	86	85	75	84	78	72	65	85
9	> 90	> 88	> 88	> 88	> 87	78	83	75	74	83	71	79
10	> 90	> 89	> 88	> 88	85	86	86	89	76	> 94	93	83

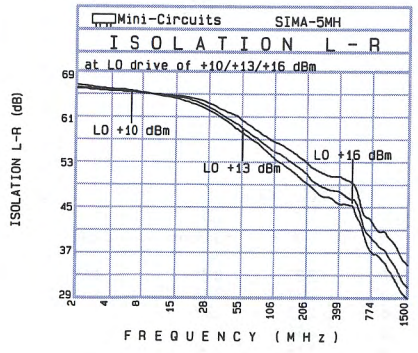
Harmonic LO Order

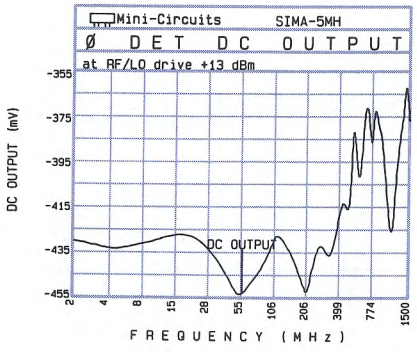
test condition: RF IN:1000.10 MHZ; +4.92 DBM
LO IN: 970.01 MHZ; +13.02 DBM
IF OUT: 30.09 MHZ; -1.77 DBM

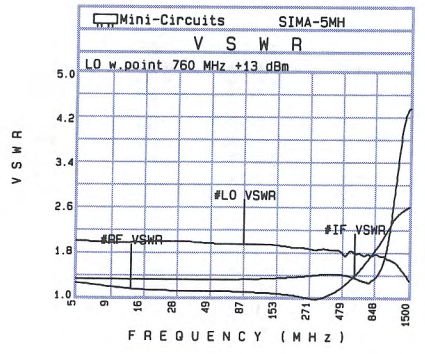
typical performance curves

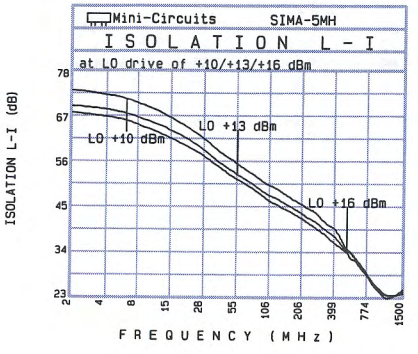
(production unit)

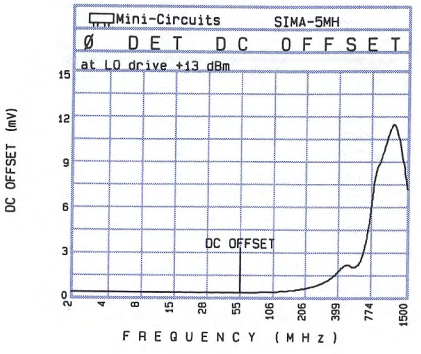












In Stock...Immediate Delivery

plug-in, surface-mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
TUF-5
TUF-5SM



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
20.000	50.000	6.33	5.76	5.50	69.02	69.06	68.24	50.16	50.01	49.77
40.000	70.000	6.11	5.54	5.27	63.58	63.75	63.61	46.13	45.70	45.41
50.000	80.000	6.00	5.44	5.20	61.66	61.73	61.60	44.11	43.88	43.72
100.000	70.000	5.94	5.38	5.14	56.16	56.05	55.78	38.85	38.99	38.98
158.750	128.750	5.96	5.40	5.19	52.34	52.30	51.82	36.10	36.23	35.74
200.000	170.000	5.91	5.41	5.20	50.15	49.90	48.79	34.62	34.38	33.79
297.500	267.500	6.12	5.58	5.33	47.03	46.54	45.34	31.74	31.36	30.79
436.250	406.250	6.40	5.81	5.52	45.66	46.39	47.22	28.23	28.70	28.59
500.000	470.000	6.57	5.94	5.63	45.24	46.35	47.53	26.79	27.70	27.93
575.000	545.000	6.79	6.28	5.78	44.28	45.43	46.69	25.50	26.65	27.62
713.750	683.750	7.45	6.65	6.23	42.95	43.76	44.80	23.58	25.47	27.32
750.000	720.000	7.62	6.73	6.29	42.81	43.43	44.23	23.20	25.18	27.28
852.500	822.500	7.67	6.83	6.35	41.93	42.21	42.70	22.64	24.77	26.98
991.250	961.250	7.85	7.20	6.70	40.44	40.31	40.22	21.27	22.85	24.04
1000.000	970.000	7.77	7.15	6.66	40.30	40.23	40.15	21.10	22.65	23.80
1130.000	1100.000	7.86	7.28	6.85	39.02	38.87	38.41	19.21	19.85	19.82
1268.750	1238.750	7.86	7.27	6.91	38.49	38.46	38.13	16.87	17.22	17.01
1407.500	1377.500	8.15	7.29	6.91	37.51	37.61	37.31	14.38	14.48	14.44
1453.750	1423.750	8.29	7.22	6.79	37.09	37.14	36.69	13.51	13.58	13.43
1500.000	1470.000	8.60	7.38	6.93	36.81	36.87	36.41	12.94	12.98	12.91

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
20.000	1.66	1.56	1.49	1.67	2.37	3.26	1.61	1.34	1.15	20.000	-227.32	0.17
50.000	1.56	1.44	1.35	1.63	2.31	3.18	1.61	1.34	1.15	40.000	-238.44	0.11
100.000	1.69	1.56	1.46	1.54	2.17	2.97	1.61	1.34	1.15	50.000	-242.56	0.10
200.000	1.75	1.62	1.51	1.54	2.16	2.94	1.62	1.34	1.16	100.000	-253.79	0.12
323.400	2.04	1.89	1.77	1.58	2.18	2.92	1.60	1.33	1.15	158.750	-229.69	0.16
401.100	2.28	2.12	1.99	1.63	2.20	2.90	1.58	1.31	1.15	200.000	-231.62	0.17
438.100	2.42	2.25	2.10	1.67	2.23	2.90	1.57	1.30	1.14	297.500	-238.47	0.33
552.800	2.84	2.65	2.48	1.77	2.27	2.88	1.51	1.26	1.11	436.250	-243.06	0.36
663.800	3.22	3.02	2.85	1.88	2.33	2.87	1.42	1.19	1.07	500.000	-208.99	0.46
741.500	3.45	3.26	3.10	1.93	2.35	2.85	1.35	1.13	1.05	575.000	-217.27	0.70
778.500	3.53	3.36	3.19	1.97	2.38	2.88	1.30	1.10	1.05	713.750	-202.23	0.92
815.500	3.60	3.43	3.29	2.03	2.42	2.91	1.26	1.07	1.08	750.000	-217.23	1.22
930.200	3.75	3.60	3.46	2.20	2.54	2.97	1.10	1.08	1.20	852.500	-189.86	0.76
1044.900	3.76	3.65	3.53	2.41	2.71	3.09	1.10	1.28	1.42	991.250	-185.84	0.51
1118.900	3.79	3.65	3.55	2.58	2.84	3.19	1.24	1.43	1.58	1000.000	-183.93	0.55
1159.600	3.79	3.62	3.54	2.68	2.90	3.24	1.34	1.55	1.71	1130.000	-196.56	1.95
1270.600	3.73	3.58	3.50	3.02	3.10	3.38	1.74	1.97	2.14	1268.750	-202.24	4.70
1385.300	3.66	3.50	3.42	3.48	3.39	3.57	2.32	2.57	2.75	1407.500	-169.06	5.38
1463.000	3.58	3.42	3.35	3.91	3.62	3.67	2.77	3.00	3.18	1453.750	-184.80	9.35
1500.000	3.54	3.39	3.32	4.09	3.76	3.76	3.06	3.30	3.48	1500.000	-159.22	8.52

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	24	8	36	17	48	36	50	47	42
1	-	30	+0	44	27	38	36	60	39	60	47	51
2	94	> 74	47	68	46	68	50	67	52	73	65	> 68
3	95	70	69	73	57	73	65	> 75	66	> 74	67	68
4	> 97	> 75	> 74	> 73	> 75	> 75	73	> 74	> 74	74	> 74	> 73
5	> 97	> 74	73	> 72	> 74	> 74	> 75	> 74	73	> 73	> 74	73
6	> 97	> 74	> 52	> 74	> 74	> 74	74	> 74	> 74	73	73
7	89	64	> 75	73	> 74	> 74	72	> 74	> 75	74	> 75	> 75
8	> 91	68	66	> 75	> 75	> 74	> 74	72	> 75	> 75	> 75	> 74
9	> 91	> 69	> 69	> 67	> 75	> 74	74	> 73	71	> 74	> 74	74
10	91	> 69	> 70	67	66	> 75	73	> 74	> 74	> 73	74	> 75

Harmonic LO Order

test condition: RF IN: 945.10 MHZ; -14.94 DBM
LO IN: 915.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -21.95 DBM

RF ORDER HARMONIC

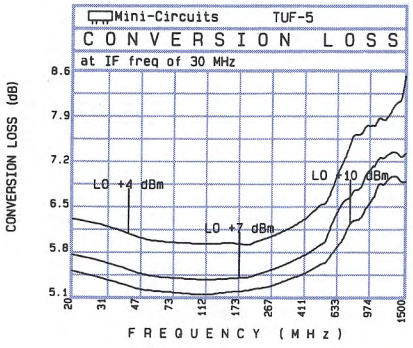
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	34	19	49	30	56	46	69	64	62
1	-	30	0	46	27	41	40	64	46	69	57	65
2	76	64	41	61	40	64	44	63	48	79	60	71
3	> 96	53	53	66	38	64	48	59	50	82	56	73
4	> 96	81	68	75	56	74	55	73	60	73	61	81
5	> 96	> 84	71	75	72	75	55	74	62	73	65	> 84
6	94	83	72	84	80	82	67	> 84	65	> 84	73	81
7	82	76	> 85	> 84	84	> 85	> 84	> 84	71	82	75	> 84
8	> 91	78	> 78	> 85	> 84	> 84	> 84	> 84	78	> 84	75	> 84
9	> 91	78	> 79	76	> 85	> 84	> 84	> 84	> 84	> 85	81	83
10	> 92	78	79	> 80	75	> 85	83	> 85	> 84	> 83	83	> 85

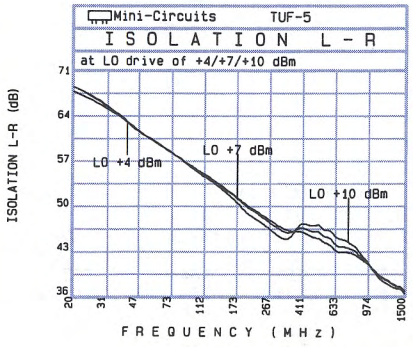
Harmonic LO Order

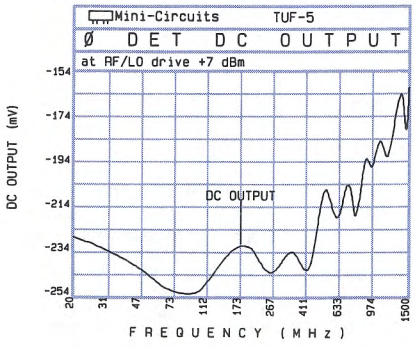
test condition: RF IN: 945.10 MHZ; -5.01 DBM
LO IN: 915.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -11.88 DBM

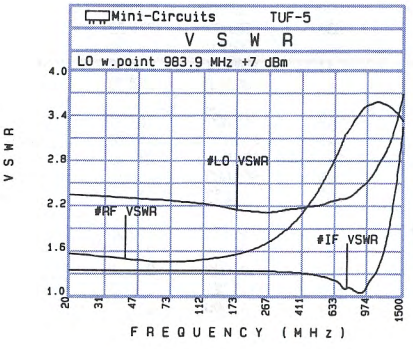
typical performance curves

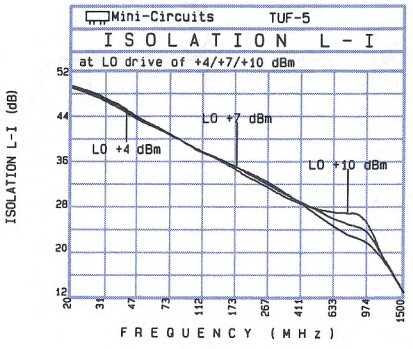
(production unit)

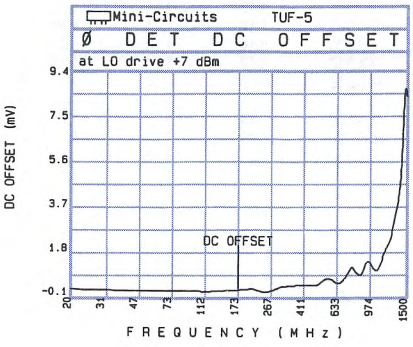












In Stock...Immediate Delivery

broadband high dynamic range
Frequency Mixers

Model
LMX-1481

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
3.000	33.000	7.14	6.60	6.34	64.01	67.32	50.75	56.77	56.71	56.67
6.000	36.000	7.01	6.47	6.22	63.18	66.32	52.34	55.97	55.19	54.77
10.000	40.000	6.97	6.42	6.18	63.38	66.86	53.61	54.84	53.60	52.46
20.000	50.000	6.98	6.46	6.22	63.34	66.82	52.59	51.99	49.63	48.11
30.000	60.000	7.01	6.54	6.35	63.47	66.65	52.59	49.97	47.18	45.41
50.000	80.000	7.17	6.62	6.35	63.09	66.07	48.15	45.96	42.87	41.05
100.000	70.000	7.13	6.61	6.38	61.06	63.12	45.79	40.78	37.52	35.91
149.267	119.267	7.11	6.54	6.35	59.05	60.28	42.70	38.24	35.16	33.72
200.000	170.000	7.01	6.52	6.36	57.59	58.40	41.69	36.55	33.75	31.74
295.533	265.533	6.94	6.56	6.39	56.76	56.16	38.59	34.68	31.40	29.10
441.800	411.800	7.07	6.64	6.42	50.72	48.00	39.81	27.96	26.80	25.31
514.933	484.933	7.10	6.66	6.44	48.85	45.79	42.84	25.67	25.09	24.28
550.000	520.000	7.12	6.68	6.47	46.48	43.84	44.82	24.73	24.33	23.40
588.067	558.067	7.13	6.66	6.46	45.05	42.95	50.33	23.75	23.48	22.81
734.333	704.333	7.54	6.91	6.53	39.67	39.00	38.01	19.81	20.31	20.02
880.600	850.600	8.21	7.30	6.70	37.05	37.65	37.16	17.41	18.47	18.55
1000.000	970.000	8.40	7.57	7.03	33.64	34.80	35.13	16.25	17.41	17.81
1026.867	996.867	8.54	7.70	7.21	32.89	34.29	34.91	16.02	17.31	17.80
1063.433	1033.433	8.59	7.90	7.35	31.43	32.77	33.24	15.66	16.86	17.34
1100.000	1070.000	8.82	8.13	7.66	30.34	31.95	32.78	15.35	16.74	17.33

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
3.000	1.33	1.38	1.44	1.83	2.58	3.64	2.02	1.62	1.36	3.000	-269.18	-0.41
6.000	1.17	1.25	1.31	1.69	2.48	3.56	2.03	1.62	1.37	5.000	-270.30	-0.40
10.000	1.12	1.21	1.29	1.56	2.34	3.38	2.04	1.63	1.37	6.000	-270.11	-0.46
20.000	1.11	1.21	1.29	1.60	2.39	3.46	2.04	1.63	1.37	10.000	-273.41	-0.43
30.000	1.12	1.22	1.30	1.58	2.36	3.41	2.04	1.63	1.37	20.000	-263.78	-0.41
50.000	1.13	1.24	1.31	1.57	2.35	3.37	2.04	1.63	1.37	30.000	-265.36	-0.38
100.000	1.14	1.24	1.32	1.52	2.26	3.24	2.04	1.63	1.38	50.000	-279.32	-0.37
200.000	1.14	1.24	1.31	1.49	2.20	3.13	2.04	1.65	1.42	100.000	-286.36	-0.39
244.340	1.14	1.24	1.31	1.54	2.29	3.25	2.05	1.65	1.43	159.714	-265.18	-0.34
365.010	1.13	1.22	1.30	1.59	2.30	3.20	2.01	1.65	1.47	200.000	-278.20	-0.36
485.680	1.14	1.20	1.28	1.68	2.35	3.19	1.93	1.61	1.47	316.429	-286.56	-0.11
550.000	1.19	1.23	1.29	1.74	2.38	3.19	1.89	1.59	1.47	473.143	-247.56	0.48
584.410	1.22	1.25	1.31	1.75	2.37	3.14	1.85	1.57	1.45	500.000	-239.03	0.55
639.260	1.29	1.30	1.35	1.82	2.43	3.19	1.82	1.54	1.43	550.000	-256.74	0.86
759.930	1.49	1.47	1.49	1.92	2.49	3.19	1.69	1.43	1.32	629.857	-251.19	0.42
891.570	1.78	1.75	1.76	1.94	2.44	3.08	1.55	1.29	1.17	786.571	-209.25	0.70
1000.000	2.16	2.10	2.09	1.99	2.43	3.04	1.43	1.18	1.05	943.286	-217.02	2.15
1034.180	2.30	2.23	2.22	2.04	2.50	3.12	1.40	1.15	1.04	1000.000	-216.18	2.36
1067.090	2.44	2.36	2.35	2.08	2.50	3.09	1.35	1.12	1.06	1060.821	-234.55	4.40
1100.000	2.61	2.52	2.50	2.09	2.46	3.02	1.31	1.10	1.09	1100.000	-211.59	5.34

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	14	+1	19	29	35	14	48	31	44
1	-	20	+0	37	13	35	25	54	59	67	50	58
2	94	62	43	67	42	69	43	66	60	70	59	69
3	95	72	71	73	70	> 74	67	> 74	73	> 73	> 73	72
4	> 96	> 73	> 74	> 73	> 74	> 75	> 75	> 75	> 75	> 73	72	71
5	94	> 73	73	> 75	> 74	74	> 75	71	73	74	72	> 74
6	> 96	> 73	> 51	73	73	> 75	> 75	> 74	> 75	> 74	> 74	> 73
7	> 95	73	72	> 73	> 74	> 74	73	74	74	74	> 75	71
8	> 95	> 74	> 73	> 73	> 71	> 73	> 75	> 75	74	74	> 75	> 75
9	> 96	> 74	> 74	> 75	> 73	> 73	> 73	> 74	> 75	> 75	> 74	> 74
10	> 96	> 74	69	73	> 74	> 74	> 74	> 74	73	> 74	> 75	> 75

Harmonic LO Order

test condition: RF IN: 490.10 MHZ; -15.00 DBM
LO IN: 460.01 MHZ; + 10.00 DBM
IF OUT: 30.09 MHZ; -21.58 DBM

RF ORDER HARMONIC

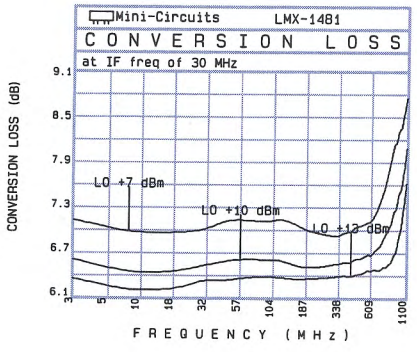
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	5	24	10	30	39	47	26	58	44	57
1	-	20	+0	36	13	35	26	57	52	69	51	60
2	95	51	34	56	33	61	34	56	51	64	50	63
3	95	56	55	57	54	61	49	65	62	71	62	> 84
4	> 96	80	70	75	66	69	65	74	62	74	77	80
5	> 95	> 84	81	> 84	74	81	72	81	72	82	77	> 84
6	> 95	> 84	> 72	> 84	> 84	> 85	80	> 85	81	> 85	78	> 84
7	> 95	> 84	82	> 83	> 84	84	84	84	> 85	> 85	> 85	> 85
8	> 97	83	84	> 83	> 84	> 84	83	> 84	83	> 86	> 85	> 85
9	> 96	> 83	> 84	> 84	> 84	> 84	81	> 84	84	> 85	82	84
10	> 96	84	82	82	> 85	> 84	> 84	83	> 84	> 84	> 85	> 85

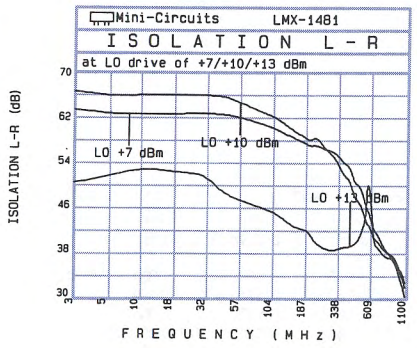
Harmonic LO Order

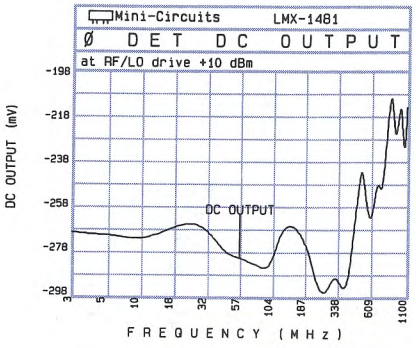
test condition: RF IN: 490.10 MHZ; -5.03 DBM
LO IN: 460.01 MHZ; + 10.06 DBM
IF OUT: 30.09 MHZ; -11.38 DBM

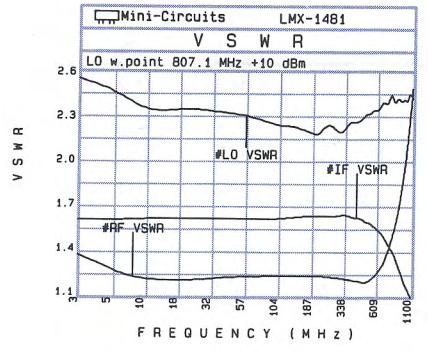
typical performance curves

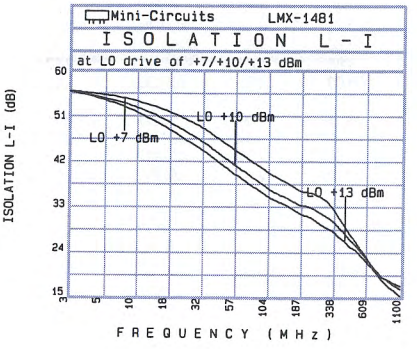
(production unit)

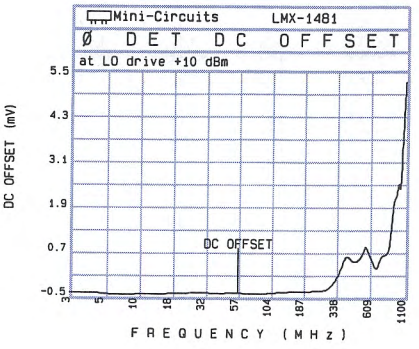












In Stock...Immediate Delivery

low LO power

Frequency Mixers

LEVEL 3 (+3 dBm LO, up to −3 dBm RF)

Models

RMS-5L
RMS-2L
LRMS-5L
LRMS-2L



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO + 0 dBm	LO + 3 dBm	LO + 6 dBm	Isolation L-R (dB) LO + 0 dBm	LO + 3 dBm	LO + 6 dBm	Isolation L-I (dB) LO + 0 dBm	LO + 3 dBm	LO + 6 dBm
400.000	430.000	8.66	7.74	7.20	45.46	39.94	36.72	24.05	28.82	37.26
476.923	506.923	7.78	6.92	6.36	62.86	43.12	37.83	23.06	28.11	37.19
553.846	583.846	7.38	6.37	5.88	42.17	56.16	42.66	22.44	27.98	34.31
605.128	635.128	7.31	6.19	5.62	35.40	41.52	49.39	22.31	27.30	31.00
630.769	660.769	7.29	6.10	5.53	33.19	37.96	44.09	22.11	26.89	29.79
707.692	737.692	7.31	5.93	5.24	26.55	29.29	32.70	21.20	24.68	25.30
733.333	763.333	7.29	5.89	5.20	25.16	27.74	30.80	20.90	24.04	24.60
810.256	840.256	7.19	5.81	5.13	21.99	24.32	26.65	19.83	21.96	21.48
835.897	865.897	7.26	5.95	5.22	21.36	23.55	25.64	19.66	21.29	20.21
887.180	917.180	7.41	6.28	5.55	20.36	22.39	24.29	19.24	20.26	18.77
912.821	942.821	7.27	6.26	5.56	19.91	21.89	23.56	18.82	19.74	18.14
989.744	959.744	7.67	6.84	6.15	18.83	20.56	21.86	17.29	17.73	16.22
1066.667	1036.667	7.78	7.26	6.69	17.90	19.47	20.59	15.29	15.58	14.42
1117.949	1087.949	7.84	7.40	6.99	17.43	18.97	20.08	14.11	14.31	13.41
1143.590	1113.590	8.15	7.64	7.35	17.16	18.77	19.92	13.50	13.78	12.95
1220.513	1190.513	8.36	7.63	7.41	16.55	18.25	19.45	12.04	12.26	11.30
1297.436	1267.436	8.73	7.75	7.47	16.05	17.96	19.40	10.74	10.95	10.27
1348.718	1318.718	8.96	7.73	7.47	15.83	17.87	19.45	9.84	10.20	9.64
1374.359	1344.359	9.16	7.64	7.32	15.81	17.90	19.58	9.40	9.72	9.22
1400.000	1370.000	9.33	7.79	7.46	15.74	17.92	19.67	8.95	9.13	8.78

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO + 0 dBm	LO + 3 dBm	LO + 6 dBm	VSWR LO port LO + 0 dBm	LO + 3 dBm	LO + 6 dBm	FREQ. (MHz)	VSWR IF port LO + 0 dBm	LO + 3 dBm	LO + 6 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
400.000	1.53	1.50	1.47	1.32	1.45	1.67	1.000	2.65	2.10	1.73	400.000	142.20	-3.39
477.500	1.44	1.40	1.36	1.40	1.53	1.71	2.000	2.65	2.11	1.74	475.000	143.89	-3.99
500.000	1.42	1.38	1.34	1.43	1.56	1.73	5.000	2.66	2.11	1.74	500.000	147.80	-4.34
580.000	1.33	1.28	1.23	1.51	1.64	1.77	10.000	2.67	2.12	1.74	575.000	147.54	-4.94
657.500	1.25	1.19	1.15	1.60	1.71	1.81	20.000	2.61	2.09	1.79	650.000	153.50	-4.93
707.500	1.23	1.16	1.12	1.65	1.75	1.83	50.000	2.67	2.13	1.75	700.000	148.82	-4.06
732.500	1.22	1.17	1.12	1.68	1.78	1.85	100.000	2.69	2.14	1.77	725.000	151.91	-3.25
760.000	1.22	1.17	1.13	1.72	1.80	1.85	156.000	2.68	2.15	1.80	750.000	153.86	-2.53
800.000	1.21	1.18	1.14	1.77	1.85	1.89	200.000	2.67	2.17	1.83	800.000	155.38	-0.83
862.500	1.22	1.20	1.17	1.86	1.93	1.95	267.000	2.65	2.18	1.87	850.000	143.16	1.10
937.500	1.25	1.24	1.22	1.99	2.03	2.00	356.000	2.56	2.17	1.91	925.000	142.71	3.74
1000.000	1.26	1.26	1.25	2.13	2.10	2.04	400.000	2.49	2.14	1.94	1000.000	146.75	7.02
1040.000	1.27	1.27	1.26	2.21	2.18	2.09	423.000	2.45	2.11	1.92	1025.000	142.23	7.68
1092.500	1.28	1.29	1.29	2.33	2.28	2.14	467.000	2.37	2.06	1.91	1075.000	141.82	7.20
1117.500	1.29	1.30	1.30	2.39	2.34	2.16	500.000	2.31	2.04	1.92	1100.000	153.67	7.35
1200.000	1.31	1.32	1.32	2.60	2.51	2.25	578.000	2.14	1.92	1.88	1175.000	152.39	8.63
1272.500	1.31	1.32	1.32	2.81	2.68	2.33	667.000	1.92	1.78	1.82	1250.000	154.48	9.41
1347.500	1.33	1.33	1.34	2.99	2.89	2.46	750.000	1.72	1.64	1.77	1325.000	154.45	9.87
1375.000	1.34	1.34	1.35	3.06	2.98	2.52	778.000	1.65	1.62	1.77	1375.000	142.31	11.36
1400.000	1.35	1.35	1.35	3.12	3.06	2.57	800.000	1.60	1.58	1.76	1400.000	151.00	12.56

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+9	1	7	15	29	32	53	40	31	40
1	-	9	+0	18	29	28	36	40	51	57	52	39
2	>96	42	36	37	36	50	56	45	54	61	58	59
3	>96	65	64	54	62	54	68	60	63	65	>70	61
4	>97	>70	69	68	>70	70	>70	>69	>70	68	>69	>71
5	>97	>70	>71	>70	>70	>71	>70	>71	67	>71	69	>69
6	>96	>70	>44	>71	>70	>70	70	>70	69	>70	69	69
7	89	63	69	>70	>70	>70	>69	>70	>71	>70	68	>70
8	>91	>65	63	>69	>70	>70	>70	69	>70	>70	70	>69
9	>91	>66	63	>64	>69	68	>70	69	>69	70	70	>71
10	91	>65	>65	>65	>64	>70	68	>68	>71	>70	>71	70

Harmonic LO Order

test condition: RF IN: 910.10 MHZ; -19.93 DBM
LO IN: 940.01 MHZ; +2.96 DBM
IF OUT: 29.91 MHZ; -26.16 DBM

RF ORDER HARMONIC

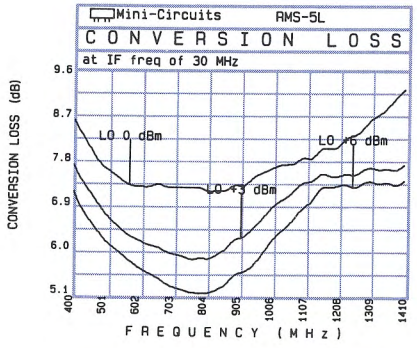
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	1	13	20	29	38	56	57	60	67	60
1	-	10	0	19	32	31	39	52	61	64	58	51
2	85	33	27	30	26	44	54	42	52	63	63	63
3	94	50	50	37	48	40	54	48	53	58	65	62
4	>98	61	66	57	58	47	71	62	58	55	62	65
5	95	>79	75	77	72	56	61	59	72	65	59	67
6	>96	78	62	80	>80	>79	66	65	72	77	68	67
7	88	>75	>79	>79	80	>80	79	78	71	74	>79	78
8	>90	>74	>75	79	>80	>80	79	79	73	77	>80	>79
9	>92	>75	71	>75	>80	79	79	>82	>80	79	>80	>81
10	>91	>75	74	>74	>74	>80	79	>80	>80	>79	79	80

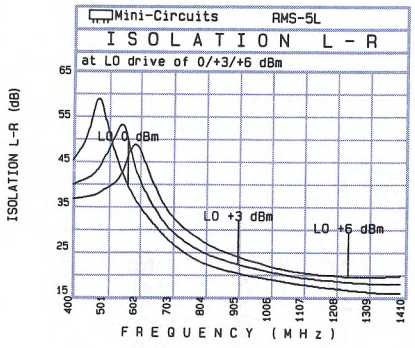
Harmonic LO Order

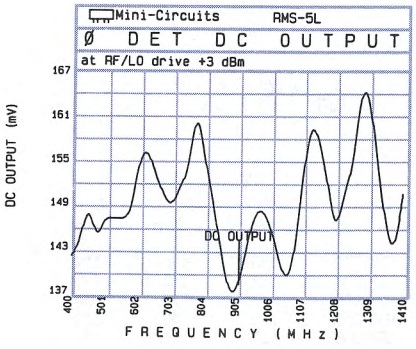
test condition: RF IN: 910.10 MHZ; -9.95 DBM
LO IN: 940.01 MHZ; +2.96 DBM
IF OUT: 29.91 MHZ; -16.00 DBM

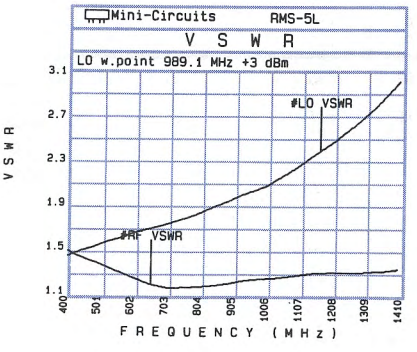
typical performance curves

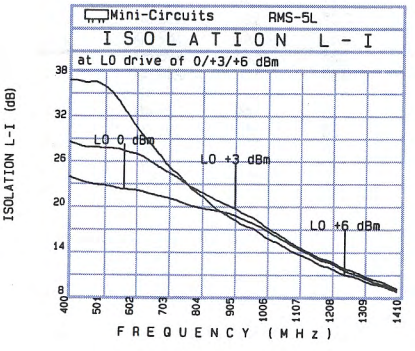
(production unit)

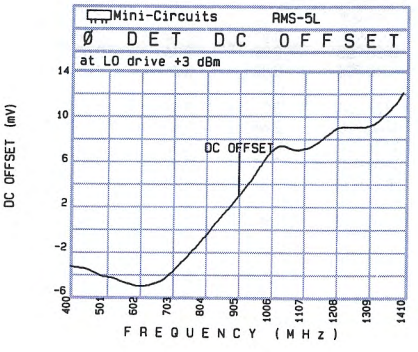












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
RMS-11A
LRMS-11A



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
1500.000	1699.000	6.97	6.31	5.89	25.39	25.21	25.10	21.14	21.11	20.55
1530.000	1729.000	6.83	6.20	5.82	25.14	25.01	24.84	21.50	21.56	20.90
1560.000	1759.000	6.82	6.25	5.90	25.06	25.04	24.91	22.14	22.26	21.48
1580.000	1779.000	6.69	6.10	5.74	25.00	24.98	24.84	22.44	22.45	21.63
1590.000	1789.000	6.70	6.10	5.74	24.89	24.92	24.74	22.66	22.77	21.88
1620.000	1819.000	6.80	6.31	5.93	24.65	24.76	24.69	23.31	23.47	22.53
1650.000	1849.000	6.69	6.21	5.81	24.35	24.60	24.63	23.99	24.30	23.12
1670.000	1869.000	6.80	6.41	6.04	24.33	24.50	24.48	24.40	24.57	23.36
1680.000	1879.000	6.89	6.53	6.15	24.19	24.39	24.35	24.66	24.92	23.72
1710.000	1511.000	6.38	6.07	6.05	24.17	24.36	24.36	25.59	25.81	24.44
1740.000	1541.000	6.69	6.40	6.35	24.04	24.31	24.31	26.54	26.87	25.43
1760.000	1561.000	7.11	6.74	6.62	24.04	24.31	24.39	27.15	27.57	25.97
1770.000	1571.000	7.16	6.77	6.63	23.97	24.27	24.40	27.51	28.15	26.40
1800.000	1601.000	7.38	7.00	6.83	24.15	24.40	24.65	28.77	29.79	27.73
1830.000	1631.000	8.04	7.61	7.32	24.28	24.49	24.77	30.09	31.74	29.38
1850.000	1651.000	8.02	7.60	7.29	24.59	24.72	25.00	30.94	33.24	30.74
1860.000	1661.000	8.09	7.67	7.39	24.67	24.84	25.08	31.24	34.10	31.61
1880.000	1681.000	8.62	8.19	7.92	25.10	25.08	25.43	31.28	35.70	33.47
1890.000	1691.000	8.86	8.39	8.10	25.36	25.25	25.50	31.11	36.20	34.42
1900.000	1701.000	8.93	8.44	8.14	25.48	25.40	25.64	30.83	36.33	35.25

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
1500.000	1.44	1.65	1.89	3.11	2.37	1.79	40.000	2.06	1.84	1.73
1531.000	1.43	1.68	1.94	3.17	2.38	1.76	67.000	2.06	1.88	1.74
1562.000	1.50	1.78	2.04	3.10	2.34	1.74	77.800	2.04	1.88	1.78
1572.000	1.52	1.80	2.07	3.12	2.35	1.74	104.800	2.08	1.90	1.74
1592.000	1.57	1.86	2.12	3.13	2.34	1.73	122.800	2.11	1.94	1.77
1623.000	1.71	2.00	2.27	3.05	2.31	1.70	131.800	2.11	1.94	1.77
1644.000	1.80	2.09	2.35	3.07	2.31	1.67	160.600	2.12	1.95	1.80
1654.000	1.87	2.15	2.42	3.06	2.30	1.66	187.600	2.12	1.96	1.82
1685.000	2.07	2.36	2.60	3.16	2.33	1.63	196.600	2.13	1.97	1.84
1715.000	2.40	2.71	2.95	3.21	2.33	1.60	214.600	2.12	1.98	1.85
1726.000	3.05	3.56	4.01	3.17	2.30	1.59	225.400	2.12	1.98	1.87
1746.000	2.36	2.61	2.80	3.15	2.28	1.58	252.400	2.13	2.02	1.91
1777.000	2.57	2.77	2.93	3.10	2.23	1.56	279.400	2.10	2.07	2.01
1800.000	2.70	2.89	3.02	3.03	2.19	1.55	299.200	2.13	2.05	1.97
1808.000	2.76	2.93	3.07	3.02	2.18	1.54	308.200	2.13	2.06	2.00
1838.000	2.94	3.10	3.21	2.97	2.14	1.52	335.200	2.11	2.06	2.01
1869.000	3.13	3.25	3.31	2.87	2.08	1.51	362.200	2.14	2.11	2.14
1879.000	3.19	3.26	3.33	2.86	2.06	1.50	382.000	2.09	2.10	2.12
1890.000	3.27	3.33	3.38	2.84	2.05	1.49	391.000	2.10	2.12	2.12
1900.000	3.32	3.37	3.41	2.81	2.03	1.48	400.000	2.15	1.99	2.24

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+6	12	8	27	18	18	26	39	53	51
1	-	18	+0	24	22	41	33	46	38	49	49	53
2	96	53	56	56	47	51	52	58	52	51	61	61
3	> 95	70	72	63	55	61	62	64	62	> 65	62	63
4	> 91	68	> 75	> 69	> 69	69	> 70	> 69	68	69	> 64	64
5	> 92	> 69	> 69	> 70	> 68	68	69	> 70	> 68	69	> 68	> 63
6	> 91	> 69	> 46	62	> 64	> 69	> 69	68	> 68	> 68	> 70	> 69
7	> 86	63	> 69	63	61	60	> 70	> 69	> 70	67	67	> 70
8	> 85	> 64	58	> 64	> 64	> 65	62	> 69	> 69	68	70	66
9	> 86	> 64	58	58	63	63	> 65	62	> 69	69	> 69	> 70
10	> 85	62	> 59	> 60	58	> 64	63	> 64	> 63	> 69	> 69	> 69

Harmonic LO Order

test condition: RF IN:1800.10 MHZ; -15.02 DBM
LO IN:1601.01 MHZ; +7.08 DBM
IF OUT: 199.09 MHZ; -22.22 DBM

RF ORDER HARMONIC

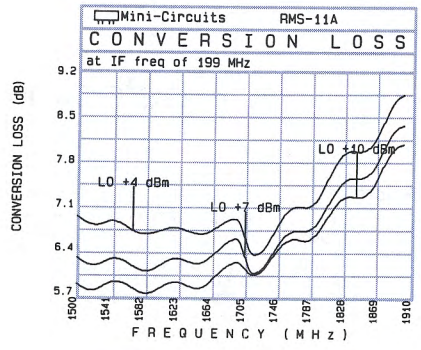
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	22	19	36	31	35	35	54	65	65
1	-	18	+0	26	22	42	37	51	49	69	57	68
2	89	42	44	41	42	44	46	50	46	46	62	71
3	88	54	53	43	33	40	47	58	58	62	58	61
4	85	68	62	74	60	53	58	56	61	64	64	61
5	85	63	70	75	78	67	57	58	57	78	75	65
6	86	> 74	> 62	72	> 74	79	75	70	72	73	74	75
7	79	69	73	> 75	> 74	73	> 79	77	74	65	> 79	77
8	> 81	> 68	> 69	71	72	74	72	> 79	> 80	77	74	78
9	> 82	> 69	> 68	> 68	72	> 74	> 74	> 73	> 80	79	78	76
10	> 80	> 67	> 69	> 69	> 69	> 72	71	73	72	> 79	78	> 79

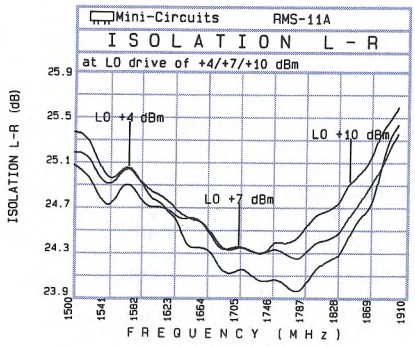
Harmonic LO Order

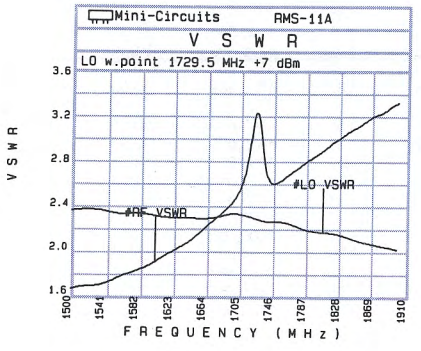
test condition: RF IN:1800.10 MHZ; -5.04 DBM
LO IN:1601.01 MHZ; +7.08 DBM
IF OUT: 199.09 MHZ; -12.30 DBM

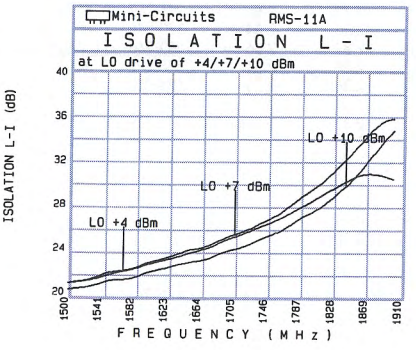
typical performance curves

(production unit)









In Stock...Immediate Delivery

most widely-used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
LMX-156



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L–R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L–I (dB) LO +4dBm	LO +7dBm	LO +10dBm
800.000	830.000	9.06	8.59	8.32	800.000	41.99	42.18	42.24	31.68	30.74	30.02
847.222	877.222	9.02	8.51	8.23	847.222	41.34	42.09	42.75	31.14	30.13	29.30
894.444	924.444	8.90	8.20	7.77	894.444	39.12	40.22	40.91	30.51	29.57	28.73
941.667	911.667	8.00	7.28	6.78	941.667	35.85	36.78	37.06	29.90	29.08	28.15
1000.000	970.000	7.42	6.67	6.28	1000.000	33.41	34.86	35.76	29.21	28.46	27.57
1083.333	1053.333	6.96	6.33	6.00	1083.333	31.47	33.45	34.57	28.09	27.56	26.89
1130.556	1100.556	7.11	6.50	6.16	1130.556	30.62	32.74	34.41	27.38	27.04	26.46
1225.000	1195.000	7.18	6.67	6.39	1225.000	31.43	32.87	34.44	25.93	25.59	25.17
1366.667	1336.667	7.52	7.08	6.77	1366.667	32.30	34.22	35.53	26.47	25.74	24.77
1413.889	1383.889	7.65	7.23	6.98	1413.889	32.86	34.67	36.07	26.06	25.12	23.95
1500.000	1470.000	7.71	7.36	7.16	1500.000	33.87	36.11	37.67	25.52	24.59	23.53
1555.556	1525.556	7.72	7.38	7.18	1555.556	32.33	34.17	35.63	25.63	24.65	23.54
1650.000	1620.000	7.80	7.44	7.23	1650.000	33.14	33.95	34.27	25.27	24.73	23.83
1791.667	1761.667	8.07	7.60	7.39	1791.667	33.96	33.93	33.77	25.43	25.57	25.38
1933.333	1903.333	8.89	7.99	7.63	1933.333	33.75	33.57	33.43	26.95	27.91	28.24
2000.000	1970.000	8.81	7.88	7.50	2000.000	33.37	33.27	33.36	28.02	29.39	29.90
2122.222	2092.222	8.70	7.72	7.32	2122.222	32.48	32.91	33.47	29.92	31.65	32.40
2263.889	2233.889	8.00	7.19	6.80	2263.889	31.21	31.82	32.58	32.17	33.61	34.08
2405.556	2375.556	7.92	7.11	6.73	2405.556	30.05	29.75	29.26	33.00	33.43	32.97
2500.000	2470.000	8.31	7.55	7.23	2500.000	29.00	28.19	27.45	32.94	32.18	31.45

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. MHz	max. DC output mV	DC offset mV
800.000	2.71	2.63	2.58	1.95	2.38	3.04	5.000	2.11	1.85	1.68	800.000	−180.04	−1.05
847.222	2.18	2.12	2.10	1.94	2.35	2.98	42.563	2.11	1.86	1.69	847.222	−193.40	−1.43
894.444	1.73	1.70	1.70	1.95	2.33	2.95	80.126	2.12	1.87	1.70	894.444	−197.63	−2.64
941.667	1.37	1.36	1.39	2.00	2.38	2.98	117.688	2.12	1.88	1.72	941.667	−199.21	−1.50
1000.000	1.03	1.11	1.18	2.01	2.35	2.93	200.000	2.12	1.92	1.80	1000.000	−194.00	−.82
1083.333	1.41	1.42	1.43	2.02	2.33	2.88	275.452	2.07	1.95	1.88	1083.333	−188.97	+1.93
1130.556	1.68	1.68	1.67	2.06	2.32	2.84	350.578	1.98	1.94	1.93	1130.556	−185.40	+3.01
1225.000	2.19	2.15	2.12	2.12	2.37	2.86	463.266	1.80	1.85	1.92	1225.000	−181.58	+5.63
1366.667	2.77	2.67	2.61	2.25	2.39	2.81	538.392	1.69	1.78	1.89	1366.667	−170.12	+4.99
1413.889	2.90	2.80	2.73	2.26	2.36	2.73	621.030	1.61	1.73	1.87	1413.889	−160.53	+4.38
1500.000	3.04	2.92	2.85	2.33	2.37	2.73	733.719	1.55	1.68	1.85	1500.000	−160.51	+3.64
1555.556	3.09	2.96	2.89	2.38	2.37	2.67	808.844	1.53	1.69	1.86	1555.556	−149.02	+5.78
1650.000	3.08	2.94	2.86	2.53	2.40	2.65	883.970	1.51	1.69	1.87	1650.000	−148.05	+7.71
1791.667	2.93	2.80	2.71	2.69	2.46	2.63	1000.000	1.43	1.63	1.84	1791.667	−132.53	+8.51
1933.333	2.69	2.58	2.48	2.88	2.51	2.57	1079.296	1.39	1.60	1.81	1933.333	−106.49	+7.51
2000.000	2.57	2.46	2.38	2.85	2.51	2.57	1154.422	1.33	1.51	1.69	2000.000	−105.69	+7.90
2122.222	2.34	2.24	2.16	2.98	2.53	2.51	1229.548	1.25	1.43	1.59	2122.222	−85.62	+8.56
2263.889	2.11	2.01	1.93	3.01	2.52	2.44	1349.749	1.25	1.42	1.58	2263.889	−66.31	+9.32
2405.556	1.97	1.86	1.79	3.04	2.49	2.34	1424.874	1.15	1.34	1.50	2405.556	−39.49	+10.40
2500.000	1.92	1.82	1.75	3.09	2.50	2.31	1500.000	1.29	1.46	1.59	2500.000	−18.66	+12.36

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+2	27	1	21	24	41	37	55	45	57
1	–	18	0	32	29	34	40	48	50	56	54	61
2	91	66	41	47	44	67	47	64	63	7	64	>66
3	95	65	71	63	53	65	72	68	72	73	66	>68
4	>96	72	73	71	>73	>74	73	>73	>73	>74	73	>68
5	>90	67	>74	>73	>72	>74	>74	>74	>73	73	72	71
6	>90	65	>68	73	>73	>74	>74	>74	73	72	72	>73
7	>91	>69	>68	>69	>73	>74	>74	>74	>74	>74	>74	>73
8	89	67	>88	67	>68	>74	>73	72	>74	>74	>74	>73
9	>91	>68	>68	>69	>68	67	72	>74	>73	>74	>74	>74
10	>90	67	>68	>68	>69	67	>68	>73	73	>74	>74	>74

LO Harmonic Order

test conditions: RF IN: 1200.10 MHZ; −15.07 DBM
LO IN: 1170.01 MHZ;+6.92 DBM
IF OUT:30.09 MHZ; −22.06 DBM

RF ORDER HARMONIC

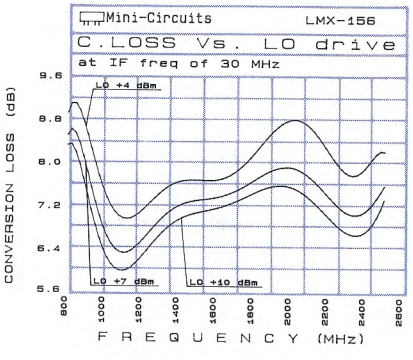
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	9	37	12	32	36	52	56	69	51	76
1	–	18	0	35	29	40	41	54	59	68	63	71
2	72	61	33	43	36	75	41	58	61	71	69	>78
3	95	46	53	52	35	54	64	52	62	69	67	76
4	>95	71	62	77	54	59	51	>83	58	70	77	76
5	89	78	78	72	76	65	54	68	72	71	76	83
6	>90	>79	77	83	75	83	66	70	67	>83	78	77
7	>90	78	>78	>79	>84	>84	>84	78	67	78	>83	81
8	>90	>78	>79	>78	>78	>84	83	82	83	83	80	>84
9	>90	77	>78	>79	>79	>78	>84	>84	>83	>82	82	>84
10	90	>79	78	>79	>79	>79	>78	>84	83	82	>84	83

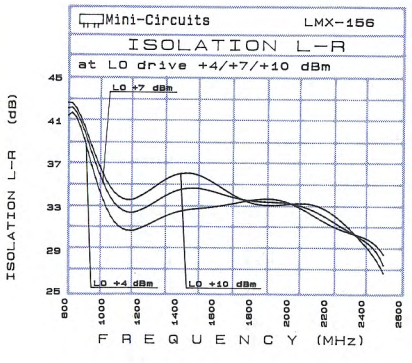
LO Harmonic Order

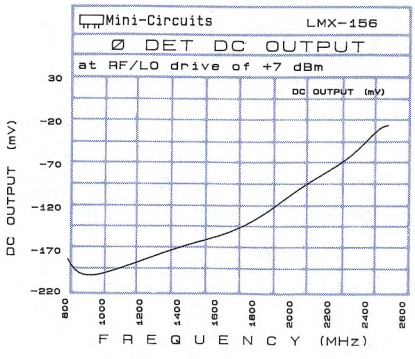
test conditions: RF IN: 1200.10 MHZ;−4.99 DBM
LO IN: 1170.01 MHZ;+6.92 DBM
IF OUT:30.09 MHZ; −11.79 DBM

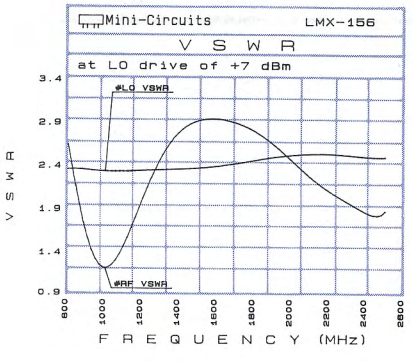
typical performance curves

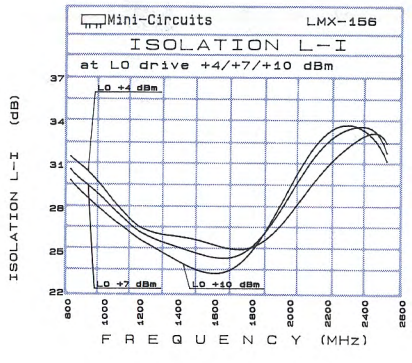
(production unit)

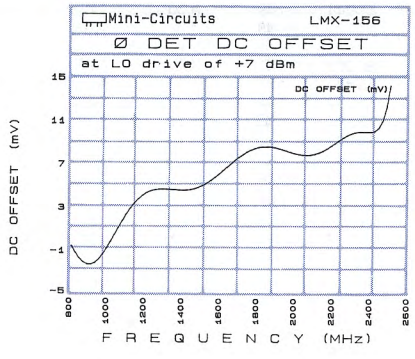












In Stock...Immediate Delivery

ultra-low distortion

Frequency Mixers

Model RAY-6U

LEVEL 23 (+23dBm LO, up to +15dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20dBm	LO +23dBm	LO +26dBm	freq. (MHz)	Isolation L-R (dB) LO +20dBm	LO +23dBm	LO +26dBm	Isolation L-I (dB) LO +20dBm	LO +23dBm	LO +26dBm
.010	30.010	6.10	5.66	5.47	.010	81.53	79.86	76.21	73.93	76.26	74.21
.020	30.020	5.70	5.33	5.08	.020	82.38	80.63	77.59	64.28	63.63	60.81
.050	30.050	5.58	5.17	4.97	.050	81.90	79.19	75.88	63.40	61.75	58.07
.100	30.100	5.58	5.22	5.01	.100	81.84	79.45	75.64	63.44	61.54	57.94
.200	30.200	5.59	5.20	4.99	.200	81.65	79.24	75.12	63.35	61.54	57.70
.500	30.500	5.61	5.22	5.01	.500	80.95	78.84	74.72	63.35	61.56	57.67
1.000	31.000	5.58	5.23	5.02	1.000	80.37	78.29	74.72	63.57	61.49	57.71
2.000	32.000	5.60	5.24	5.04	2.000	78.69	77.60	74.30	63.79	61.76	57.86
5.000	35.000	5.71	5.35	5.13	5.000	73.33	74.22	72.34	65.63	62.90	58.20
10.000	40.000	5.85	5.47	5.36	10.000	67.90	69.60	69.92	68.80	65.50	59.84
14.294	44.294	5.69	5.37	5.25	14.294	64.59	66.38	66.12	66.49	67.38	60.96
20.000	50.000	5.30	4.94	4.79	20.000	61.83	64.53	74.44	57.97	61.45	74.54
25.007	55.007	5.27	4.84	4.69	25.007	60.14	63.21	70.59	53.42	57.36	74.09
32.150	62.150	5.67*	5.21	4.93	32.150	58.94	61.72	60.61	49.75	52.92	62.46
39.292	69.292	5.93	5.52	5.32	39.292	54.17	56.11	58.54	46.15	49.37	53.89
50.000	80.000	5.92	5.59	5.50	50.000	58.73	62.58	60.63	44.21	46.14	49.77
60.718	90.718	5.99	5.60	5.60	60.718	47.22	49.27	48.57	42.32	45.21	47.32
75.002	45.003	6.18	5.80	5.63	75.002	41.40	42.49	45.34	38.20	40.86	41.40
85.716	55.716	6.17	6.04	5.93	85.716	42.27	43.68	42.05	35.63	38.59	33.30
100.000	70.000	6.38	6.29	6.15	100.000	43.06	46.53	39.36	37.34	37.83	33.32

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +20dBm	LO +23dBm	LO +26dBm	VSWR, LO port LO +20dBm	LO +23dBm	LO +26dBm	freq. (MHz)	VSWR, IF port LO +20dBm	LO +23dBm	LO +26dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.56	1.35	1.22	1.03	1.70	2.82	5.000	1.70	1.53	1.43	.010	−865.20	−.02
7.639	1.56	1.35	1.22	1.04	1.66	2.75	7.639	1.71	1.54	1.43	.020	−1681.10	−.26
10.000	1.56	1.35	1.22	1.05	1.61	2.65	10.000	1.73	1.56	1.45	.050	−1730.00	−.33
15.556	1.55	1.35	1.22	1.03	1.61	2.54	15.556	1.76	1.59	1.49	.500	−1755.70	−.36
20.000	1.54	1.34	1.21	1.04	1.67	2.56	20.000	1.78	1.62	1.52	2.000	−1750.60	−.37
23.472	1.53	1.33	1.21	1.05	1.65	2.46	23.472	1.82	1.65	1.55	5.000	−1764.90	−.39
31.389	1.51	1.31	1.20	1.11	1.61	2.32	31.389	1.91	1.74	1.64	10.723	−1782.50	−.36
36.667	1.50	1.31	1.20	1.15	1.60	2.26	36.667	1.99	1.82	1.72	17.865	−1848.70	+.02
41.944	1.49	1.30	1.20	1.18	1.59	2.23	41.944	2.08	1.91	1.80	21.436	−1883.80	+.22
47.222	1.48	1.30	1.20	1.20	1.60	2.26	47.222	2.20	2.00	1.89	28.579	−1954.70	−1.16
50.000	1.47	1.29	1.20	1.22	1.62	2.29	50.000	2.26	2.06	1.94	35.721	−1992.80	−.58
55.139	1.45	1.29	1.21	1.26	1.63	2.33	55.139	2.36	2.15	2.04	42.863	−1997.40	−.52
60.417	1.44	1.29	1.22	1.28	1.67	2.41	60.417	2.45	2.26	2.12	50.000	−1950.00	−1.53
65.694	1.43	1.30	1.24	1.30	1.69	2.48	65.694	2.55	2.36	2.24	53.576	−1908.60	−1.94
70.972	1.43	1.31	1.27	1.33	1.69	2.53	70.972	2.68	2.47	2.35	60.718	−1839.70	−2.19
76.250	1.44	1.34	1.30	1.38	1.71	2.53	76.250	2.84	2.62	2.48	67.860	−1783.40	−1.31
81.528	1.46	1.37	1.34	1.43	1.73	2.52	81.528	3.01	2.83	2.66	75.002	−1663.70	+3.92
89.444	1.49	1.41	1.39	1.46	1.77	2.46	89.444	3.37	3.12	3.01	85.716	−1577.20	+12.27
94.722	1.49	1.43	1.42	1.45	1.78	2.42	94.722	3.54	3.30	3.20	92.858	−1532.60	+14.60
100.000	1.49	1.45	1.44	1.42	1.77	2.37	100.000	3.58	3.40	3.32	100.000	−1485.90	+19.25

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	–	–	10	21	11	13	3	21	13	35	20	41
1	–	19	+0	27	13	31	20	33	30	54	29	56
2	95	75	79	72	69	69	73	71	66	77	65	>80
3	>97	>77	>81	76	71	76	70	>79	72	80	73	>79
4	93	79	77	>80	>81	>81	>80	>76	>81	>79	>81	>81
5	>96	>78	77	>78	80	>80	>80	>79	>80	>81	>81	>81
6	>97	80	>80	>81	>81	>81	>80	>80	77	79	>80	>81
7	96	>81	>79	>80	>79	>80	>80	>80	78	79	>80	80
8	>97	>81	>81	>80	>80	>81	79	>80	76	>81	>80	>81
9	>96	>81	>79	>81	78	>81	>80	>82	>79	>80	>80	>81
10	>96	>82	80	>80	>80	77	78	77	>80	>80	>80	>81
		0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 10.10 MHZ; −10.00 DBM
LO IN: 40.10 MHZ; +22.98 DBM
IF OUT: 30.00 MHZ; −15.39 DBM

RF ORDER HARMONIC

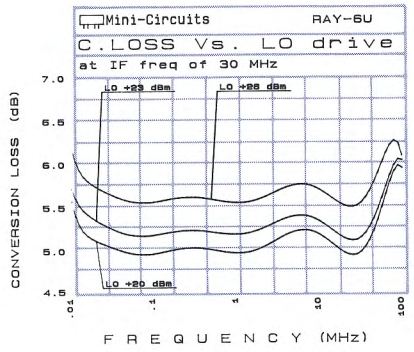
	RF CAL											
0	–	–	20	31	21	23	13	31	23	45	30	50
1	–	19	+0	27	12	32	20	32	>30	53	30	60
2	76	72	67	68	76	63	60	62	57	70	56	85
3	73	>64	65	62	55	59	54	66	54	70	55	69
4	>97	81	80	81	75	>79	75	>68	76	>76	77	>81
5	>97	>65	82	>66	76	>71	76	>75	75	>83	82	>78
6	>96	>89	87	88	85	89	87	86	>90	>90	>90	87
7	>96	>88	62	>86	>69	>89	70	>87	77	87	84	89
8	>96	>90	86	>88	>87	>89	79	78	>72	>87	73	89
9	>96	>88	>67	>85	66	>88	>74	84	74	>88	80	90
10	95	>90	>90	>88	>88	88	>89	89	>90	89	89	>90
		0	1	2	3	4	5	6	7	8	9	10

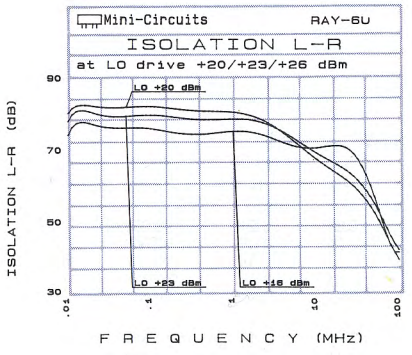
LO Harmonic Order

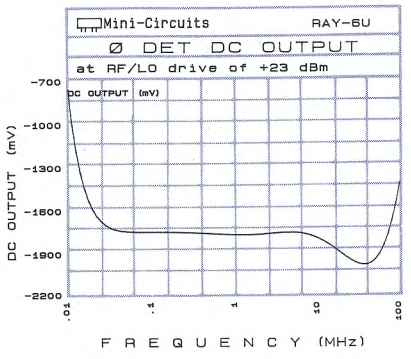
test conditions: RF IN: 10.01 MHZ; +.09 DBM
LO IN: 40.10 MHZ; +22.98 DBM
IF OUT: 30.09 MHZ; −5.47 DBM

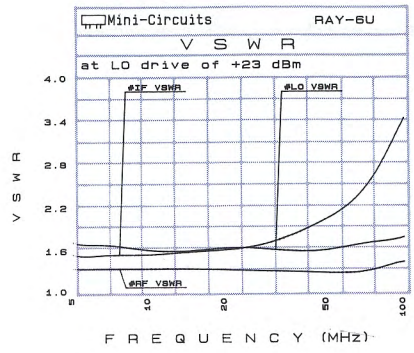
typical performance curves

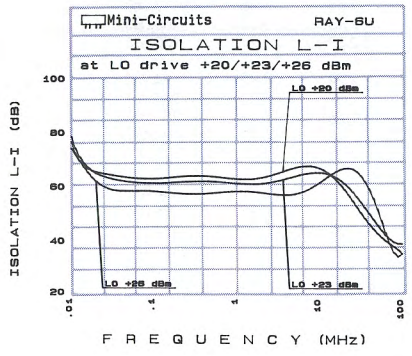
(production unit)

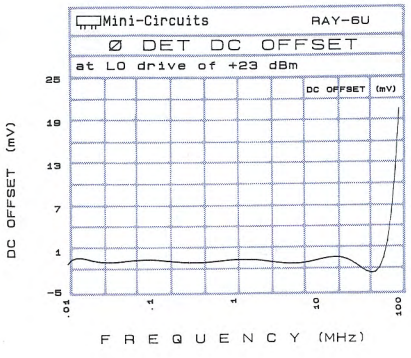












In Stock...Immediate Delivery

most widely-used, surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

LRMS-1R
RMS-1
LRMS-1

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
.500	30.500	7.81	7.45	7.25	.500	77.47	89.00	86.40	58.57	64.40	71.90
1.000	31.000	7.02	6.68	6.52	1.000	76.77	82.65	81.16	59.07	64.35	70.66
2.000	32.000	6.45	6.15	6.00	2.000	74.40	76.59	75.41	58.90	63.49	66.01
5.000	35.000	6.12	5.84	5.69	5.000	68.98	68.78	67.98	57.58	59.68	59.61
10.000	40.000	6.09	5.78	5.64	10.000	63.87	63.45	62.82	55.47	55.38	54.46
20.000	50.000	6.18	5.84	5.66	20.000	57.27	56.92	56.64	50.26	48.99	48.06
50.000	80.000	6.16	5.84	5.67	50.000	48.30	48.06	49.87	42.15	40.83	40.96
67.100	97.100	6.07	5.78	5.63	67.100	47.09	47.33	48.46	40.99	39.62	39.46
100.000	70.000	6.01	5.74	5.59	100.000	45.58	45.42	45.04	38.53	36.85	35.88
117.050	87.050	5.99	5.71	5.57	117.050	45.23	45.23	44.81	37.97	36.32	35.29
150.350	120.350	6.00	5.73	5.59	150.350	45.07	44.09	42.81	36.76	34.84	33.16
200.000	170.000	6.06	5.78	5.63	200.000	43.85	41.97	40.59	35.32	32.90	31.04
216.950	186.950	6.14	5.84	5.66	216.950	42.30	40.74	39.65	34.64	32.23	30.22
250.000	220.000	6.25	5.91	5.72	250.000	40.08	38.62	37.54	32.78	30.58	28.88
283.550	253.550	6.13	5.81	5.64	283.550	38.42	36.99	35.87	31.34	29.19	27.41
333.500	303.500	6.11	5.81	5.69	333.500	35.20	34.17	33.03	28.71	26.96	25.49
383.450	353.450	6.31	6.03	5.90	383.450	32.23	31.17	30.12	27.01	25.64	24.22
433.400	403.400	6.63	6.34	6.21	433.400	30.09	29.18	28.64	24.83	23.85	22.69
466.700	436.700	6.92	6.56	6.43	466.700	28.97	27.71	27.04	23.95	22.78	21.60
500.000	470.000	7.25	6.82	6.59	500.000	28.29	27.09	26.44	23.13	22.32	21.19

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.13	1.11	1.12	1.58	2.27	3.21	5.000	1.41	1.24	1.12	.500	+233.06	−.09
10.000	1.10	1.05	1.07	1.57	2.27	3.08	10.000	1.41	1.25	1.13	1.000	+240.55	−.08
20.000	1.09	1.02	1.05	1.68	2.43	3.34	20.000	1.41	1.24	1.13	5.000	+245.92	−.07
34.118	1.09	1.01	1.05	1.75	2.52	3.51	34.118	1.40	1.24	1.12	10.000	+246.17	−.06
50.000	1.09	1.01	1.05	1.77	2.50	3.52	50.000	1.41	1.24	1.12	20.000	+245.27	−.05
63.235	1.09	1.02	1.06	1.77	2.50	3.50	63.235	1.41	1.24	1.12	33.800	+242.31	−.03
77.794	1.09	1.03	1.06	1.72	2.48	3.45	77.794	1.41	1.24	1.13	50.000	+238.70	−.01
92.353	1.09	1.04	1.06	1.69	2.43	3.36	92.353	1.41	1.24	1.13	50.450	+238.56	−.01
100.000	1.10	1.04	1.06	1.67	2.40	3.33	100.000	1.41	1.24	1.13	67.100	+235.59	−.02
150.588	1.11	1.07	1.09	1.66	2.38	3.21	150.588	1.42	1.25	1.13	117.050	+236.67	−.22
194.265	1.13	1.09	1.11	1.63	2.29	3.12	194.265	1.42	1.26	1.14	167.000	+244.95	+.09
223.382	1.15	1.11	1.13	1.63	2.29	3.10	223.382	1.43	1.27	1.15	200.000	+241.01	+.37
250.000	1.16	1.13	1.14	1.63	2.25	3.03	250.000	1.42	1.25	1.14	216.950	+238.64	+.89
296.177	1.19	1.17	1.18	1.64	2.28	3.03	296.177	1.44	1.28	1.16	266.900	+243.96	+1.77
325.294	1.22	1.19	1.20	1.67	2.30	2.97	325.294	1.46	1.29	1.18	300.200	+249.58	+2.52
354.412	1.25	1.22	1.24	1.68	2.23	2.87	354.412	1.46	1.30	1.18	333.500	+251.46	+4.04
398.088	1.29	1.28	1.29	1.72	2.29	2.91	398.088	1.46	1.30	1.19	383.450	+243.55	+5.99
427.206	1.32	1.31	1.32	1.73	2.24	2.82	427.206	1.46	1.31	1.20	416.750	+234.95	+7.51
470.882	1.38	1.37	1.38	1.81	2.34	2.95	470.882	1.46	1.31	1.21	466.700	+221.12	+9.24
500.000	1.43	1.43	1.43	1.83	2.31	2.89	500.000	1.45	1.31	1.21	500.000	+216.50	+11.38

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL											
0	–	–	5	14	5	16	9	27	17	34	32	31
1	–	14	+0	26	12	32	22	34	35	38	36	44
2	96	63	46	57	46	51	45	54	45	61	49	60
3	93	67	65	70	63	69	60	69	62	74	61	71
4	96	72	72	>76	75	>75	>75	>75	>76	>75	>75	>75
5	>97	>75	>75	>75	>75	>75	>76	74	75	>75	75	>75
6	>97	>75	>75	>75	>76	>75	>76	>76	>75	>76	>75	>76
7	>97	>76	74	>75	>75	>75	>75	75	>75	>76	73	72
8	>96	70	>76	>75	>75	>75	>76	74	>75	74	>75	>76
9	>96	>74	>74	>75	>76	>75	>75	>76	>75	>76	75	>75
10	>97	>75	>75	>75	>76	74	>75	>75	>76	>75	>75	>75
		0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −14.97 DBM
LO IN: 155.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −20.88 DBM

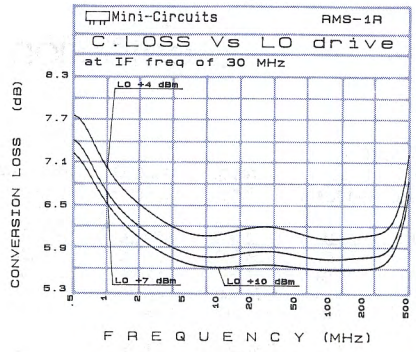
RF ORDER HARMONIC	RF CAL											
0	–	–	14	23	15	26	20	38	30	45	39	50
1	–	14	+0	26	12	32	21	34	34	41	41	49
2	82	49	42	55	40	48	39	51	38	54	42	60
3	>96	53	53	54	54	54	51	58	54	62	52	59
4	>97	74	64	66	60	62	61	57	60	58	57	66
5	>97	71	70	66	64	66	60	66	58	66	58	75
6	>96	77	76	76	73	76	72	78	76	77	76	81
7	>96	84	84	80	>84	82	82	81	81	80	80	82
8	>96	83	>85	83	>85	84	>85	>85	>85	82	80	>86
9	>96	>86	81	>85	>85	>85	>86	>85	82	>86	>84	84
10	95	>85	>85	83	>85	>85	>85	>84	>85	>85	>85	84
		0	1	2	3	4	5	6	7	8	9	10

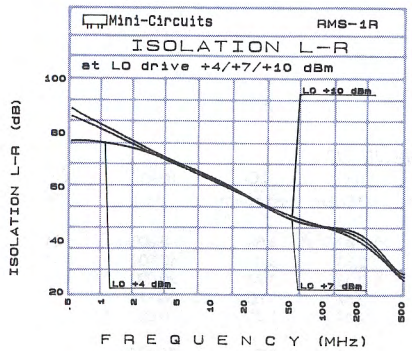
LO Harmonic Order

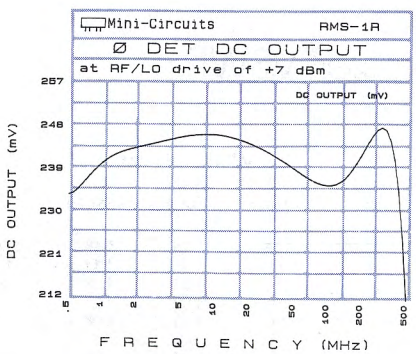
test conditions: RF IN: 185.10 MHZ; −5.02 DBM
LO IN: 155.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −11.18 DBM

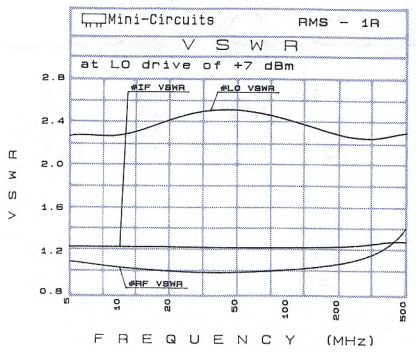
typical performance curves

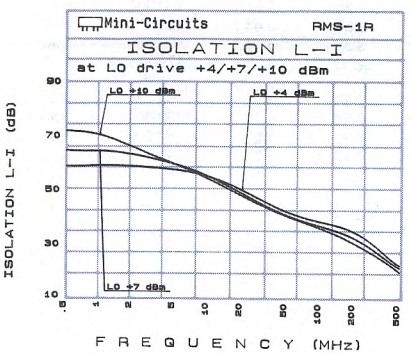
(production unit)

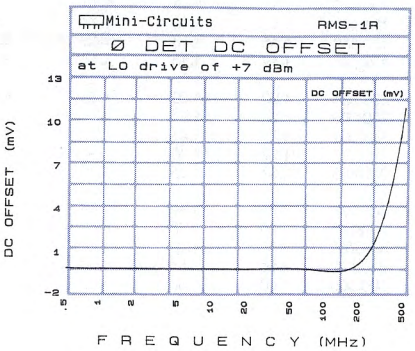












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Models
RMS-1LH
LRMS-1LH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	Isolation L-R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L-I (dB) LO +7dBm	LO +10dBm	LO +13dBm
2.000	32.000	7.08	6.73	6.55	2.000	65.89	68.96	71.56	55.04	58.87	62.73
5.000	35.000	6.14	5.87	5.71	5.000	65.11	67.37	69.67	54.46	56.74	57.76
10.000	40.000	6.47	6.17	5.99	10.000	63.38	65.16	66.06	52.78	52.79	52.34
20.000	50.000	6.52	6.15	5.98	20.000	59.44	60.74	61.11	48.83	47.32	46.43
32.182	62.182	6.43	6.06	5.90	32.182	55.84	57.04	57.56	45.02	43.21	42.62
50.000	80.000	6.39	6.05	5.90	50.000	54.54	48.82	48.60	31.02	29.76	29.52
77.454	47.454	6.41	6.06	5.89	77.454	53.04	55.97	56.08	39.92	37.96	36.59
100.000	70.000	6.22	5.90	5.76	100.000	53.94	59.73	58.30	38.89	36.65	35.45
122.727	92.727	6.19	5.91	5.80	122.727	60.06	63.14	58.62	38.06	35.55	34.01
152.909	122.909	6.16	5.92	5.84	152.909	60.00	56.38	54.16	36.71	34.01	32.14
198.182	168.182	6.19	5.94	5.85	198.182	50.27	48.84	47.52	34.51	32.04	30.39
228.364	198.364	6.23	5.96	5.86	228.364	46.53	45.44	44.39	32.73	30.49	28.84
250.000	220.000	6.31	6.03	5.91	250.000	44.76	43.77	42.72	31.59	29.78	28.17
273.636	243.636	6.36	6.06	5.91	273.636	42.98	42.07	41.03	30.44	28.92	27.32
303.818	273.818	6.48	6.12	5.95	303.818	40.23	39.63	38.75	29.00	27.42	25.96
334.000	304.000	6.45	6.12	5.94	334.000	38.50	37.56	36.43	27.44	26.38	24.74
379.273	349.273	6.42	6.09	5.89	379.273	36.16	34.91	33.95	25.55	25.00	23.68
409.455	379.455	6.29	5.98	5.81	409.455	34.74	33.53	32.01	24.30	24.14	22.53
454.727	424.727	6.38	6.04	5.92	454.727	32.96	31.70	30.24	22.91	22.72	21.21
500.000	470.000	6.49	6.19	6.05	500.000	31.47	30.03	28.73	21.67	21.67	20.55

mixer VSWR

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm
5.000	1.15	1.16	1.18	1.61	2.42	3.53	5.000	1.31	1.18	1.08
10.000	1.09	1.08	1.11	1.58	2.33	3.49	10.000	1.31	1.18	1.08
20.000	1.06	1.03	1.08	1.67	2.43	3.73	20.000	1.31	1.18	1.08
34.118	1.06	1.02	1.07	1.68	2.47	3.60	34.118	1.32	1.18	1.08
50.000	1.07	1.03	1.08	1.64	2.47	3.43	50.000	1.33	1.19	1.09
77.794	1.08	1.05	1.09	1.61	2.35	3.39	77.794	1.33	1.20	1.10
100.000	1.11	1.08	1.10	1.62	2.35	3.37	100.000	1.34	1.20	1.11
121.471	1.13	1.10	1.12	1.65	2.35	3.43	121.471	1.34	1.21	1.12
150.588	1.15	1.13	1.15	1.66	2.35	3.43	150.588	1.35	1.23	1.14
179.706	1.19	1.16	1.17	1.66	2.30	3.35	179.706	1.37	1.24	1.16
208.824	1.22	1.20	1.20	1.67	2.31	3.29	208.824	1.38	1.26	1.18
250.000	1.26	1.24	1.24	1.73	2.34	3.28	250.000	1.38	1.24	1.16
267.059	1.28	1.26	1.26	1.70	2.32	3.23	267.059	1.41	1.28	1.20
296.177	1.32	1.30	1.30	1.75	2.33	3.21	296.177	1.44	1.31	1.23
339.853	1.37	1.35	1.35	1.82	2.37	3.21	339.853	1.46	1.34	1.25
368.971	1.41	1.39	1.39	1.83	2.34	3.12	368.971	1.48	1.36	1.28
398.088	1.45	1.43	1.43	1.86	2.39	3.17	398.088	1.50	1.37	1.29
441.765	1.51	1.49	1.49	1.89	2.36	3.10	441.765	1.52	1.40	1.32
470.882	1.56	1.54	1.53	1.92	2.39	3.08	470.882	1.53	1.41	1.33
500.000	1.60	1.58	1.57	1.98	2.46	3.17	500.000	1.53	1.42	1.34

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
2.000	+336.50	+.37
5.000	+341.20	+.37
17.091	+341.40	+.36
20.000	+340.50	+.37
47.273	+335.30	+.41
62.364	+335.60	+.30
92.545	+335.90	+.08
107.636	+338.80	+.03
137.818	+340.00	+.14
168.000	+340.40	+.75
198.182	+338.00	+1.47
243.455	+339.90	+3.08
258.545	+343.50	+3.66
288.727	+346.70	+4.56
334.000	+352.70	+7.63
364.182	+351.00	10.03
394.364	+339.70	11.54
439.636	+321.60	14.70
469.818	+314.50	16.19
500.000	+312.10	17.82

Mini-Circuits™ P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945 EUROPE 44-252-835094 Fax 44-252-837010

Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	8	17	9	23	8	21	17	31	20	46
1	-	18	+0	30	12	34	20	34	28	36	43	46
2	91	60	43	57	43	51	44	50	42	54	45	64
3	96	76	67	76	58	68	55	68	54	78	56	78
4	>97	79	73	77	74	77	75	75	74	75	73	79
5	>97	>80	76	80	76	77	77	>80	75	>80	75	>81
6	>97	80	78	79	78	77	>80	>81	>80	>80	>80	79
7	>96	>80	>80	>80	77	>80	>80	80	>80	>80	>81	>81
8	>96	79	>80	>80	>81	>81	>81	76	>80	>81	>81	>80
9	>96	>80	79	79	>81	79	>81	>80	79	80	80	>80
10	>96	>80	>80	>80	>80	>81	80	77	>80	79	>81	79

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −9.93 DBM
LO IN: 155.01 MHZ; +10.00 DBM
IF OUT: 30.09 MHZ; −15.80 DBM

RF ORDER HARMONIC

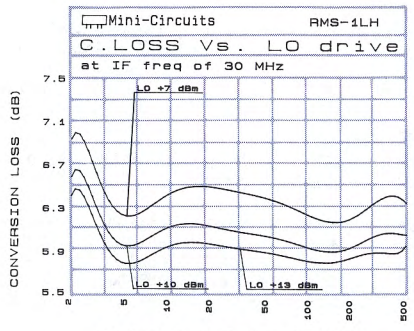
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	17	26	22	36	21	35	33	47	39	53
1	-	19	+0	30	12	35	20	36	27	38	40	49
2	72	49	38	58	38	49	39	49	37	47	40	54
3	82	53	57	52	62	53	51	60	53	55	59	54
4	>97	65	59	60	57	58	57	55	56	54	54	57
5	>96	65	62	61	56	63	53	62	52	63	50	68
6	95	76	71	74	72	70	72	71	70	72	65	67
7	96	80	86	78	>91	75	79	74	72	72	69	72
8	>97	79	86	78	82	77	78	77	83	76	87	74
9	>96	86	81	85	80	83	78	89	80	86	83	89
10	>96	86	>90	88	>90	86	>90	83	84	84	87	81

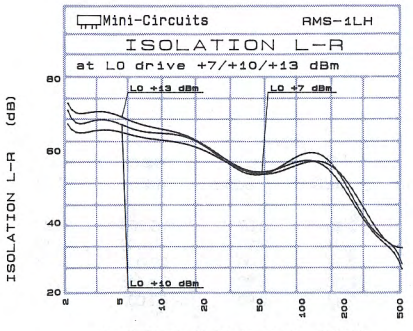
LO Harmonic Order

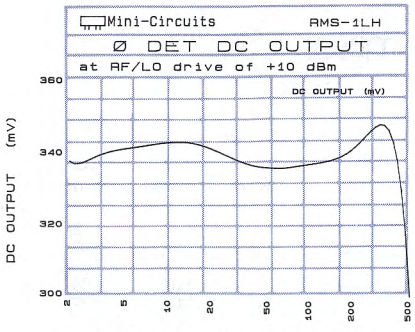
test conditions: RF IN: 185.10 MHZ; −.03 DBM
LO IN: 155.01 MHZ; +9.94 DBM
IF OUT: 30.09 MHZ; −5.88 DBM

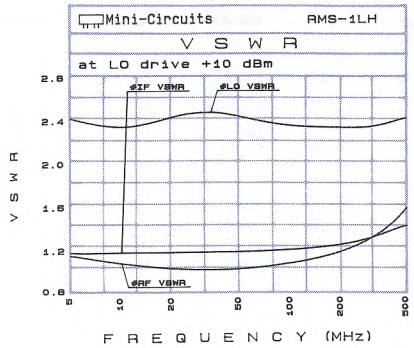
typical performance curves

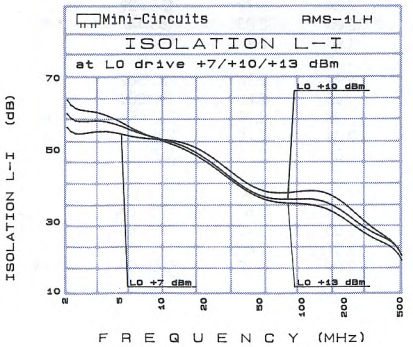
(production unit)

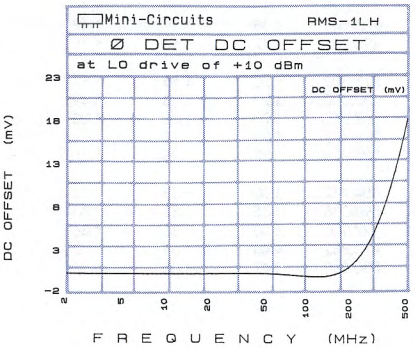












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Models
RMS-1MH
LRMS-1MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
2.000	32.000	7.33	6.87	6.69	2.000	76.01	74.51	74.01	68.31	65.71	64.46
5.000	35.000	6.39	5.99	5.81	5.000	69.66	68.76	68.46	63.66	61.00	59.73
10.000	40.000	6.66	6.21	6.01	10.000	64.01	63.07	62.89	58.52	55.80	54.50
20.000	50.000	6.70	6.21	6.02	20.000	58.46	57.31	57.09	52.30	49.78	48.69
32.182	62.182	6.62	6.13	5.92	32.182	54.07	52.98	53.07	47.44	45.20	44.53
50.000	80.000	6.60	6.10	5.92	50.000	50.44	49.34	49.74	42.93	40.85	40.18
77.454	47.454	6.68	6.18	5.97	77.454	48.40	47.86	47.41	40.44	38.28	37.07
100.000	70.000	6.39	6.00	5.79	100.000	48.50	47.68	47.27	39.28	37.14	36.11
122.727	92.727	6.48	6.08	5.94	122.727	49.19	47.59	46.53	38.54	36.20	35.00
168.000	138.000	6.43	6.07	5.95	168.000	48.05	45.07	43.92	36.55	34.10	32.44
198.182	168.182	6.43	6.11	5.98	198.182	44.92	42.15	40.89	34.20	31.58	30.54
228.364	198.364	6.45	6.11	5.97	228.364	41.35	39.78	38.41	32.53	30.31	28.77
250.000	220.000	6.56	6.27	6.11	250.000	38.94	37.93	36.65	31.31	29.36	27.82
273.636	243.636	6.51	6.21	6.03	273.636	36.56	35.54	34.67	29.52	27.74	26.84
303.818	273.818	6.65	6.26	6.06	303.818	33.81	32.56	32.01	27.84	25.93	25.11
349.091	319.091	6.76	6.39	6.14	349.091	31.78	29.95	29.08	25.87	24.88	23.39
379.273	349.273	6.78	6.47	6.27	379.273	30.58	28.87	27.79	24.17	23.78	22.39
409.455	379.455	6.71	6.45	6.29	409.455	29.17	27.89	26.33	22.28	22.58	21.08
454.727	424.727	7.10	6.64	6.52	454.727	26.85	25.80	24.60	20.37	20.47	19.35
500.000	470.000	7.66	7.03	6.81	500.000	24.92	23.97	23.20	19.00	18.39	17.86

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
5.000	1.16	1.13	1.15	1.38	2.10	3.07	5.000	1.41	1.24	1.14
10.000	1.12	1.06	1.09	1.33	2.01	2.91	10.000	1.42	1.25	1.14
20.000	1.10	1.02	1.06	1.40	2.15	3.00	20.000	1.41	1.24	1.14
34.118	1.10	1.01	1.06	1.42	2.20	2.92	34.118	1.41	1.24	1.14
50.000	1.10	1.02	1.07	1.40	2.17	2.92	50.000	1.42	1.25	1.14
77.794	1.11	1.04	1.08	1.34	2.08	2.83	77.794	1.42	1.25	1.14
100.000	1.12	1.06	1.09	1.34	2.06	2.92	100.000	1.43	1.26	1.15
136.029	1.14	1.09	1.11	1.37	2.04	2.79	136.029	1.44	1.27	1.16
165.147	1.15	1.11	1.12	1.36	2.00	2.83	165.147	1.45	1.28	1.17
194.265	1.17	1.13	1.15	1.37	1.98	2.77	194.265	1.46	1.29	1.18
223.382	1.20	1.16	1.17	1.39	1.99	2.74	223.382	1.48	1.30	1.20
250.000	1.21	1.18	1.19	1.40	1.98	2.80	250.000	1.46	1.28	1.18
267.059	1.23	1.20	1.20	1.41	1.98	2.79	267.059	1.49	1.31	1.21
296.177	1.25	1.23	1.23	1.45	2.01	2.72	296.177	1.51	1.34	1.23
325.294	1.28	1.25	1.25	1.48	2.01	2.76	325.294	1.52	1.35	1.25
354.412	1.30	1.28	1.28	1.52	2.01	2.68	354.412	1.54	1.37	1.27
398.088	1.35	1.33	1.33	1.56	2.01	2.69	398.088	1.56	1.39	1.29
427.206	1.38	1.36	1.36	1.59	2.03	2.73	427.206	1.58	1.41	1.31
470.882	1.44	1.41	1.42	1.63	2.07	2.69	470.882	1.59	1.43	1.34
500.000	1.47	1.45	1.46	1.67	2.09	2.79	500.000	1.61	1.45	1.35

ϕ detection

freq. MHz	max. DC output mV	DC offset mV
2.000	+511.40	+.13
5.000	+521.50	+.14
17.091	+522.60	+.12
20.000	+521.30	+.14
47.273	+517.60	+.36
62.364	+519.10	+.39
92.545	+521.30	+.03
122.727	+521.40	+.23
152.909	+527.40	+.33
183.091	+533.50	+.66
213.273	+521.50	+1.49
243.455	+518.30	+2.59
258.545	+524.50	+2.82
288.727	+529.80	+3.66
318.909	+542.00	+3.97
349.091	+547.60	+5.07
394.364	+527.70	+12.25
424.546	+500.60	+13.20
469.818	+475.50	+16.63
500.000	+468.10	+19.31

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	7	15	9	23	6	20	14	29	17	42
1	–	17	+0	30	12	35	22	37	32	38	35	47
2	91	61	46	61	46	55	48	53	46	54	51	70
3	96	77	70	74	60	70	57	70	57	78	57	77
4	>97	>81	78	>81	77	>81	76	>81	74	>80	73	>80
5	>97	77	>80	>80	>80	>80	77	79	78	>80	79	>81
6	>97	>80	>80	>80	>80	79	80	>80	79	>81	>80	80
7	>96	79	79	>81	80	>81	79	>80	>81	80	>80	>81
8	>96	77	>80	>80	>81	>81	>80	>80	>81	>80	>80	>80
9	>96	79	>80	79	80	>80	>81	79	>81	77	>81	>80
10	>96	>80	78	>80	>80	>80	>81	>80	>80	>80	>81	76

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −10.07 DBM
LO IN: 155.01 MHZ; +12.92 DBM
IF OUT: 30.09 MHZ; −15.97 DBM

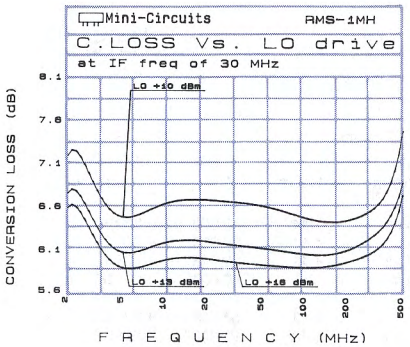
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	16	25	20	36	17	31	27	41	31	57
1	–	17	+0	30	12	35	21	37	28	38	43	45
2	72	53	40	56	40	50	42	48	39	47	41	66
3	81	65	64	65	51	69	46	62	45	64	45	67
4	>97	70	60	70	59	69	60	66	61	65	59	64
5	96	70	71	72	64	71	60	69	59	70	59	74
6	96	83	76	79	73	80	72	83	71	82	69	77
7	93	81	82	80	76	82	74	82	72	83	72	>91
8	>96	>90	>90	89	88	87	81	>90	80	>91	79	87
9	93	>90	86	88	85	90	85	89	83	90	83	>91
10	95	>91	>90	>90	>91	89	89	>90	>89	>90	89	>91

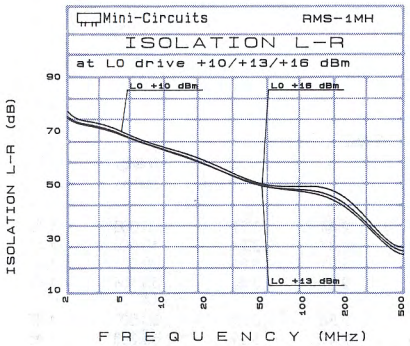
LO Harmonic Order

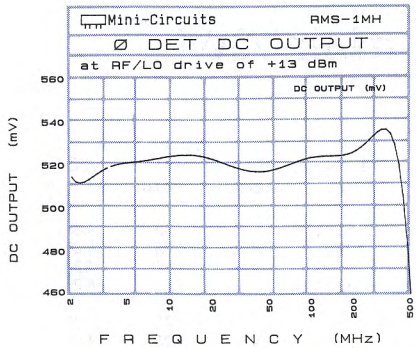
test conditions: RF IN: 185.10 MHZ; +.03 DBM
LO IN: 155.01 MHZ; +12.92 DBM
IF OUT: 30.09 MHZ; −5.99 DBM

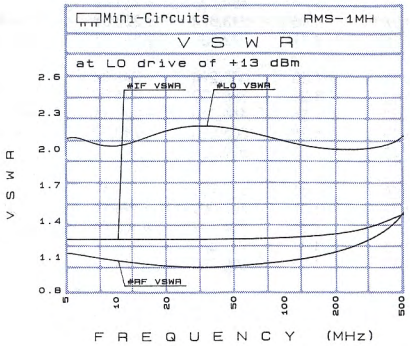
typical performance curves

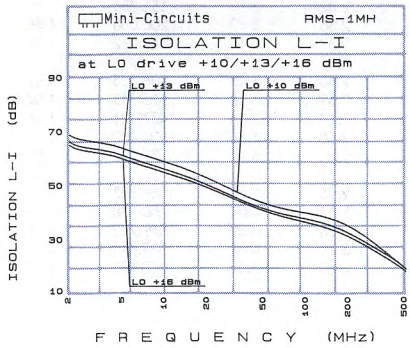
(production unit)

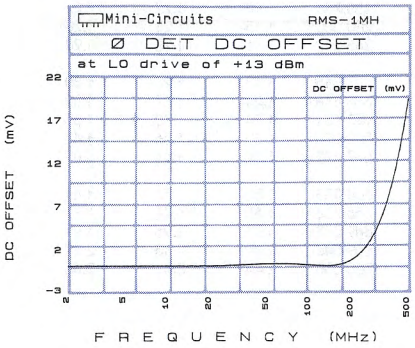












In Stock...Immediate Delivery

most widely-used, surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
RMS-2
LRMS-2R
LRMS-2



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.000	7.36	6.93	6.73	5.000	63.51	67.42	71.51	54.09	57.23	60.91
10.000	40.000	7.46	7.00	6.77	10.000	62.56	66.49	69.85	53.93	56.87	60.05
20.000	50.000	7.48	6.97	6.74	20.000	62.58	65.94	67.41	54.31	56.78	58.53
35.151	65.151	7.44	6.92	6.69	35.151	61.45	62.92	63.63	54.38	55.59	55.96
50.000	80.000	7.34	6.86	6.64	50.000	59.46	60.51	60.50	53.62	53.87	53.50
65.303	95.303	7.34	6.89	6.83	65.303	58.47	58.52	58.32	52.68	52.15	51.36
100.000	70.000	7.28	6.84	6.63	100.000	55.37	55.07	54.79	50.33	48.85	47.88
155.758	125.758	7.13	6.72	6.69	155.758	52.32	52.10	52.01	47.76	46.19	45.23
200.000	170.000	7.05	6.70	6.57	200.000	50.02	49.75	49.52	46.56	44.71	43.39
246.212	216.212	7.10	6.75	6.62	246.212	48.29	48.10	47.91	45.70	43.71	42.09
306.515	276.515	7.36	6.96	6.76	306.515	45.94	45.81	45.93	44.23	41.99	40.44
366.818	336.818	7.32	6.97	6.74	366.818	44.47	44.49	44.55	41.86	39.66	38.17
427.121	397.121	7.33	6.99	6.72	427.121	41.97	42.09	41.90	39.61	37.81	36.16
500.000	470.000	7.39	7.03	6.79	500.000	39.79	39.89	40.06	36.42	35.06	33.99
577.879	547.879	7.76	7.29	6.96	577.879	38.54	38.51	38.57	33.96	32.59	31.15
668.333	638.333	8.01	7.63	7.29	668.333	36.95	36.87	36.82	30.50	29.46	28.24
758.788	728.788	8.26	7.68	7.26	758.788	35.07	34.71	34.32	27.57	26.72	25.82
849.242	819.242	8.75	7.98	7.47	849.242	33.45	33.07	32.91	24.48	23.71	23.08
909.545	879.545	9.29	8.51	7.90	909.545	32.65	32.47	32.32	22.84	22.35	21.55
1000.000	970.000	9.54	8.90	8.34	1000.000	32.22	32.02	31.76	20.37	20.21	19.62

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.30	1.35	1.38	1.72	2.44	3.27	5.000	1.40	1.22	1.11	10.000	+230.39	−.33
10.000	1.19	1.25	1.29	1.68	2.37	3.24	10.000	1.41	1.22	1.11	20.000	+229.73	−.33
20.000	1.15	1.22	1.27	1.80	2.52	3.36	20.000	1.42	1.23	1.12	39.118	+228.12	−.33
35.151	1.15	1.22	1.28	1.79	2.57	3.40	35.151	1.43	1.23	1.11	50.000	+228.00	−.30
50.000	1.15	1.23	1.29	1.77	2.54	3.37	50.000	1.45	1.24	1.12	68.235	+225.82	−.27
65.303	1.15	1.23	1.29	1.75	2.49	3.29	65.303	1.45	1.24	1.12	97.353	+226.77	−.27
100.000	1.15	1.22	1.28	1.70	2.44	3.24	100.000	1.45	1.25	1.13	126.471	+227.26	−.01
155.758	1.14	1.22	1.27	1.72	2.43	3.29	155.758	1.45	1.25	1.14	184.706	+231.16	−.21
200.000	1.15	1.23	1.28	1.68	2.36	3.19	200.000	1.46	1.27	1.16	213.824	+228.88	−.14
246.212	1.16	1.23	1.28	1.69	2.37	3.14	246.212	1.47	1.28	1.17	272.059	+231.97	−.06
306.515	1.18	1.25	1.30	1.71	2.40	3.16	306.515	1.51	1.31	1.20	330.294	+243.02	+.13
366.818	1.21	1.27	1.32	1.75	2.39	3.15	366.818	1.54	1.34	1.23	388.529	+241.59	+.44
427.121	1.24	1.30	1.35	1.81	2.44	3.24	427.121	1.56	1.37	1.26	446.765	+221.41	+1.08
500.000	1.30	1.36	1.41	1.91	2.58	3.36	500.000	1.55	1.35	1.25	505.000	+210.09	+.90
577.879	1.39	1.44	1.49	2.07	2.74	3.57	577.879	1.61	1.43	1.33	592.353	+198.96	+.85
668.333	1.52	1.56	1.61	2.26	2.95	3.85	668.333	1.63	1.46	1.36	679.706	+195.18	+1.19
758.788	1.68	1.72	1.77	2.50	3.17	4.04	758.788	1.62	1.46	1.37	767.059	+196.67	+2.99
849.242	1.91	1.95	1.99	2.81	3.58	4.39	849.242	1.59	1.44	1.37	854.412	+185.41	+3.77
909.545	2.09	2.13	2.17	2.96	3.70	4.51	909.545	1.56	1.43	1.37	912.647	+176.74	+4.58
1000.000	2.44	2.45	2.48	3.15	3.80	4.52	1000.000	1.49	1.38	1.33	1000.000	+174.33	+5.34

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL											
0	–	–	11	21	11	52	27	46	34	53	57	49
1	–	21	+0	28	13	46	28	44	38	43	46	46
2	91	65	44	62	43	63	42	59	57	65	56	69
3	>96	62	64	62	57	60	52	65	62	71	58	66
4	>96	78	>79	>79	76	>79	>79	>80	>78	>78	>78	>78
5	>97	>78	>79	>78	78	>79	76	>79	78	>80	76	>78
6	>95	>78	>79	>78	>79	>79	78	>78	>79	>79	>79	>79
7	>96	>80	>79	>77	>78	>79	76	>79	75	78	>79	>80
8	>97	>79	>79	>79	77	>78	78	>79	79	>79	>78	78
9	>96	>78	>79	>79	>79	>78	>78	78	>80	>79	79	>78
10	96	>79	>79	>79	78	>79	>79	77	>80	>79	79	>80
		0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −9.94 DBM
LO IN: 470.01 MHZ; +6.95 DBM
IF OUT: 30.09 MHZ; −16.94 DBM

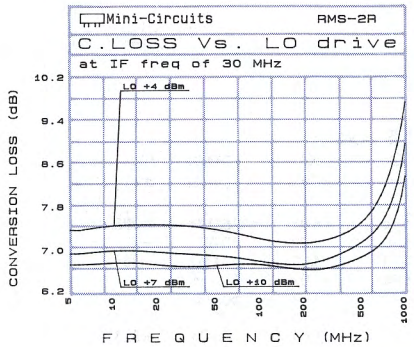
RF ORDER HARMONIC	RF CAL											
0	–	–	20	33	23	57	39	58	64	70	57	65
1	–	21	+0	28	13	50	31	51	45	51	56	62
2	72	47	37	48	37	62	41	57	56	78	58	88
3	88	41	40	48	37	54	40	68	51	58	54	54
4	95	65	58	56	56	58	50	62	49	63	64	69
5	94	60	64	57	45	62	46	54	48	60	62	70
6	>95	77	77	75	69	71	67	64	84	66	65	70
7	>96	73	72	77	72	67	56	63	54	62	55	67
8	>97	84	85	85	86	84	82	69	67	77	67	75
9	>96	76	88	84	79	81	79	84	67	81	72	74
10	>97	87	86	>88	>89	>88	>87	87	83	74	76	74
		0	1	2	3	4	5	6	7	8	9	10

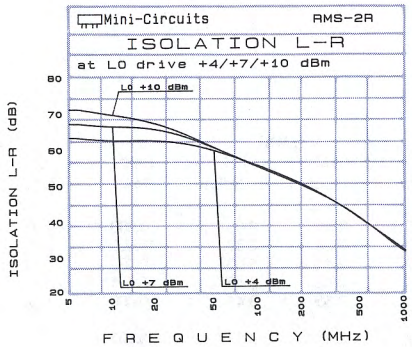
LO Harmonic Order

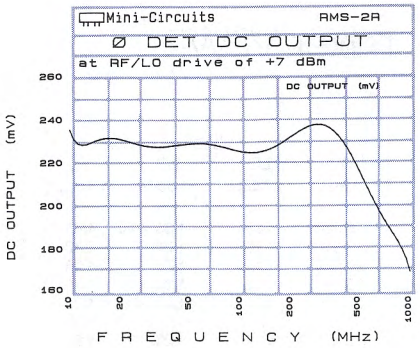
test conditions: RF IN: 500.10 MHZ; +.08 DBM
LO IN: 470.01 MHZ; +6.95 DBM
IF OUT: 30.09 MHZ; −7.19 DBM

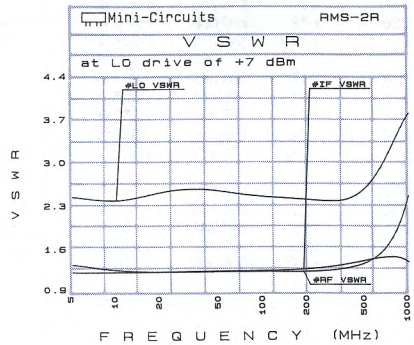
typical performance curves

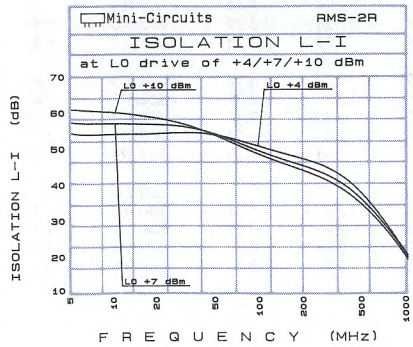
(production unit)

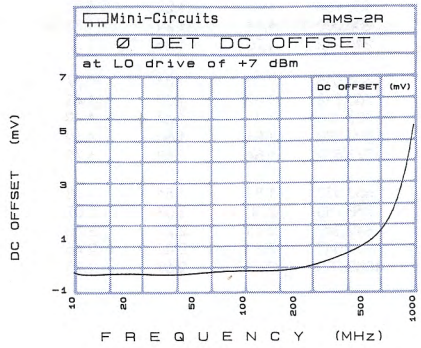












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Models
RMS-2LH
LRMS-2LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	Isolation L-R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L-I (dB) LO +7dBm	LO +10dBm	LO +13dBm
5.000	35.000	7.21	6.77	6.54	5.000	62.90	63.03	63.17	61.70	59.74	58.59
10.000	40.000	7.35	6.92	6.69	10.000	60.72	60.63	60.56	56.64	54.85	53.02
20.000	50.000	7.43	6.93	6.68	20.000	56.90	56.56	56.38	50.87	48.96	47.44
35.151	65.151	7.26	6.82	6.54	35.151	52.94	52.70	52.19	46.68	44.78	43.21
50.000	80.000	7.27	6.80	6.52	50.000	50.55	50.21	49.76	44.19	42.03	40.63
65.303	95.303	7.19	6.77	6.55	65.303	48.62	48.42	48.07	42.20	40.14	38.52
100.000	70.000	7.09	6.71	6.43	100.000	45.57	46.01	45.50	38.94	37.18	35.43
155.758	125.758	7.05	6.67	6.50	155.758	45.00	44.69	43.50	36.99	34.75	32.64
200.000	170.000	7.00	6.65	6.50	200.000	43.27	42.20	40.74	35.71	33.10	30.66
246.212	216.212	7.14	6.76	6.58	246.212	41.61	40.22	38.78	33.82	31.46	29.12
306.515	276.515	7.21	6.78	6.54	306.515	38.09	37.07	35.78	30.82	29.28	27.31
366.818	336.818	6.99	6.62	6.43	366.818	35.00	33.94	32.69	27.62	26.64	24.87
427.121	397.121	7.07	6.68	6.48	427.121	32.17	30.94	29.87	25.77	24.95	23.42
500.000	470.000	7.13	6.70	6.51	500.000	29.37	28.40	27.45	23.10	22.81	21.62
577.879	547.879	7.16	6.71	6.51	577.879	26.83	25.77	25.06	20.87	20.52	19.50
668.333	638.333	7.47	7.07	6.91	668.333	24.18	23.71	22.90	18.33	18.54	17.51
758.788	728.788	8.23	7.63	7.34	758.788	22.16	21.83	21.42	16.22	16.38	15.80
849.242	819.242	9.07	8.30	7.83	849.242	20.62	20.52	20.48	14.76	14.77	14.11
909.545	879.545	9.58	8.82	8.38	909.545	19.88	20.13	20.36	14.06	14.18	13.66
1000.000	970.000	9.80	9.17	8.89	1000.000	19.27	19.83	20.36	12.63	12.95	12.47

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.33	1.36	1.41	1.63	2.36	3.52	5.000	1.32	1.14	1.01	5.000	+328.30	-.65
10.000	1.19	1.24	1.30	1.60	2.34	3.39	10.000	1.33	1.15	1.02	10.000	+333.90	-.64
20.000	1.12	1.20	1.26	1.69	2.44	3.55	20.000	1.32	1.14	1.02	20.000	+331.70	-.64
35.151	1.12	1.20	1.26	1.64	2.42	3.45	35.151	1.32	1.14	1.02	35.151	+327.10	-.62
50.000	1.11	1.20	1.26	1.61	2.36	3.41	50.000	1.32	1.14	1.03	50.000	+326.90	-.55
65.303	1.11	1.20	1.26	1.59	2.31	3.37	65.303	1.33	1.14	1.04	65.303	+323.10	-.55
100.000	1.12	1.20	1.27	1.61	2.32	3.29	100.000	1.33	1.15	1.05	100.000	+326.50	-.94
155.758	1.14	1.22	1.28	1.64	2.34	3.41	155.758	1.35	1.17	1.09	155.758	+329.40	-1.40
200.000	1.17	1.24	1.30	1.64	2.28	3.29	200.000	1.37	1.20	1.12	200.000	+330.90	-.71
246.212	1.20	1.26	1.32	1.64	2.29	3.28	246.212	1.38	1.21	1.14	246.212	+337.50	+1.33
306.515	1.25	1.31	1.37	1.69	2.32	3.17	306.515	1.40	1.24	1.17	306.515	+345.80	+2.25
366.818	1.32	1.37	1.43	1.76	2.33	3.09	366.818	1.42	1.26	1.21	366.818	+357.50	+5.78
427.121	1.39	1.44	1.49	1.82	2.40	3.17	427.121	1.42	1.28	1.22	427.121	+332.90	+8.81
500.000	1.51	1.54	1.60	1.94	2.47	3.24	500.000	1.38	1.24	1.19	500.000	+318.00	+11.81
577.879	1.64	1.68	1.72	2.00	2.54	3.26	577.879	1.39	1.27	1.23	577.879	+301.88	+13.86
668.333	1.81	1.84	1.88	2.13	2.67	3.44	668.333	1.36	1.25	1.22	668.333	+306.80	+19.75
758.788	2.00	2.03	2.07	2.28	2.83	3.54	758.788	1.30	1.22	1.21	758.788	+308.30	+27.51
849.242	2.23	2.27	2.32	2.43	2.95	3.58	849.242	1.26	1.18	1.19	849.242	+286.14	+28.33
909.545	2.39	2.42	2.46	2.49	2.94	3.59	909.545	1.22	1.16	1.18	909.546	+279.70	+27.10
1000.000	2.67	2.69	2.70	2.53	2.91	3.49	1000.000	1.16	1.13	1.17	1000.000	+276.78	+24.83

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+4	8	2	19	26	23	18	44	25	36
1	–	15	+0	33	14	25	26	43	33	37	39	46
2	90	48	37	49	36	61	38	51	58	52	47	59
3	>97	69	73	63	68	63	63	63	68	74	64	65
4	>95	>79	>80	75	75	76	>80	75	75	>79	76	>79
5	>95	>78	>79	>79	>79	>80	>79	>80	>80	>79	77	>79
6	>96	75	78	>79	76	>80	79	>79	78	79	78	78
7	>97	>79	>78	>78	>79	>79	>79	78	>80	>80	>80	78
8	>96	>79	>79	>79	78	77	>79	>79	>80	>80	>79	>80
9	>96	78	76	76	>79	>79	>79	>79	>79	>79	>80	>79
10	>96	>80	>79	>80	>79	>79	>79	>79	>79	>79	>80	>79

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −10.01 DBM
LO IN: 470.01 MHZ; +10.01 DBM
IF OUT: 30.09 MHZ; −16.67 DBM

RF CAL

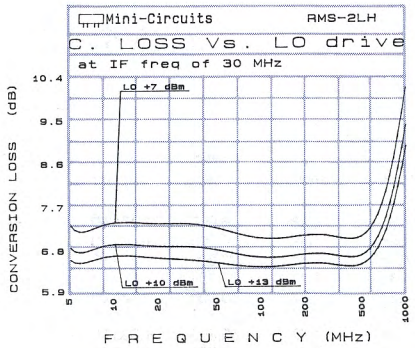
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	5	19	13	31	33	36	35	50	41	58
1	–	15	+0	31	14	29	28	48	37	40	44	51
2	72	41	31	43	28	44	32	50	55	51	40	62
3	87	51	53	44	45	46	47	42	50	59	53	52
4	>96	65	58	53	51	50	49	54	47	55	60	59
5	>96	76	70	77	62	71	60	61	65	68	65	71
6	>96	77	87	79	73	67	72	66	65	62	68	65
7	>96	85	80	85	79	84	73	81	72	77	69	69
8	93	>89	>89	86	>88	87	88	80	74	75	72	81
9	>96	87	88	88	>89	85	88	83	79	76	82	76
10	>96	>90	88	86	88	>88	>89	>89	85	>89	>89	88

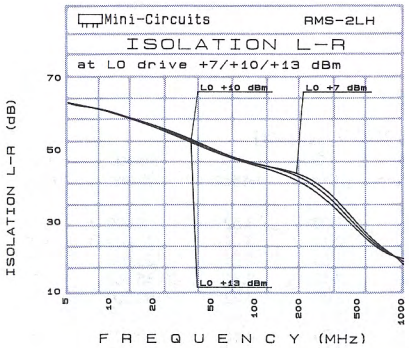
LO Harmonic Order

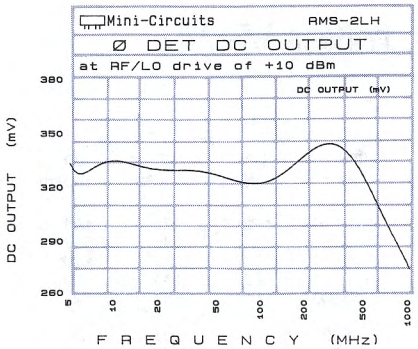
test conditions: RF IN: 500.10 MHZ; −.05 DBM
LO IN: 470.01 MHZ; +10.01 DBM
IF OUT: 30.09 MHZ; −6.85 DBM

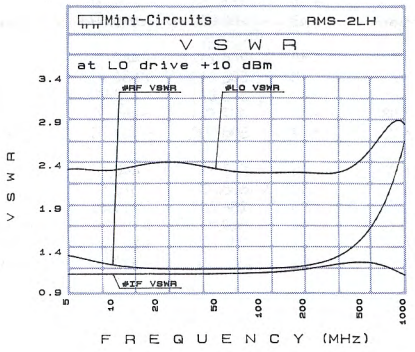
typical performance curves

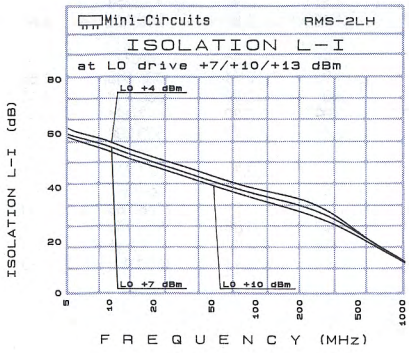
(production unit)

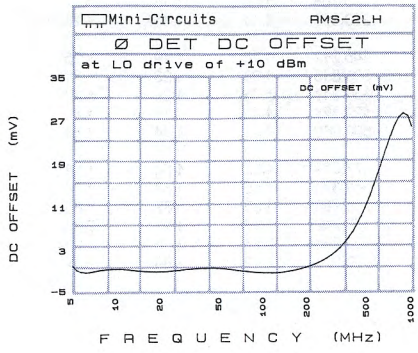












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Models
RMS-2MH
LRMS-2MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
5.000	35.000	7.41	6.87	6.60	5.000	68.00	67.46	67.25	64.60	60.42	58.26
10.000	40.000	7.27	6.71	6.43	10.000	61.75	61.14	60.85	58.56	54.89	52.71
20.000	50.000	7.41	6.81	6.50	20.000	55.65	55.36	55.06	53.14	49.28	47.35
35.151	65.151	7.42	6.82	6.50	35.151	50.90	50.90	50.76	47.75	44.75	42.96
50.000	80.000	7.46	6.86	6.52	50.000	48.21	48.33	48.26	45.36	42.38	40.27
65.303	95.303	7.37	6.76	6.47	65.303	46.21	46.42	46.53	43.63	40.39	38.31
100.000	70.000	7.30	6.73	6.46	100.000	43.43	44.03	44.68	41.54	37.91	35.78
155.758	125.758	7.07	6.54	6.34	155.758	42.00	43.58	43.20	41.16	37.14	34.01
200.000	170.000	6.99	6.54	6.35	200.000	42.03	42.48	41.47	40.48	36.16	32.68
246.212	216.212	7.07	6.62	6.43	246.212	41.80	40.92	39.46	37.44	34.54	31.13
306.515	276.515	7.26	6.76	6.50	306.515	39.70	38.19	37.21	32.86	31.82	29.51
366.818	336.818	7.35	6.79	6.46	366.818	36.73	34.91	33.65	29.34	28.84	26.71
427.121	397.121	7.11	6.59	6.33	427.121	33.75	32.18	30.97	26.78	26.69	25.11
500.000	470.000	6.95	6.52	6.32	500.000	30.60	29.15	28.09	24.29	24.87	23.43
577.879	547.879	7.19	6.74	6.54	577.879	27.74	26.48	25.54	22.08	22.60	21.35
668.333	638.333	7.51	7.07	6.78	668.333	25.24	24.41	23.63	19.75	20.55	19.39
758.788	728.788	7.91	7.37	7.08	758.788	22.84	22.47	21.97	17.57	18.54	18.08
849.242	819.242	8.61	7.86	7.43	849.242	20.95	20.85	20.75	16.26	16.52	16.18
909.546	879.546	9.18	8.30	7.75	909.546	19.82	19.83	19.82	15.31	15.54	15.05
1000.000	970.000	9.54	8.73	8.22	1000.000	18.72	19.01	19.26	13.94	14.41	14.09

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.22	1.26	1.31	1.43	2.23	3.52	5.000	1.70	1.38	1.18	5.000	+474.50	−.06
10.000	1.11	1.16	1.23	1.34	2.14	3.44	10.000	1.70	1.38	1.18	10.000	+486.20	−.05
20.000	1.04	1.12	1.20	1.28	2.06	3.24	20.000	1.70	1.38	1.18	20.000	+484.90	−.01
35.151	1.02	1.13	1.21	1.36	2.13	3.31	35.151	1.70	1.38	1.17	35.151	+511.00	+.06
50.000	1.03	1.13	1.21	1.35	2.09	3.22	50.000	1.69	1.37	1.17	50.000	+526.80	+.21
65.303	1.03	1.13	1.21	1.30	2.04	3.15	65.303	1.69	1.37	1.17	65.303	+505.80	+.45
100.000	1.04	1.14	1.21	1.28	2.02	3.10	100.000	1.69	1.37	1.17	100.000	+489.30	−.21
155.758	1.08	1.15	1.22	1.27	1.97	2.94	155.758	1.69	1.37	1.18	155.758	+501.70	−.91
200.000	1.11	1.16	1.23	1.27	1.95	2.87	200.000	1.69	1.37	1.18	200.000	+515.60	−1.23
246.212	1.14	1.19	1.25	1.31	1.98	2.86	246.212	1.68	1.37	1.18	246.212	+487.00	+.94
306.515	1.20	1.23	1.29	1.35	1.93	2.71	306.515	1.68	1.37	1.18	306.515	+536.60	+2.37
366.818	1.26	1.29	1.34	1.42	2.04	2.89	366.818	1.66	1.35	1.17	366.818	+475.90	+6.58
427.121	1.32	1.35	1.40	1.49	2.09	2.89	427.121	1.62	1.33	1.17	427.121	+457.60	+10.90
500.000	1.41	1.44	1.48	1.58	2.11	2.79	500.000	1.55	1.28	1.12	500.000	+401.70	+15.53
577.879	1.52	1.54	1.58	1.66	2.15	2.80	577.879	1.51	1.26	1.12	577.879	+440.10	+23.21
668.333	1.65	1.68	1.71	1.77	2.21	2.84	668.333	1.45	1.23	1.10	668.333	+376.40	+34.10
758.788	1.80	1.82	1.85	1.87	2.31	2.89	758.788	1.40	1.21	1.08	758.788	+391.40	+46.83
849.242	1.97	1.98	2.04	2.03	2.47	3.05	849.242	1.37	1.18	1.06	849.242	+428.80	+49.54
909.546	2.17	2.18	2.23	2.13	2.56	3.14	909.546	1.34	1.16	1.05	909.546	+380.20	+47.85
1000.000	2.42	2.43	2.44	2.21	2.61	3.15	1000.000	1.30	1.13	1.03	1000.000	+432.10	+43.09

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL											
0	-	-	+11	4	3	20	12	29	30	30	39	33
1	-	6	+0	27	15	35	39	39	37	57	56	55
2	89	48	42	50	38	48	48	60	57	57	60	64
3	94	>77	65	65	61	69	63	76	77	78	75	>78
4	>94	>77	>77	>78	76	77	74	>77	>78	76	77	>78
5	>95	>78	>78	>78	>78	>79	>79	77	77	>78	74	>78
6	>95	76	>78	77	76	>77	>79	>79	>78	>78	74	>77
7	>95	76	>78	>79	>78	75	>78	>79	>78	>78	>78	76
8	>90	>72	>79	76	77	>78	>77	>77	>78	>78	77	>79
9	>88	>71	71	>78	>78	>78	>78	>77	75	>78	>78	>78
10	87	>72	>72	>73	77	>77	>78	76	>77	77	>78	77
		0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 750.10 MHZ; −10.00 DBM
LO IN: 720.01 MHZ; +12.97 DBM
IF OUT: 30.09 MHZ; −17.65 DBM

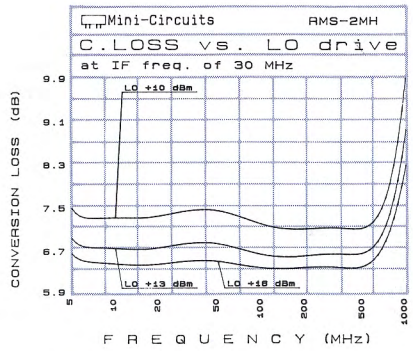
RF ORDER HARMONIC	RF CAL											
0	-	-	+2	15	15	30	23	40	37	45	51	49
1	-	6	+0	27	15	35	37	38	39	56	58	60
2	70	38	32	39	28	39	38	49	45	47	54	56
3	78	71	52	51	48	59	49	61	67	64	64	70
4	>96	79	76	67	56	62	53	60	62	71	73	72
5	>96	82	78	82	69	68	64	68	65	79	81	84
6	>96	>88	88	>89	86	84	71	77	68	75	78	>88
7	>96	>87	>88	>89	>89	86	82	79	74	78	76	84
8	>91	>82	>88	>88	>89	88	>87	>87	83	85	81	85
9	>88	>81	>83	>89	87	88	>88	86	85	86	83	87
10	90	82	>83	>83	>88	>87	>89	>88	>87	>87	>89	>89
		0	1	2	3	4	5	6	7	8	9	10

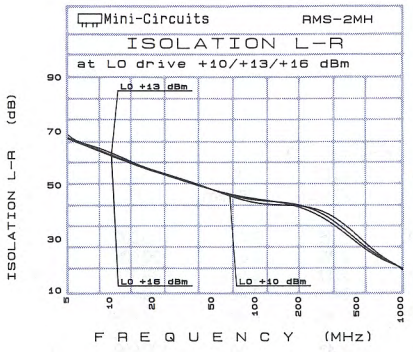
LO Harmonic Order

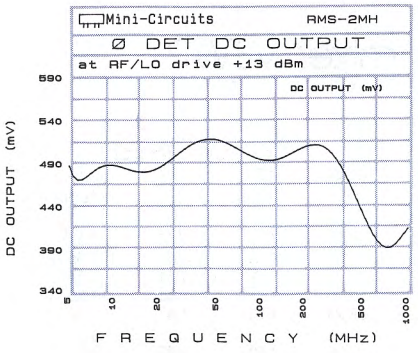
test conditions: RF IN: 750.10 MHZ; +.05 DBM
LO IN: 720.01 MHZ; +12.98 DBM
IF OUT: 30.09 MHZ; −7.55 DBM

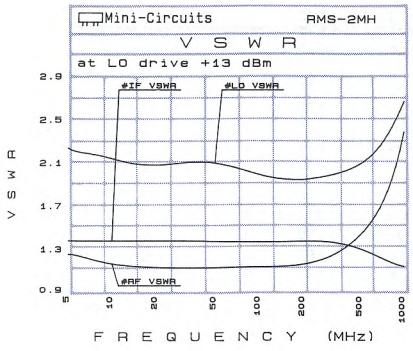
typical performance curves

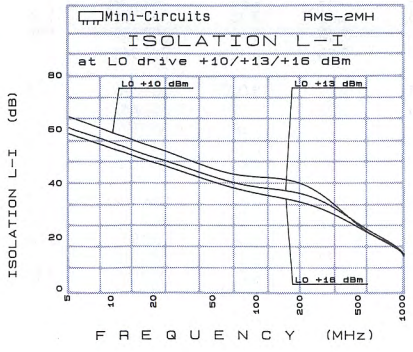
(production unit)

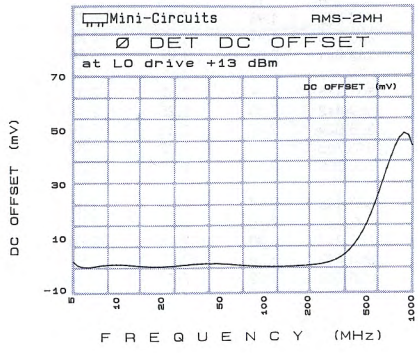












In Stock...Immediate Delivery

most widely-used, surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
RMS-2U
LRMS-2U



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
10.000	40.000	5.89	5.69	5.59	10.000	54.08	55.08	56.02	56.58	57.44	57.25
20.000	50.000	6.01	5.78	5.68	20.000	53.01	53.83	54.58	53.57	52.73	51.98
39.118	69.118	6.18	5.90	5.76	39.118	50.70	51.99	51.76	48.99	47.22	47.02
50.000	80.000	6.14	5.88	5.74	50.000	49.49	51.27	50.26	47.00	45.11	45.30
68.235	98.235	6.06	5.83	5.72	68.235	47.86	49.27	48.10	44.43	42.51	42.63
100.000	70.000	5.97	5.82	5.72	100.000	45.46	46.22	45.85	41.67	39.55	39.22
126.471	96.471	6.14	5.90	5.76	126.471	43.90	44.61	44.63	39.82	37.77	37.05
155.588	125.588	6.30	6.04	5.88	155.588	42.73	43.33	43.53	38.44	35.95	34.84
200.000	170.000	6.65	6.28	6.03	200.000	41.63	42.36	42.99	36.81	34.23	33.08
242.941	212.941	6.76	6.39	6.13	242.941	41.41	42.52	42.95	35.71	32.47	30.63
301.176	271.176	7.02	6.60	6.33	301.176	41.43	42.44	43.27	34.38	31.27	29.43
330.294	300.294	6.95	6.58	6.24	330.294	41.60	42.50	42.67	33.85	30.71	28.56
388.529	358.529	7.27	6.70	6.44	388.529	40.92	42.62	42.67	32.34	29.23	27.36
446.765	416.765	7.04	6.58	6.19	446.765	36.93	38.36	39.45	31.17	28.68	27.09
500.000	470.000	7.16	6.61	6.26	500.000	35.46	35.52	36.63	29.59	27.43	26.20
592.353	562.353	7.38	6.89	6.59	592.353	35.99	34.35	33.58	31.09	28.33	26.50
708.824	678.824	7.84	7.34	6.97	708.824	35.44	34.65	33.66	31.77	29.18	28.34
796.176	766.176	8.02	7.61	7.33	796.176	31.93	30.87	30.32	29.22	28.03	28.82
912.647	882.647	8.34	7.98	7.68	912.647	31.42	29.10	27.76	25.56	26.37	30.61
1000.000	970.000	8.63	8.28	8.07	1000.000	31.17	28.18	26.44	22.44	24.07	28.80

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm
10.000	1.79	1.73	1.67	1.70	2.45	3.47	10.000	1.71	1.65	1.65
20.000	1.70	1.63	1.56	1.76	2.59	3.63	20.000	1.38	1.34	1.35
39.118	1.69	1.61	1.54	1.72	2.49	3.54	39.118	1.25	1.20	1.21
50.000	1.71	1.63	1.56	1.69	2.47	3.48	50.000	1.23	1.17	1.19
68.235	1.75	1.67	1.59	1.68	2.44	3.43	68.235	1.21	1.14	1.16
100.000	1.80	1.72	1.63	1.69	2.43	3.38	100.000	1.20	1.12	1.14
155.588	1.91	1.81	1.73	1.74	2.44	3.25	155.588	1.18	1.11	1.15
184.706	1.98	1.87	1.78	1.68	2.40	3.15	184.706	1.16	1.11	1.16
200.000	1.99	1.89	1.80	1.70	2.35	3.15	200.000	1.15	1.11	1.17
242.941	2.09	1.97	1.88	1.70	2.33	3.12	242.941	1.13	1.12	1.19
301.176	2.27	2.12	2.02	1.71	2.29	3.02	301.176	1.11	1.16	1.25
359.412	2.40	2.25	2.13	1.74	2.25	2.92	359.412	1.12	1.22	1.32
388.529	2.47	2.31	2.19	1.75	2.23	2.89	388.529	1.14	1.26	1.36
446.765	2.67	2.47	2.33	1.77	2.21	2.84	446.765	1.21	1.36	1.48
500.000	2.39	2.20	2.06	1.84	2.29	2.91	500.000	1.37	1.54	1.65
534.118	2.61	2.43	2.31	1.85	2.28	2.87	534.118	1.39	1.56	1.68
592.353	2.76	2.57	2.45	1.86	2.29	2.89	592.353	1.53	1.71	1.83
737.941	3.00	2.83	2.74	1.92	2.31	2.86	737.941	2.04	2.24	2.39
854.412	3.18	3.03	2.91	2.02	2.30	2.82	854.412	2.48	2.68	2.81
1000.000	3.52	3.42	3.27	2.17	2.32	2.72	1000.000	3.14	3.24	3.30

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+0	15	8	31	13	25	19	43	45	49
1	–	28	0	32	16	41	37	36	34	40	42	47
2	>97	58	46	55	44	61	57	58	50	56	48	70
3	95	74	59	69	53	69	57	>74	69	>74	59	69
4	>96	>74	>75	>75	73	>74	69	>75	>75	>74	>74	>74
5	94	>74	>74	>75	>75	>75	>75	74	74	>75	>73	>74
6	>96	>73	>74	>74	>75	>75	74	>75	74	70	>74	>75
7	>96	72	>73	>74	>74	>75	>75	>76	>74	>75	>75	>74
8	>96	>75	>75	73	>73	>74	73	>75	>75	>75	>75	>75
9	92	>74	>74	>74	>74	>74	>75	>75	73	>75	>75	>75
10	>96	>74	>74	>73	>75	>74	73	>74	>74	74	>75	>75

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −14.96 DBM
LO IN: 470.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −21.37 DBM

RF CAL

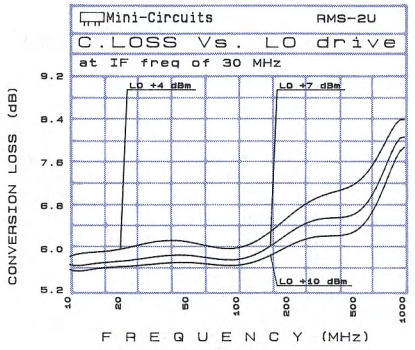
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	9	27	19	49	25	37	34	57	52	71
1	–	28	0	31	16	46	39	41	41	47	52	56
2	82	45	38	46	35	54	45	56	45	56	47	65
3	95	56	39	48	37	49	44	59	60	56	49	56
4	93	68	69	66	53	54	48	60	58	62	62	62
5	>96	62	72	65	59	57	52	60	54	69	65	69
6	>95	71	72	79	72	71	61	64	57	70	66	73
7	94	>84	80	83	>85	77	74	77	65	67	67	73
8	>97	>84	81	83	76	83	78	82	70	73	64	80
9	>97	83	>85	>84	>84	81	80	>84	80	75	82	70
10	96	84	>84	>84	>83	>84	>84	83	83	>84	76	83

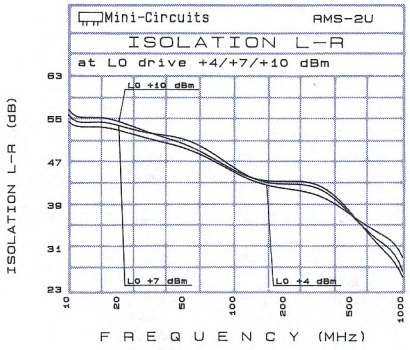
LO Harmonic Order

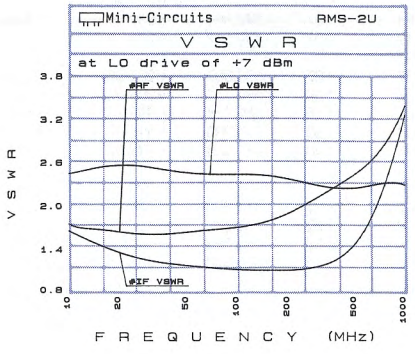
test conditions: RF IN: 500.10 MHZ; −4.98 DBM
LO IN: 470.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; −11.23 DBM

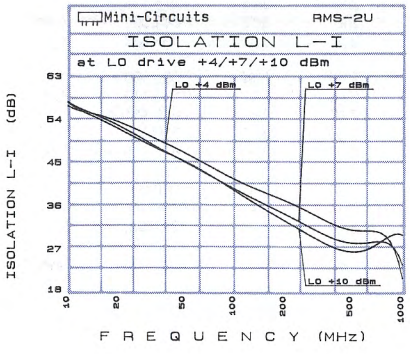
typical performance curves

(production unit)









In Stock...Immediate Delivery

most widely-used, surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

RMS-5
LRMS-5
LRMS-5R



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq.- (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.000	6.56	6.17	5.95	5.000	77.61	78.28	78.52	69.01	82.08	77.02
10.000	40.000	6.45	6.03	5.79	10.000	71.70	73.09	73.85	63.30	75.39	72.75
20.000	50.000	6.30	5.86	5.58	20.000	65.75	67.43	68.70	56.85	67.33	69.10
50.000	80.000	5.86	5.46	5.27	50.000	58.22	60.16	61.98	49.81	61.16	60.18
100.000	70.000	5.65	5.31	5.14	100.000	51.76	53.66	55.73	43.72	53.86	54.91
149.677	119.677	5.65	5.33	5.15	149.677	48.05	50.07	51.88	40.10	50.77	51.03
200.000	170.000	5.67	5.37	5.22	200.000	45.70	47.54	49.42	37.65	48.24	48.88
246.129	216.129	5.89	5.54	5.34	246.129	43.96	45.92	47.81	36.21	48.66	44.32
342.581	312.581	6.12	5.71	5.44	342.581	41.17	43.07	44.96	34.58	48.72	38.42
439.032	409.032	6.17	5.77	5.51	439.032	38.94	40.76	42.41	34.20	43.78	33.68
500.000	470.000	6.52	5.97	5.64	500.000	37.83	39.74	41.60	35.19	38.41	30.83
583.710	553.710	6.87	6.25	5.90	583.710	36.92	39.21	41.49	35.66	33.19	27.46
680.161	650.161	7.26	6.55	6.09	680.161	35.89	38.34	40.17	33.77	29.32	24.53
750.000	720.000	7.71	6.89	6.36	750.000	35.57	37.60	38.86	30.59	26.77	23.19
873.065	843.065	8.22	7.45	6.96	873.065	34.72	36.91	37.92	25.15	21.63	19.44
1000.000	970.000	8.19	7.70	7.38	1000.000	33.19	35.50	37.01	20.93	18.14	16.11
1114.194	1084.194	8.20	7.76	7.48	1114.194	31.77	33.72	35.34	18.44	16.32	14.67
1210.645	1180.645	8.39	8.02	7.78	1210.645	30.70	32.50	33.79	16.50	14.96	13.44
1355.323	1325.323	8.78	8.41	8.25	1355.323	28.98	30.92	32.34	14.10	13.25	12.20
1500.000	1470.000	9.59	8.83	8.49	1500.000	26.92	28.64	29.93	12.76	12.28	11.48

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	2.73	2.64	2.55	1.68	2.43	3.47	5.000	1.51	1.21	1.03	5.000	+221.90	−.01
10.000	1.68	1.62	1.58	1.67	2.43	3.47	10.000	1.52	1.22	1.03	10.000	+231.01	−.01
20.000	1.45	1.37	1.32	1.62	2.37	3.38	20.000	1.52	1.22	1.03	20.000	+233.72	−.01
50.000	1.38	1.27	1.19	1.71	2.46	3.47	50.000	1.52	1.21	1.03	50.000	+231.15	+0.00
100.000	1.41	1.29	1.20	1.63	2.38	3.29	100.000	1.53	1.22	1.04	100.000	+236.20	+.06
149.677	1.47	1.34	1.24	1.60	2.33	3.27	149.677	1.53	1.22	1.05	149.677	+244.16	+.17
200.000	1.53	1.40	1.30	1.63	2.28	3.20	200.000	1.53	1.22	1.06	200.000	+238.66	+.31
246.129	1.61	1.48	1.37	1.62	2.29	3.15	246.129	1.52	1.22	1.06	246.129	+241.33	+.63
342.581	1.82	1.68	1.57	1.70	2.29	3.12	342.581	1.51	1.21	1.07	342.581	+239.71	+1.04
439.032	2.09	1.93	1.80	1.79	2.33	3.12	439.032	1.46	1.19	1.07	439.032	+206.12	+1.79
500.000	2.27	2.10	1.96	1.86	2.41	3.19	500.000	1.43	1.17	1.07	500.000	+203.55	+2.00
583.710	2.56	2.36	2.22	1.96	2.48	3.27	583.710	1.35	1.13	1.09	583.710	+208.69	+3.07
680.161	2.96	2.71	2.52	2.12	2.69	3.40	680.161	1.25	1.08	1.15	680.161	+199.24	+4.09
750.000	3.17	2.92	2.74	2.25	2.80	3.59	750.000	1.10	1.14	1.30	750.000	+193.29	+5.44
873.065	3.56	3.32	3.14	2.54	3.09	3.90	873.065	1.07	1.23	1.40	873.065	+192.02	+6.35
1000.000	3.73	3.56	3.40	2.73	3.20	3.82	1000.000	1.36	1.57	1.75	1000.000	+200.88	+5.97
1114.194	3.76	3.69	3.53	2.81	3.18	3.93	1114.194	1.81	2.02	2.23	1114.194	+188.00	+5.59
1210.645	3.79	3.73	3.66	2.95	3.19	3.94	1210.645	2.36	2.60	2.82	1210.645	+183.61	+5.78
1355.323	3.78	3.75	3.73	3.15	3.12	4.13	1355.323	3.52	3.78	4.03	1355.323	+192.03	+6.69
1500.000	3.86	3.83	3.80	3.29	2.98	4.30	1500.000	4.99	5.07	5.22	1500.000	+185.85	+8.33

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+2	18	5	21	10	33	28	38	38	43
1	–	9	0	31	20	33	31	34	35	46	40	51
2	>96	53	39	48	37	57	45	46	51	52	58	55
3	>94	66	67	60	60	60	68	65	64	63	65	68
4	>94	>73	71	72	>74	>74	>73	73	>74	70	>73	>72
5	>95	73	>73	>73	72	>73	>74	>73	>74	71	>72	>73
6	>95	>73	>74	>74	>73	>74	>73	72	>73	>73	72	73
7	>96	73	>73	>74	>74	>72	73	>74	>74	>74	>74	>73
8	>90	67	>74	>73	>73	>74	>72	73	>74	73	>74	>73
9	>87	65	>67	72	>73	>74	>73	>72	>73	>74	73	>74
10	>90	67	>66	>67	>74	72	73	>73	>72	>73	>73	>74

LO Harmonic Order

test conditions: RF IN: 750.10 MHZ; −14.98 DBM
LO IN: 720.01 MHZ; +6.97 DBM
IF OUT: 30.09 MHZ; −22.17 DBM

RF ORDER HARMONIC

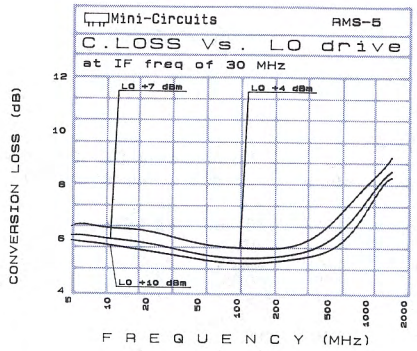
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	7	28	16	31	23	50	39	54	53	67
1	–	9	0	32	21	36	35	38	41	56	46	68
2	79	44	30	42	27	49	39	43	46	51	56	58
3	91	49	51	43	46	44	55	51	52	52	54	61
4	>94	65	62	63	54	49	55	54	58	51	76	59
5	95	75	70	71	76	62	64	57	70	63	67	60
6	>95	>83	>83	79	73	79	74	64	69	66	77	64
7	>96	>84	>84	>83	>83	82	83	75	82	67	79	74
8	>90	77	>83	>84	>84	>85	>82	>83	>84	74	82	78
9	>89	>76	>79	>83	82	83	>83	>82	>83	>83	>84	77
10	89	>78	>77	>77	>83	>83	83	82	81	>83	>84	>84

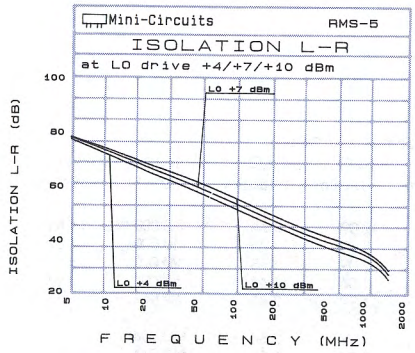
LO Harmonic Order

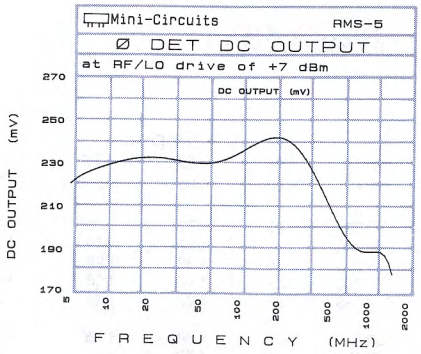
test conditions: RF IN: 750.10 MHZ; −5.04 DBM
LO IN: 720.01 MHZ; +6.97 DBM
IF OUT: 30.09 MHZ; −11.98 DBM

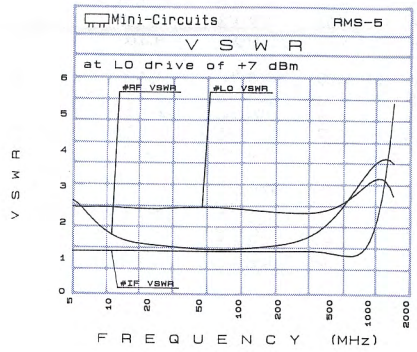
typical performance curves

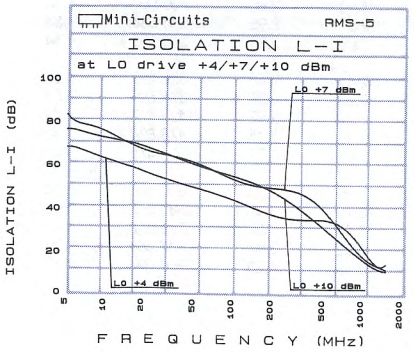
(production unit)

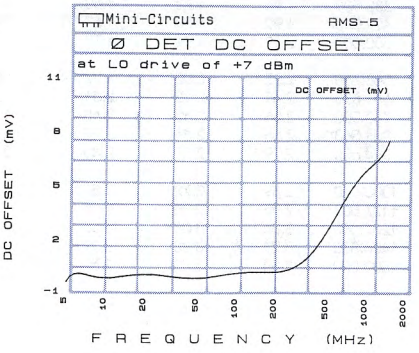












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Models
RMS-5MH
LRMS-5MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	Isolation L-R (dB) LO +10dBm	LO +13dBm	LO +16dBm	Isolation L-I (dB) LO +10dBm	LO +13dBm	LO +16dBm
10.000	40.000	6.19	5.67	5.41	10.000	75.02	72.72	71.13	64.92	71.62	72.43
20.000	50.000	5.91	5.34	5.11	20.000	68.86	69.32	68.89	58.72	67.42	69.79
50.000	80.000	5.67	5.13	4.83	50.000	63.03	64.80	65.49	52.46	61.00	68.55
100.000	70.000	5.34	4.84	4.61	100.000	55.25	57.53	59.59	44.78	52.99	63.30
149.688	119.688	5.29	4.83	4.64	149.688	49.18	51.47	54.06	38.90	47.61	54.72
200.000	170.000	5.22	4.84	4.66	200.000	42.62	45.11	47.66	33.29	42.45	50.33
289.375	259.375	5.71	5.23	4.92	289.375	40.53	42.74	44.83	31.70	40.45	47.39
382.500	352.500	6.15	5.65	5.17	382.500	37.75	40.00	42.00	29.04	38.72	39.28
429.063	399.063	6.33	5.74	5.43	429.063	36.23	38.30	39.79	28.28	38.06	37.13
500.000	470.000	6.69	5.96	5.54	500.000	34.56	36.54	38.40	27.19	37.26	32.19
568.750	538.750	7.04	6.21	5.76	568.750	33.85	36.02	38.14	27.80	36.79	27.85
661.875	631.875	7.27	6.31	5.86	661.875	32.14	34.63	36.57	27.98	31.64	24.96
750.000	720.000	7.90	6.75	6.17	750.000	30.64	32.69	33.86	27.83	27.81	22.50
801.563	771.563	8.21	7.02	6.38	801.563	30.07	32.12	33.03	27.37	26.48	22.48
894.688	864.688	8.69	7.51	6.87	894.688	29.08	31.35	32.02	25.70	22.10	19.21
1000.000	970.000	8.85	8.06	7.47	1000.000	27.23	29.45	30.79	22.14	18.64	16.09
1127.500	1097.500	8.67	8.09	7.67	1127.500	25.53	27.46	29.11	19.50	16.61	14.31
1267.188	1237.188	8.60	8.18	8.07	1267.188	24.74	26.47	27.96	15.66	13.75	12.02
1406.875	1376.875	8.64	8.33	8.30	1406.875	24.15	26.08	27.52	13.49	12.44	11.22
1500.000	1470.000	9.20	8.59	8.44	1500.000	23.67	25.44	26.71	11.82	11.30	10.43

mixer VSWR

freq. MHz	VSWR, RF port LO +10dBm	LO +13dBm	LO +16dBm	VSWR, LO port LO +10dBm	LO +13dBm	LO +16dBm	freq. (MHz)	VSWR, IF port LO +10dBm	LO +13dBm	LO +16dBm
10.000	1.82	1.72	1.66	1.31	2.09	3.34	5.000	1.51	1.15	1.06
20.000	1.60	1.47	1.39	1.27	2.05	3.20	10.000	1.52	1.15	1.06
50.000	1.55	1.39	1.28	1.34	2.09	3.15	20.000	1.52	1.15	1.06
100.000	1.57	1.40	1.28	1.30	2.06	3.14	50.000	1.28	1.09	1.08
149.688	1.61	1.43	1.31	1.27	1.99	2.88	83.971	1.53	1.16	1.07
200.000	1.66	1.48	1.36	1.28	1.97	2.88	110.294	1.53	1.16	1.06
289.375	1.76	1.59	1.46	1.34	1.97	2.83	162.941	1.53	1.16	1.07
382.500	1.91	1.72	1.60	1.43	1.98	2.80	200.000	1.54	1.16	1.07
429.063	1.99	1.79	1.67	1.48	2.07	2.92	215.588	1.54	1.16	1.07
500.000	2.13	1.91	1.77	1.55	2.06	2.81	268.235	1.54	1.16	1.07
568.750	2.25	2.02	1.87	1.61	2.11	2.81	320.882	1.52	1.16	1.08
661.875	2.40	2.18	2.01	1.74	2.23	2.89	373.529	1.51	1.15	1.08
750.000	2.56	2.32	2.18	1.86	2.32	2.97	426.177	1.49	1.14	1.08
801.563	2.66	2.41	2.27	2.00	2.44	3.15	478.824	1.46	1.12	1.09
894.688	2.79	2.56	2.43	2.18	2.61	3.27	531.471	1.42	1.10	1.11
1000.000	2.89	2.72	2.59	2.32	2.70	3.33	610.441	1.35	1.05	1.15
1127.500	2.95	2.85	2.77	2.63	2.90	3.45	689.412	1.26	1.01	1.22
1267.188	3.04	3.03	3.00	3.02	3.14	3.57	768.382	1.19	1.16	1.33
1406.875	3.21	3.25	3.29	3.65	3.52	3.81	847.353	1.13	1.20	1.39
1500.000	3.34	3.40	3.50	4.20	3.82	4.03	900.000	1.12	1.26	1.44

ϕ detection

freq. (MHz)	max. DC output mV	DC offset mV
10.000	+494.00	+.05
20.000	+491.80	+.09
50.000	+532.40	+.20
100.000	+493.60	+.37
149.688	+489.30	+.83
200.000	+519.20	+.95
289.375	+517.70	+3.25
382.500	+461.10	+5.40
429.063	+460.20	+6.05
500.000	+403.00	+8.05
568.750	+434.00	+10.02
661.875	+372.30	+14.12
750.000	+417.80	+18.21
801.563	+374.50	+21.66
894.688	+400.70	+23.39
1000.000	+427.80	+22.17
1127.500	+424.30	+17.52
1267.188	+394.10	+25.82
1406.875	+360.90	+33.65
1500.000	+407.70	+27.87

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	+1	11	3	20	14	30	24	33	36	36
1	–	8	0	28	21	32	36	33	33	42	45	46
2	89	47	41	42	38	50	56	46	57	52	65	56
3	94	>78	>79	63	71	59	72	70	>78	63	74	69
4	>94	>78	>78	>79	78	78	78	>79	>78	>78	>79	>78
5	>95	>79	>78	>78	>80	>79	>79	>79	>79	78	76	>78
6	>95	>78	78	>80	76	>79	>79	>79	>79	78	77	78
7	>95	>78	>78	>80	>79	>78	>80	>79	78	>79	>79	>78
8	>90	>73	76	78	>78	>79	>78	>79	>80	>79	>79	>79
9	>88	>72	>73	>78	>79	>79	77	>77	78	>79	>80	>79
10	87	>74	71	>72	>79	>78	>78	78	>77	>78	79	78

LO Harmonic Order

test conditions: RF IN: 750.10 MHZ; −10.00 DBM
LO IN: 720.01 MHZ; +12.97 DBM
IF OUT: 30.09 MHZ; −16.70 DBM

RF ORDER HARMONIC

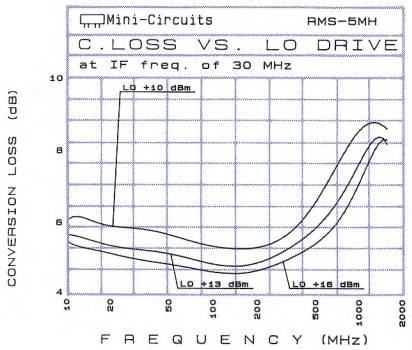
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	8	21	13	33	27	46	33	53	45	54
1	–	8	1	29	22	34	40	38	37	48	50	58
2	70	38	32	34	29	40	47	38	56	49	68	54
3	79	62	61	45	56	42	55	53	68	49	63	57
4	94	77	74	68	57	53	57	55	70	58	60	59
5	>95	83	82	>88	83	84	72	68	79	71	67	67
6	>96	>88	>89	86	>88	85	79	76	72	>89	82	79
7	>96	>88	>89	>89	>89	>88	>89	80	79	76	77	86
8	>90	>83	88	>89	>90	>89	>87	>88	>88	84	85	86
9	87	>82	>83	>89	>89	>89	>89	>88	>87	>89	>89	88
10	89	>84	>83	>83	88	>89	>89	88	86	>89	88	87

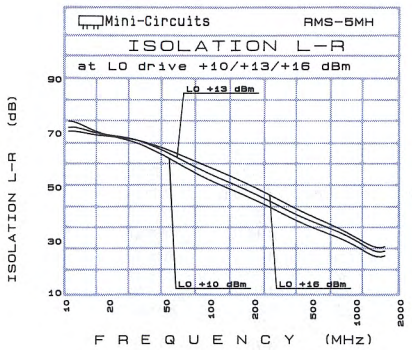
LO Harmonic Order

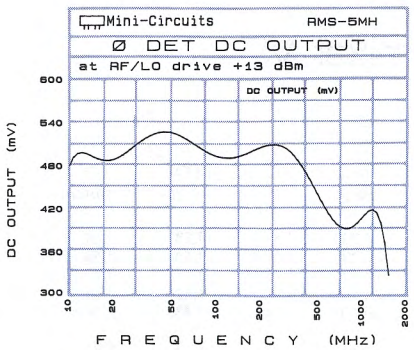
test conditions: RF IN: 750.10 MHZ; +0.00 DBM
LO IN: 720.01 MHZ; +12.97 DBM
IF OUT: 30.09 MHZ; −6.61 DBM

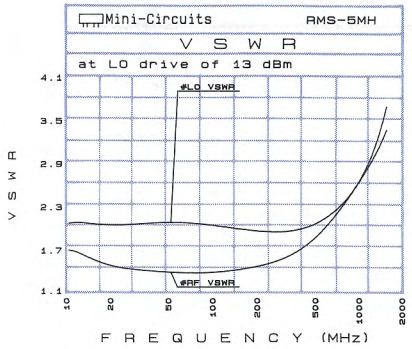
typical performance curves

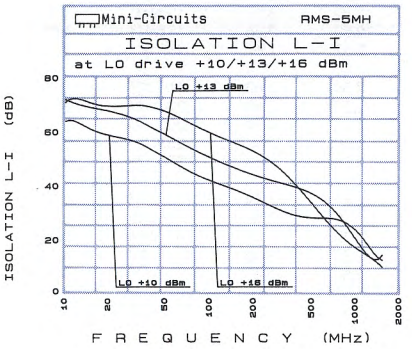
(production unit)

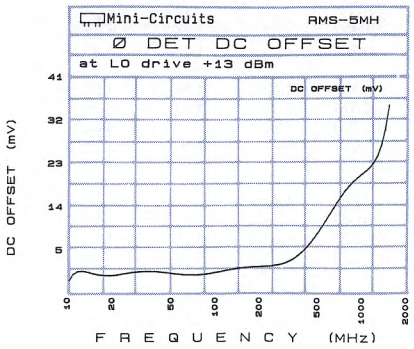












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

Model SCM-1

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
1.000	31.000	6.58	6.20	6.00	1.000	71.78	72.88	73.48	65.58	66.78	67.58
2.000	32.000	6.53	6.16	5.97	2.000	71.15	72.45	73.65	65.65	67.15	68.05
5.000	35.000	5.48	5.16	5.00	5.000	70.67	72.07	72.97	65.67	67.07	67.77
10.000	40.000	5.72	5.46	5.30	10.000	69.97	70.97	72.17	65.37	66.57	67.47
20.000	50.000	5.76	5.51	5.33	20.000	67.69	68.99	69.89	64.89	65.69	66.09
32.188	62.188	5.76	5.48	5.32	32.188	65.07	65.97	66.87	63.67	64.17	64.27
50.000	80.000	5.78	5.52	5.38	50.000	61.61	62.51	64.01	62.01	62.11	62.01
78.969	48.969	5.81	5.53	5.38	78.969	57.88	59.28	60.27	58.98	58.98	58.69
100.000	70.000	5.63	5.46	5.35	100.000	56.48	57.50	58.70	57.28	57.03	57.16
125.750	95.750	5.52	5.33	5.24	125.750	53.40	56.16	57.25	54.89	55.12	55.75
156.938	126.938	5.52	5.36	5.29	156.938	52.92	54.05	54.91	51.54	52.46	53.17
188.125	158.125	5.63	5.50	5.43	188.125	50.98	51.97	52.83	49.56	51.08	51.98
219.313	189.313	5.69	5.56	5.50	219.313	49.84	50.13	50.64	47.50	49.66	51.79
250.000	220.000	5.76	5.61	5.50	250.000	49.38	50.85	51.64	45.44	46.65	47.65
281.687	251.688	5.89	5.72	5.60	281.687	47.86	48.93	49.97	44.71	45.50	46.78
328.469	298.469	5.86	5.69	5.58	328.469	45.24	46.10	46.78	44.04	46.51	48.79
375.250	345.250	5.89	5.80	5.76	375.250	43.31	43.70	44.66	42.20	44.36	45.15
422.031	392.031	6.22	6.12	6.04	422.031	43.62	45.26	45.97	41.18	41.75	41.40
453.219	423.219	6.47	6.26	6.06	453.219	44.39	45.18	45.87	40.33	41.16	40.94
500.000	470.000	7.00	6.56	5.99	500.000	42.58	43.13	43.99	41.60	42.64	41.91

mixer VSWR

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.19	1.23	1.28	1.65	2.68	4.16	5.000	1.53	1.39	1.29	1.000	−232.35	−.18
10.000	1.09	1.14	1.19	1.60	2.55	4.01	10.000	1.51	1.39	1.29	2.000	−235.90	−.17
20.000	1.03	1.11	1.17	1.72	2.69	4.18	20.000	1.51	1.38	1.29	10.000	−237.92	−.15
34.118	1.02	1.12	1.18	1.71	2.66	4.07	34.118	1.52	1.39	1.29	16.594	−237.61	−.15
50.000	1.04	1.13	1.19	1.62	2.52	3.82	50.000	1.53	1.40	1.31	32.188	−234.39	−.15
63.235	1.04	1.13	1.20	1.61	2.50	3.78	63.235	1.53	1.41	1.32	47.781	−234.81	−.17
92.353	1.06	1.15	1.21	1.62	2.48	3.72	92.353	1.59	1.45	1.36	63.375	−234.44	−.16
100.000	1.06	1.15	1.21	1.64	2.49	3.69	100.000	1.60	1.46	1.37	78.969	−237.46	−.14
121.471	1.07	1.16	1.22	1.65	2.50	3.56	121.471	1.64	1.50	1.41	100.000	−242.94	−.14
150.588	1.09	1.17	1.23	1.66	2.52	3.62	150.588	1.70	1.56	1.47	125.750	−245.99	+0.00
165.147	1.10	1.19	1.24	1.69	2.54	3.62	165.147	1.75	1.60	1.51	141.344	−243.17	−.09
208.824	1.15	1.22	1.29	1.71	2.54	3.50	208.824	1.90	1.74	1.65	188.125	−235.89	−.04
250.000	1.20	1.27	1.33	1.77	2.53	3.54	250.000	2.00	1.86	1.73	234.906	−247.51	−.14
267.059	1.23	1.30	1.36	1.77	2.50	3.40	267.059	2.14	1.99	1.84	250.500	−250.94	−.13
296.177	1.29	1.36	1.41	1.82	2.56	3.46	296.177	2.26	2.09	1.94	281.687	−245.08	−.02
339.853	1.40	1.47	1.52	1.91	2.61	3.54	339.853	2.49	2.30	2.13	328.469	−225.76	−.13
398.088	1.58	1.67	1.72	2.01	2.59	3.48	398.088	2.85	2.62	2.44	390.844	−203.31	+.16
427.206	1.68	1.76	1.81	2.16	2.72	3.54	427.206	2.93	2.72	2.54	422.031	−201.69	+.52
456.324	1.76	1.84	1.90	2.25	2.87	3.66	456.324	3.02	2.81	2.64	453.219	−206.11	+.35
500.000	1.84	1.92	1.97	2.33	3.00	3.80	500.000	3.06	2.87	2.73	500.000	−205.13	+.33

ϕ detection

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	37	39	38	45	34	39	32	41	30	43
1	–	26	+0	35	12	44	18	47	21	31	40	41
2	91	65	63	69	70	66	74	64	64	63	54	64
3	>97	59	49	63	54	66	51	62	49	61	51	67
4	>97	>81	>80	80	>81	>81	80	>81	80	>81	>81	75
5	>97	79	73	79	71	79	73	>81	68	80	66	79
6	>96	>82	>81	>81	80	>81	>81	>82	>81	80	>81	>82
7	>96	80	>81	>81	80	>81	>81	>81	81	>81	80	>81
8	95	>81	78	>82	>81	80	>81	>81	80	79	80	>81
9	>96	>81	>81	>81	>81	>81	>81	>81	80	>81	>81	>81
10	>96	>80	>80	>81	>81	>81	80	>81	78	>81	>82	>81

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −9.99 DBM
LO IN: 155.01 MHZ; +7.03 DBM
IF OUT: 30.09 MHZ; −15.27 DBM

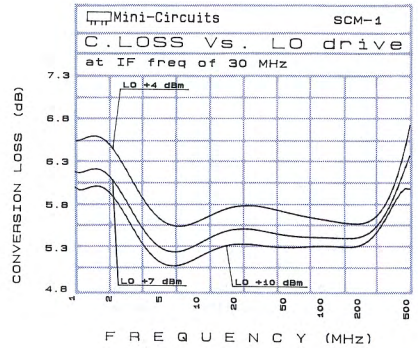
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	44	52	47	57	48	56	50	57	48	63
1	–	24	0	40	12	44	22	49	27	42	46	59
2	72	62	54	67	57	74	60	71	59	63	59	63
3	81	42	33	53	38	57	37	56	37	67	37	48
4	96	70	67	73	64	72	80	76	67	72	65	71
5	>96	55	43	59	49	63	53	70	54	59	50	63
6	>96	81	72	78	74	88	77	76	85	80	70	76
7	>96	65	59	62	67	69	53	67	53	78	55	65
8	>96	87	76	83	80	>91	80	84	82	87	88	87
9	>97	82	>90	76	69	79	62	84	64	77	58	73
10	95	86	81	88	83	>90	88	90	83	89	85	86

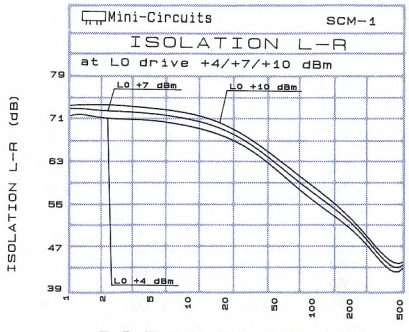
LO Harmonic Order

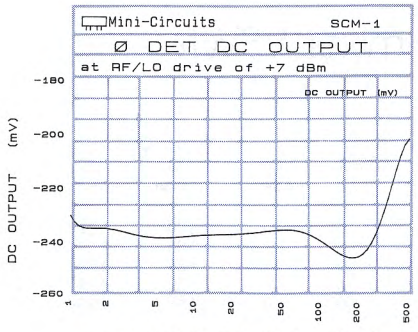
test conditions: RF IN: 185.10 MHZ; −.01 DBM
LO IN: 155.01 MHZ; +7.03 DBM
IF OUT: 30.09 MHZ; −5.46 DBM

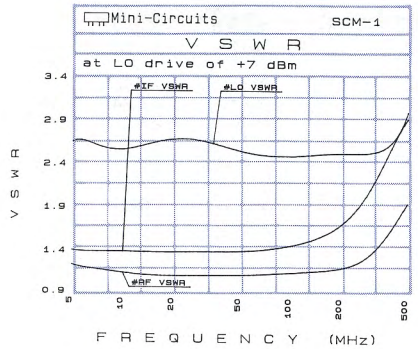
typical performance curves

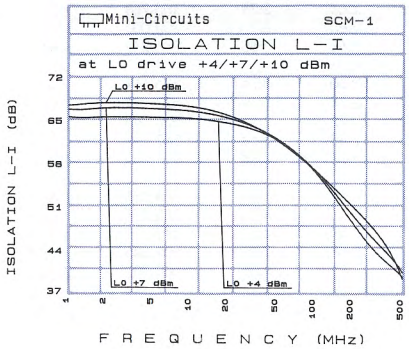
(production unit)

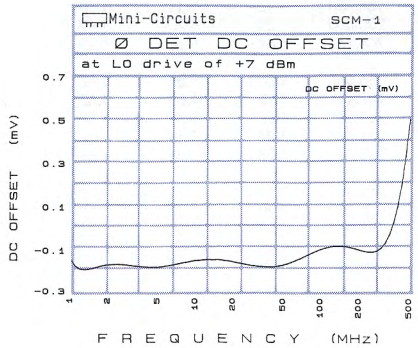












In Stock...Immediate Delivery

most widely-used, surface-mount

Frequency Mixers

Model SCM-2

LEVEL 7 (+7dBm LO, up to +1dBm RF)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.000	7.93	7.70	7.46	5.000	88.15	91.15	90.85	87.15	81.65	77.95
10.000	40.000	7.07	6.74	6.62	10.000	75.96	79.06	79.76	78.96	74.26	72.26
20.000	50.000	6.62	6.43	6.16	20.000	70.93	72.63	75.43	70.63	67.23	66.13
35.151	65.151	6.32	6.02	5.81	35.151	65.32	67.42	69.52	65.12	61.82	61.02
50.000	80.000	6.20	5.92	5.71	50.000	60.82	62.72	64.62	56.32	54.16	53.31
65.303	95.303	6.04	5.79	5.61	65.303	58.98	61.08	62.98	58.88	56.02	54.56
100.000	70.000	5.88	5.69	5.52	100.000	55.19	57.24	59.02	58.19	54.55	52.69
155.758	125.758	5.86	5.65	5.51	155.758	50.90	52.92	54.84	53.85	50.70	48.87
200.000	170.000	5.93	5.73	5.58	200.000	48.72	50.87	52.80	50.83	48.52	47.30
246.212	216.212	6.05	5.83	5.65	246.212	46.23	47.20	48.37	48.26	46.40	45.18
336.667	306.667	6.24	5.96	5.75	336.667	43.32	45.14	46.37	43.72	43.55	42.78
427.121	397.121	6.21	5.89	5.65	427.121	41.03	41.17	41.74	41.39	41.75	41.11
500.000	470.000	6.60	6.32	6.02	500.000	40.77	42.19	42.70	40.11	40.98	41.37
547.727	517.727	6.63	6.50	6.21	547.727	40.40	41.49	42.31	39.92	40.81	41.57
608.030	578.030	6.63	6.41	6.08	608.030	41.07	41.53	42.33	37.89	38.45	39.05
668.333	638.333	6.89	6.50	6.08	668.333	38.33	38.93	39.77	37.13	37.08	37.22
758.788	728.788	8.68	7.67	6.60	758.788	39.17	41.79	43.85	35.24	36.35	38.61
819.091	789.091	8.49	7.83	7.01	819.091	40.03	43.08	46.07	34.08	35.42	36.19
909.545	879.545	8.55	7.89	7.20	909.545	40.82	45.07	49.33	33.17	33.32	33.38
1000.000	970.000	7.79	7.08	6.59	1000.000	37.88	39.99	42.12	28.75	28.91	28.50

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	6.01	5.79	5.59	4.37	4.26	5.49	5.000	1.40	1.25	1.13	5.000	−213.11	−.08
10.000	2.30	2.25	2.21	2.57	3.25	4.63	10.000	1.41	1.26	1.14	10.000	−226.17	−.08
20.000	1.60	1.59	1.58	2.15	3.04	4.52	20.000	1.41	1.27	1.14	20.000	−229.30	−.08
35.151	1.31	1.30	1.31	1.95	2.89	4.32	35.151	1.40	1.26	1.13	35.151	−228.98	−.10
50.000	1.20	1.19	1.20	1.83	2.77	4.01	50.000	1.41	1.26	1.13	50.000	−230.14	−.13
65.303	1.14	1.12	1.13	1.79	2.72	4.00	65.303	1.41	1.26	1.14	65.303	−229.01	−.09
100.000	1.07	1.02	1.04	1.74	2.63	3.76	100.000	1.42	1.26	1.14	100.000	−233.76	−.07
155.758	1.15	1.11	1.10	1.75	2.61	3.79	155.758	1.43	1.28	1.16	155.758	−231.30	−.02
200.000	1.24	1.20	1.19	1.77	2.60	3.73	200.000	1.43	1.28	1.17	200.000	−231.19	+.04
246.212	1.34	1.30	1.29	1.80	2.60	3.80	246.212	1.43	1.29	1.19	246.212	−238.64	+.13
336.667	1.56	1.51	1.47	1.93	2.60	3.74	336.667	1.44	1.30	1.22	336.667	−235.96	+.50
427.121	1.75	1.68	1.62	2.13	2.74	3.69	427.121	1.44	1.33	1.28	427.121	−203.34	+1.01
500.000	1.86	1.78	1.71	2.19	2.72	3.61	500.000	1.31	1.16	1.08	500.000	−209.01	+.46
547.727	1.94	1.85	1.77	2.30	2.80	3.64	547.727	1.38	1.24	1.14	547.727	−206.30	+.46
608.030	2.03	1.93	1.85	2.55	3.05	3.84	608.030	1.44	1.30	1.18	608.030	−228.73	+1.04
668.333	2.11	2.01	1.92	2.66	3.17	4.01	668.333	1.51	1.38	1.25	668.333	−206.02	+1.86
758.788	2.29	2.18	2.07	2.92	3.43	4.25	758.788	1.72	1.59	1.45	758.788	−182.02	+.68
819.091	2.38	2.25	2.14	3.01	3.47	4.17	819.091	1.92	1.79	1.65	819.091	−178.24	+1.07
909.545	2.25	2.12	2.01	3.17	3.45	4.09	909.545	2.10	2.01	1.92	909.545	−167.86	+1.38
1000.000	1.99	1.90	1.78	3.27	3.51	4.17	1000.000	2.15	2.07	2.03	1000.000	−162.74	+3.45

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	17	32	21	41	16	42	36	46	45	49
1	–	16	+0	31	13	46	27	45	45	40	51	34
2	92	53	48	52	47	58	48	58	44	61	57	65
3	>96	64	57	55	51	55	47	55	63	65	66	64
4	>96	>79	>80	>80	>80	79	>80	74	>80	>80	76	75
5	>97	>79	>80	77	74	76	73	76	74	75	77	>79
6	>95	74	>79	>79	>79	>79	>80	>80	>80	78	79	>81
7	96	76	>78	>79	>79	79	76	>80	>80	>80	77	>80
8	>97	79	>80	>79	>78	>79	>80	>80	>80	>80	>80	>80
9	95	>79	>80	>80	79	>79	>80	>79	>80	>79	79	>81
10	>96	79	>80	>79	>80	>79	>79	>79	>80	>81	>80	79

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −9.97 DBM
LO IN: 470.01 MHZ; +7.02 DBM
IF OUT: 30.09 MHZ; −16.01 DBM

RF CAL

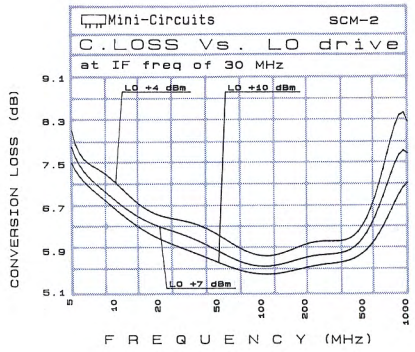
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	27	41	29	60	30	61	48	60	52	67
1	–	15	0	30	14	41	34	50	46	58	54	53
2	72	52	48	63	48	54	53	62	46	63	62	73
3	87	35	27	44	31	42	37	51	49	60	58	58
4	90	64	55	58	54	64	60	63	61	70	54	79
5	>96	54	56	51	47	55	47	51	61	59	62	74
6	93	68	69	69	66	61	66	71	68	71	69	76
7	87	57	60	61	68	57	48	58	50	70	57	62
8	>96	81	78	82	79	86	76	70	70	80	74	86
9	>96	67	58	65	67	69	72	63	58	65	57	68
10	>96	>90	>89	84	78	80	83	>89	80	74	79	81

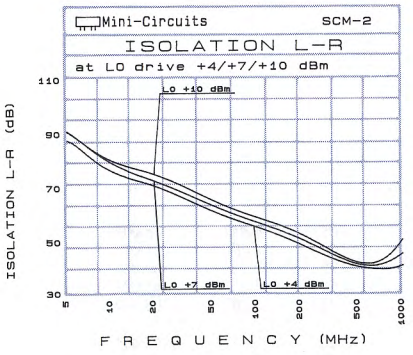
LO Harmonic Order

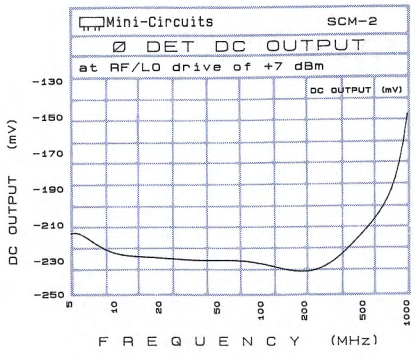
test conditions: RF IN: 500.10 MHZ; +.06 DBM
LO IN: 470.01 MHZ; +6.96 DBM
IF OUT: 30.09 MHZ; −6.22 DBM

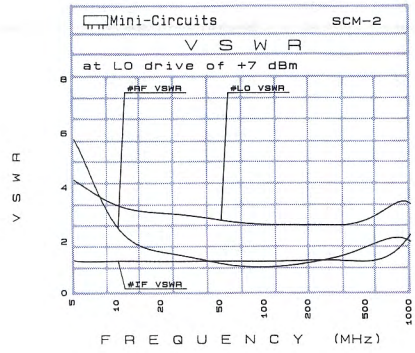
typical performance curves

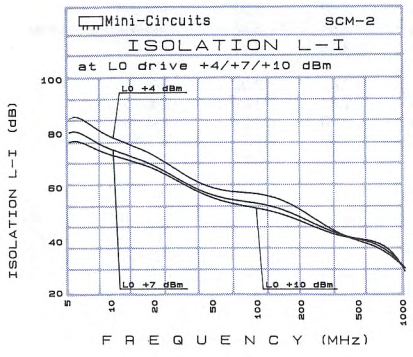
(production unit)

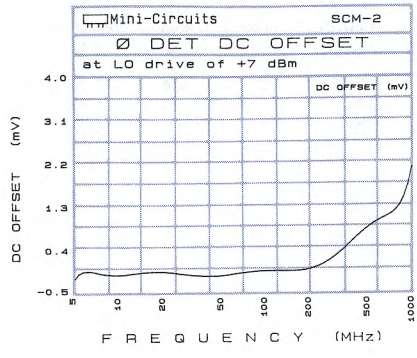












most widely-used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
SRA-149



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
5.000	35.000	5.73	5.49	5.37	5.000	84.38	86.28	88.18	59.18	60.08	60.09
10.000	40.000	5.72	5.44	5.30	10.000	80.85	82.65	83.15	53.94	55.47	56.58
20.000	50.000	5.82	5.48	5.32	20.000	76.11	76.91	77.61	48.74	50.61	52.27
34.118	64.118	5.77	5.48	5.35	34.118	71.91	72.61	73.31	44.31	46.52	48.61
50.000	80.000	5.78	5.48	5.35	50.000	68.56	69.16	70.06	41.33	43.64	46.04
63.235	93.235	5.72	5.49	5.37	63.235	66.41	67.21	68.41	39.46	42.00	44.28
77.794	47.794	5.80	5.52	5.37	77.794	64.54	65.64	66.54	37.97	40.53	42.71
92.353	62.353	5.64	5.37	5.26	92.353	63.32	64.62	65.62	36.93	39.37	41.57
100.000	70.000	5.55	5.37	5.22	100.000	63.04	64.84	65.94	36.43	38.86	40.83
121.471	91.471	5.54	5.32	5.23	121.471	60.77	60.67	61.47	35.24	37.55	39.61
165.147	135.147	5.54	5.36	5.29	165.147	58.08	58.48	58.10	32.93	34.98	36.88
194.265	164.265	5.60	5.44	5.37	194.265	56.93	56.83	57.41	31.56	33.54	35.51
223.382	193.382	5.71	5.54	5.46	223.382	57.72	58.30	57.51	30.31	32.27	34.41
250.000	220.000	5.77	5.57	5.48	250.000	58.13	58.83	58.87	29.36	31.23	32.93
267.059	237.059	5.79	5.61	5.51	267.059	59.28	59.28	61.58	28.70	30.88	32.76
296.177	266.177	5.78	5.52	5.39	296.177	58.08	58.58	58.00	27.88	29.57	31.44
354.412	324.412	5.80	5.62	5.51	354.412	54.47	53.49	53.17	27.28	28.99	30.48
398.088	368.088	6.00	5.83	5.76	398.088	52.81	52.60	51.37	26.20	27.78	29.40
456.324	426.324	6.48	6.35	6.27	456.324	52.62	52.58	50.92	26.00	26.75	27.04
500.000	470.000	6.73	6.48	6.23	500.000	55.18	56.92	58.43	27.45	28.61	29.45

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
5.000	1.20	1.20	1.21	1.76	2.81	4.41	5.000	1.50	1.38	1.30	5.000	+244.69	+.03
17.692	1.06	1.05	1.08	1.75	2.80	4.05	17.692	1.50	1.38	1.30	17.692	+244.52	+.03
30.385	1.03	1.05	1.09	1.77	2.72	3.70	30.385	1.50	1.38	1.30	30.385	+242.04	+.02
43.077	1.02	1.06	1.10	1.71	2.54	3.36	43.077	1.51	1.39	1.31	43.077	+242.79	+.01
55.769	1.02	1.06	1.11	1.65	2.45	3.28	55.769	1.51	1.39	1.31	55.769	+243.92	−.01
68.461	1.01	1.07	1.11	1.64	2.50	3.37	68.461	1.51	1.39	1.32	68.461	+243.93	−.03
93.846	1.01	1.08	1.12	1.62	2.49	3.38	93.846	1.54	1.42	1.34	93.846	+249.60	−.02
119.231	1.01	1.09	1.14	1.64	2.50	3.35	119.231	1.57	1.45	1.37	119.231	+250.13	+0.00
144.615	1.02	1.10	1.15	1.65	2.51	3.43	144.615	1.60	1.47	1.40	144.615	+250.77	+.05
170.000	1.04	1.12	1.17	1.65	2.48	3.42	170.000	1.67	1.53	1.44	170.000	+248.99	+.03
195.385	1.05	1.14	1.19	1.62	2.42	3.30	195.385	1.70	1.56	1.47	195.385	+248.00	−.03
220.769	1.07	1.16	1.21	1.63	2.41	3.29	220.769	1.78	1.62	1.54	220.769	+251.13	−.12
246.154	1.09	1.17	1.23	1.64	2.40	3.27	246.154	1.80	1.64	1.55	246.154	+255.01	−.16
271.539	1.10	1.19	1.25	1.65	2.40	3.25	271.539	1.90	1.74	1.63	271.539	+252.62	−.26
296.923	1.12	1.22	1.27	1.69	2.42	3.27	296.923	1.96	1.80	1.68	296.923	+245.64	−.38
322.308	1.15	1.24	1.29	1.72	2.42	3.27	322.308	2.03	1.85	1.75	322.308	+238.89	−.49
360.385	1.18	1.27	1.33	1.79	2.44	3.31	360.385	2.15	1.97	1.86	360.385	+226.44	−.39
398.462	1.23	1.31	1.36	1.83	2.48	3.34	398.462	2.29	2.08	1.96	398.462	+213.04	−.63
449.231	1.30	1.38	1.43	1.89	2.50	3.34	449.231	2.44	2.21	2.09	449.231	+215.56	−.52
500.000	1.38	1.47	1.52	1.98	2.51	3.37	500.000	2.54	2.31	2.18	500.000	+224.77	−.68

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	13	46	16	42	26	42	26	55	35	67
1	–	39	+0	50	12	49	19	45	20	35	26	48
2	90	>80	55	76	57	76	52	76	55	74	50	68
3	>95	71	56	71	63	70	56	71	52	72	51	66
4	93	>81	78	>81	78	>81	80	>81	76	>81	75	>80
5	>97	>81	76	80	77	>81	75	79	73	>80	71	>80
6	>97	80	>80	>81	>81	>81	79	80	>81	>81	80	>81
7	>97	>80	>81	>81	>80	>80	80	>81	>81	>81	79	79
8	>96	>80	>80	>80	>80	80	>80	80	>80	>81	80	>80
9	93	>80	>79	>80	>81	79	78	>81	76	79	>80	>80
10	>96	79	>81	>81	>81	>81	>81	>80	>81	>80	77	>81

LO Harmonic Order

test conditions: RF IN: 185.10 MHZ; −10.02 DBM
LO IN: 155.01 MHZ; +6.97 DBM
IF OUT: 30.09 MHZ; −15.52 DBM

RF ORDER HARMONIC

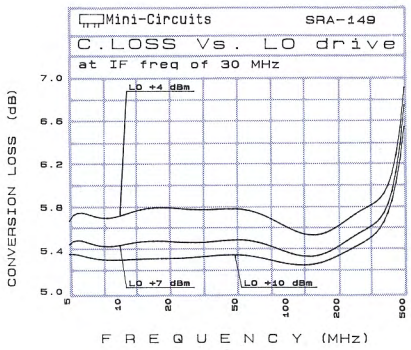
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	–	–	23	56	27	53	39	62	41	76	54	78
1	–	38	+0	53	11	62	21	63	29	53	43	68
2	72	67	47	71	44	74	49	70	50	68	53	72
3	83	52	32	63	34	66	37	63	37	62	37	57
4	>96	69	56	73	58	90	58	83	56	80	57	74
5	>96	66	43	64	56	70	52	77	58	84	53	67
6	>97	73	63	78	66	83	69	83	68	>90	62	85
7	>96	72	56	77	58	78	53	72	55	79	58	74
8	>96	>90	75	84	75	87	74	83	72	89	73	>90
9	>96	86	73	87	65	77	72	83	62	75	58	82
10	>96	>90	85	>90	83	>90	75	>90	77	>90	76	89

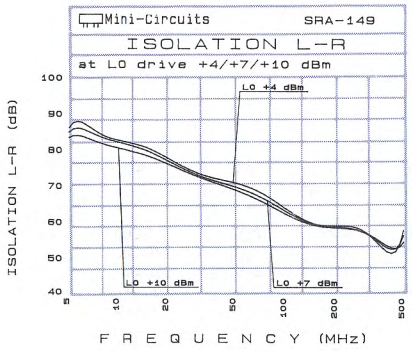
LO Harmonic Order

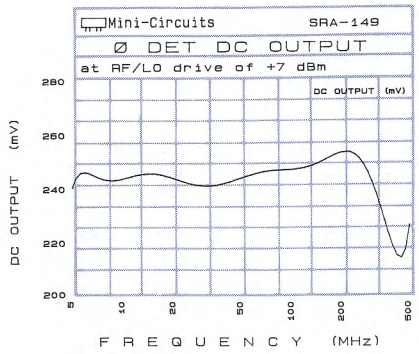
test conditions: RF IN: 185.10 MHZ; +.02 DBM
LO IN: 155.01 MHZ; +6.97 DBM
IF OUT: 30.09 MHZ; −5.76 DBM

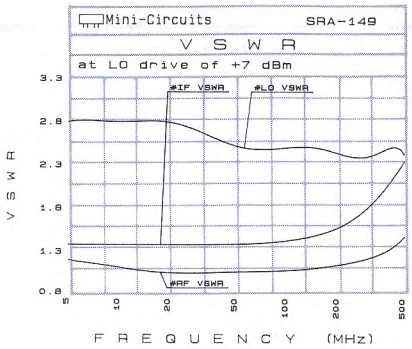
typical performance curves

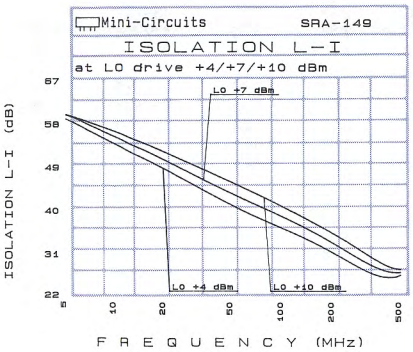
(production unit)

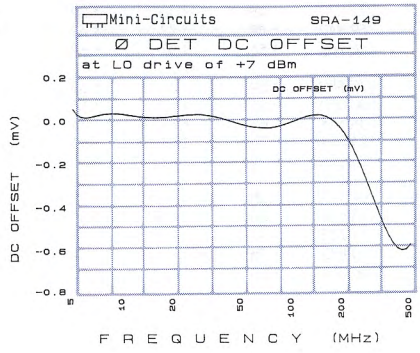












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broadband high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Model
SRA-2CR



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	Isolation L-R (dB) LO +7dBm	LO +10dBm	LO +13dBm	Isolation L-I (dB) LO +7dBm	LO +10dBm	LO +13dBm
10.000	40.000	6.30	5.87	5.62	10.000	56.71	60.06	63.79	50.41	51.74	52.97
20.000	50.000	6.06	5.70	5.51	20.000	56.56	59.97	63.61	44.34	45.75	46.94
50.000	80.000	6.34	5.95	5.76	50.000	56.91	60.34	63.51	37.03	38.56	40.23
97.353	67.353	6.58	6.16	5.88	97.353	55.95	59.24	62.18	31.78	34.17	35.98
100.000	70.000	6.57	6.13	5.85	100.000	55.87	59.13	62.16	31.62	34.03	35.84
184.706	154.706	6.30	5.91	5.72	184.706	54.94	58.77	57.61	28.50	30.33	31.67
200.000	170.000	6.22	5.89	5.74	200.000	55.02	58.88	57.13	28.02	29.84	31.25
272.059	242.059	6.35	6.04	5.84	272.059	60.14	66.01	57.10	26.01	27.72	29.07
359.412	329.412	6.49	6.13	5.89	359.412	58.23	61.92	54.38	23.28	25.21	26.73
446.765	416.765	6.51	6.07	5.75	446.765	47.89	48.69	47.46	23.16	24.81	26.47
475.882	445.882	6.18	5.85	5.63	475.882	46.28	47.01	45.28	23.49	25.23	26.78
500.000	470.000	6.09	5.79	5.60	500.000	43.08	43.34	42.13	23.59	25.72	27.33
534.118	504.118	6.09	5.81	5.63	534.118	41.39	41.56	41.45	23.19	25.74	27.68
621.471	591.471	6.15	5.98	5.93	621.471	54.97	59.03	52.13	22.22	25.67	28.30
708.824	678.824	6.66	6.42	6.26	708.824	44.93	43.56	41.51	23.18	26.15	28.88
796.177	766.177	8.11	7.24	6.57	796.177	37.71	37.66	38.25	25.47	27.17	27.51
883.529	853.529	8.40	7.19	6.49	883.529	37.60	37.82	38.10	26.17	26.16	25.02
941.765	911.765	8.07	7.28	6.76	941.765	38.05	38.41	38.60	23.24	22.04	21.12
970.882	940.882	8.17	7.40	6.95	970.882	38.06	38.44	38.57	21.46	20.22	19.28
1000.000	970.000	8.40	7.66	7.15	1000.000	37.61	38.08	38.09	19.62	18.48	17.53

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +7dBm	LO +10dBm	LO +13dBm	VSWR, LO port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	VSWR, IF port LO +7dBm	LO +10dBm	LO +13dBm	freq. (MHz)	max. DC output mV	DC offset mV
10.000	1.51	1.44	1.39	1.53	2.29	3.35	5.000	1.66	1.46	1.32	10.000	−356.40	−0.89
20.000	1.49	1.42	1.37	1.47	2.27	3.27	10.000	1.67	1.47	1.33	20.000	−351.80	−0.89
50.000	1.45	1.39	1.34	1.58	2.37	3.42	20.000	1.67	1.46	1.33	50.000	−337.60	−0.91
97.353	1.45	1.38	1.34	1.53	2.30	3.30	48.677	1.66	1.46	1.32	97.353	−344.20	−1.00
100.000	1.45	1.38	1.34	1.49	2.29	3.25	50.000	1.66	1.45	1.32	100.000	−344.30	−1.02
184.706	1.44	1.38	1.35	1.53	2.24	3.15	92.353	1.66	1.44	1.30	184.706	−349.80	−0.91
200.000	1.44	1.38	1.35	1.53	2.25	3.16	100.000	1.65	1.43	1.29	200.000	−351.60	−0.88
272.059	1.45	1.40	1.39	1.60	2.33	3.21	136.029	1.62	1.40	1.27	272.059	−344.00	−0.70
359.412	1.49	1.47	1.47	1.72	2.38	3.20	179.706	1.57	1.35	1.23	359.412	−311.00	−0.73
446.765	1.56	1.57	1.59	1.83	2.45	3.24	200.000	1.54	1.32	1.20	446.765	−302.75	−0.51
475.882	1.59	1.61	1.63	1.88	2.47	3.20	223.382	1.48	1.28	1.17	475.882	−321.40	−1.24
500.000	1.61	1.64	1.66	1.92	2.52	3.25	237.941	1.45	1.26	1.16	500.000	−335.20	−1.63
534.118	1.63	1.68	1.71	2.02	2.60	3.33	252.500	1.42	1.23	1.14	534.118	−345.90	−1.17
621.471	1.71	1.78	1.83	2.25	2.84	3.58	281.618	1.34	1.17	1.12	621.471	−336.70	−1.52
708.824	1.74	1.83	1.91	2.34	3.00	3.78	325.294	1.22	1.08	1.12	708.824	−293.17	−1.48
796.177	1.65	1.70	1.75	2.39	3.00	3.74	368.971	1.10	1.07	1.20	796.177	−235.15	−2.17
883.529	1.56	1.54	1.55	2.46	3.03	3.79	412.647	1.08	1.19	1.33	883.529	−251.99	−1.80
941.765	1.62	1.58	1.56	2.55	3.04	3.65	456.324	1.23	1.36	1.51	941.765	−261.49	−1.10
970.882	1.75	1.71	1.69	2.61	3.04	3.60	485.441	1.37	1.51	1.65	970.882	−268.11	−0.05
1000.000	1.90	1.87	1.85	2.67	3.01	3.44	500.000	1.45	1.59	1.73	1000.000	−270.23	0.15

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+7	24	17	33	20	29	28	40	46	52
1	-	30	+0	40	15	71	40	45	35	34	52	53
2	72	70	48	70	57	70	68	>74	70	66	70	70
3	>96	>75	69	74	61	71	63	>75	74	73	70	69
4	>96	>74	73	74	75	>76	74	75	>74	71	>73	>75
5	>96	>76	>75	>75	>75	75	74	>75	72	74	>75	>74
6	94	>74	>75	>75	>74	>75	75	>75	>74	>75	74	>75
7	>96	74	>74	74	>74	>74	>75	74	74	>75	>75	71
8	>96	74	>76	>75	>74	>74	74	72	>76	>76	74	>75
9	>96	73	>74	>75	>75	>75	>75	>75	74	>75	>75	>76
10	>96	>75	73	>75	>75	74	>76	>74	>74	>75	>75	>76

LO Harmonic Order

test conditions: RF IN: 500.10 MHZ; −14.98 DBM
LO IN: 470.01 MHZ; +10.05 DBM
IF OUT: 30.09 MHZ; −20.79 DBM

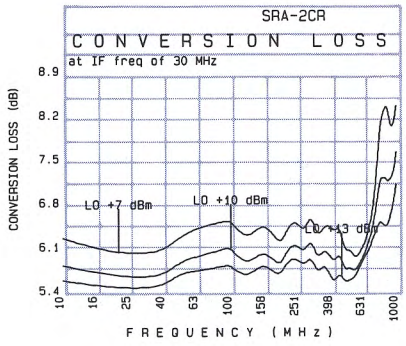
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	3	33	24	44	35	40	40	52	53	64
1	-	30	+0	45	15	53	40	48	38	38	54	58
2	64	64	39	61	47	66	55	71	63	58	62	64
3	95	72	51	56	43	55	47	64	61	66	54	55
4	95	84	76	78	63	70	58	76	65	>85	76	78
5	>97	>86	80	>85	69	77	60	78	62	80	76	82
6	>95	>84	>85	83	>85	>85	72	>85	69	84	73	>85
7	>97	>86	>84	85	>84	>85	80	>85	76	84	76	82
8	>97	>85	>86	>84	>84	81	82	>86	82	>85	78	>86
9	>96	82	>85	>85	>85	>85	>84	>85	>85	>85	84	85
10	95	>85	>85	>85	84	>85	>86	>83	81	84	>85	84

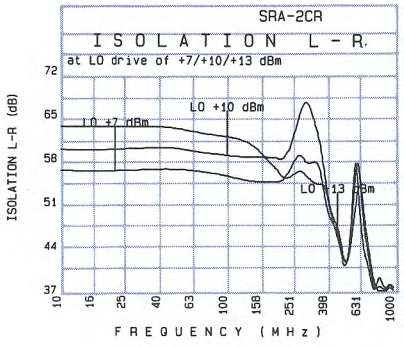
LO Harmonic Order

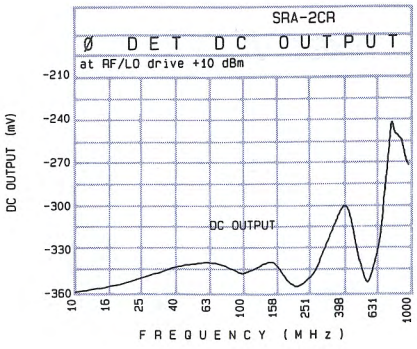
test conditions: RF IN: 500.10 MHZ; −4.97 DBM
LO IN: 470.01 MHZ; +10.05 DBM
IF OUT: 30.09 MHZ; −10.81 DBM

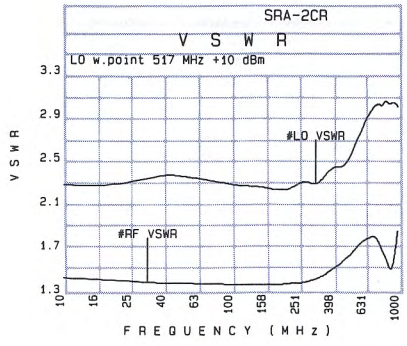
typical performance curves

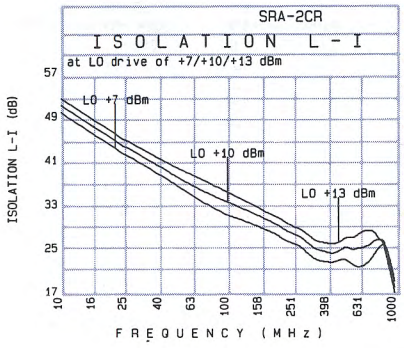
(production unit)

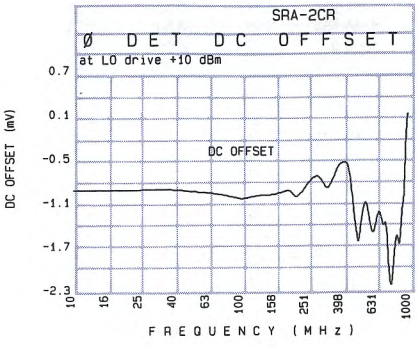












In Stock...Immediate Delivery

most widely-used

Frequency Mixers

Model SRA-3500

LEVEL 7 (+7dBm LO, up to +1dBm RF)



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
500.000	530.000	5.96	5.49	5.22	500.000	43.39	44.57	45.11	34.16	34.18	33.63
676.471	646.471	5.06	4.86	4.80	676.471	42.23	45.01	47.85	32.90	32.12	31.39
852.941	822.941	5.62	5.14	4.87	852.941	40.34	44.31	49.20	31.84	30.77	29.90
1000.000	970.000	6.31	5.49	5.05	1000.000	39.09	43.00	48.01	31.65	30.12	29.16
1117.647	1087.647	6.94	6.31	5.86	1117.647	38.56	41.48	44.70	31.38	29.93	29.04
1294.118	1264.118	7.10	6.71	6.51	1294.118	37.24	38.60	39.89	29.79	28.62	27.87
1382.353	1352.353	7.06	6.65	6.48	1382.353	37.12	38.54	39.71	30.33	29.04	27.92
1500.000	1470.000	7.00	6.73	6.59	1500.000	36.27	37.52	38.92	30.44	28.95	27.54
1647.059	1617.059	7.04	6.75	6.61	1647.059	34.35	35.53	36.50	27.39	26.47	25.58
1823.529	1793.529	7.61	7.16	6.94	1823.529	33.40	34.94	36.40	23.56	23.92	24.28
2000.000	1970.000	7.72	7.35	7.05	2000.000	32.93	34.78	36.56	21.93	22.93	23.82
2088.235	2058.235	7.73	7.33	7.02	2088.235	32.71	34.08	35.33	21.69	22.73	23.58
2264.706	2234.706	7.78	7.35	6.99	2264.706	32.54	33.58	34.38	22.13	22.82	23.50
2500.000	2470.000	7.81	7.31	6.88	2500.000	33.93	35.10	36.28	23.23	23.41	23.78
2617.647	2587.647	7.62	7.08	6.71	2617.647	33.70	34.51	35.27	23.24	23.33	23.38
2882.353	2852.353	8.42	7.51	7.15	2882.353	34.37	34.73	35.05	23.07	23.28	23.39
3000.000	2970.000	8.55	7.49	6.94	3000.000	34.72	35.30	35.71	22.79	23.26	23.25
3147.059	3117.059	8.76	7.27	6.76	3147.059	35.48	36.75	38.38	23.17	23.89	23.74
3323.529	3293.529	9.48	7.09	6.35	3323.529	39.93	43.96	43.32	24.31	25.30	24.55
3500.000	3470.000	8.88	6.45	5.82	3500.000	43.44	40.55	36.85	24.98	26.12	25.87

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
500.000	2.20	1.82	1.55	1.92	2.52	3.19	5.000	1.40	1.20	1.08	500.000	+151.79	-.87
576.923	1.44	1.20	1.12	2.00	2.56	3.19	30.513	1.41	1.20	1.08	676.471	+185.23	-.63
730.769	1.16	1.33	1.51	2.27	2.66	3.18	56.026	1.42	1.21	1.09	852.941	+127.03	-.52
884.615	1.51	1.64	1.79	2.62	2.80	3.14	81.539	1.43	1.21	1.09	1000.000	+112.30	-.32
1038.462	1.86	1.89	1.99	2.73	2.68	2.82	107.051	1.44	1.21	1.08	1117.647	+111.48	+.28
1192.308	2.48	2.32	2.27	2.63	2.35	2.37	132.564	1.44	1.21	1.08	1294.118	+113.96	+1.86
1269.231	3.15	2.85	2.68	2.50	2.17	2.11	158.077	1.44	1.21	1.07	1382.353	+113.47	+2.51
1346.154	3.91	3.54	3.26	2.41	2.01	1.90	209.103	1.42	1.17	1.06	1500.000	+101.38	+2.46
1500.000	5.19	4.67	4.38	2.10	1.68	1.54	260.128	1.36	1.12	1.09	1647.059	+65.72	+2.04
1730.769	6.01	5.54	5.20	1.55	1.27	1.29	336.667	1.22	1.06	1.22	1823.529	+19.80	+.79
1884.615	6.56	6.01	5.63	1.33	1.26	1.43	413.205	1.06	1.20	1.41	2000.000	-12.96	-.03
2038.462	5.68	5.25	4.84	1.32	1.36	1.52	489.744	1.10	1.38	1.63	2088.235	-32.09	+.43
2269.231	5.85	5.33	4.80	1.50	1.55	1.70	566.282	1.27	1.58	1.83	2264.706	-57.68	+.72
2346.154	5.74	5.23	4.72	1.58	1.61	1.74	617.308	1.38	1.70	1.95	2500.000	-83.15	+1.55
2500.000	6.13	5.56	4.96	2.00	2.09	2.30	668.333	1.47	1.79	2.03	2617.647	-98.82	+.05
2730.769	7.02	6.46	5.77	2.58	2.31	2.32	744.872	1.55	1.85	2.07	2882.353	-106.91	-.63
2961.539	5.66	5.30	4.91	2.64	2.36	2.37	821.410	1.54	1.80	1.99	3000.000	-104.33	-.78
3115.385	5.68	5.28	4.87	2.57	2.34	2.37	897.949	1.50	1.69	1.84	3147.059	-107.47	-.38
3269.231	4.72	4.27	3.92	2.58	2.29	2.23	948.974	1.49	1.63	1.76	3323.529	-87.32	+1.36
3500.000	2.67	2.39	2.20	2.46	2.15	1.99	1000.000	1.52	1.60	1.70	3500.000	-81.29	+3.48

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	1	38	18	31	30	>67	30	50	26	64
1	–	25	+0	33	38	34	33	52	50	53	34	57
2	90	>73	47	59	52	>73	69	>73	60	66	48	64
3	95	>75	72	65	52	72	70	70	59	>74	>66	>68
4	94	>73	>74	>73	73	>74	>74	>73	73	>73	71	>67
5	>91	>68	>74	>74	>72	73	>73	>74	>73	>74	>73	>75
6	88	>69	>68	>74	73	>75	>75	>74	73	>73	>74	>73
7	>90	67	>68	>68	>74	>74	>74	>74	>74	>74	>73	>73
8	88	>68	>69	67	>68	>75	>74	>73	>74	>74	>74	>73
9	>91	>68	>68	>69	>69	67	>74	>73	>73	>73	>74	>74
10	90	>69	68	>69	>69	>68	67	>74	>74	>74	>74	72

LO Harmonic Order

test conditions: RF IN: 1200.10 MHZ; −14.91 DBM
LO IN: 1170.01 MHZ; +7.05 DBM
IF OUT: 30.09 MHZ; −21.73 DBM

RF CAL

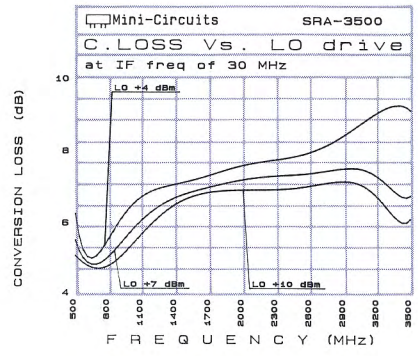
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	–	–	11	49	28	42	45	68	42	56	39	75
1	–	23	+0	35	39	36	38	56	58	64	44	70
2	73	67	39	50	43	68	58	70	60	72	54	72
3	94	65	70	46	34	58	56	55	47	72	71	69
4	94	75	67	>82	56	67	56	78	67	78	69	76
5	>90	>78	67	83	>83	63	49	66	65	67	58	82
6	>90	>78	>78	>84	82	>84	67	74	64	>83	75	81
7	>91	>79	77	>78	82	>84	>84	75	61	74	74	78
8	>90	77	78	>78	77	>83	83	>83	77	80	73	>83
9	89	>79	>78	>80	>78	>78	>83	83	>83	>83	73	80
10	89	>78	78	77	>79	>78	77	>85	>84	>83	>83	>84

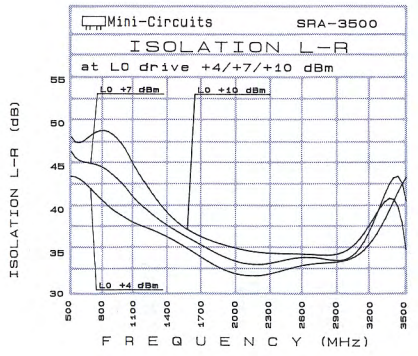
LO Harmonic Order

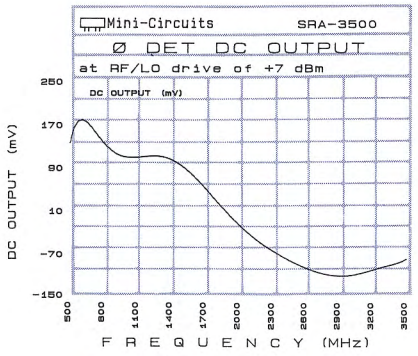
test conditions: RF IN: 1200.10 MHZ; −4.96 DBM
LO IN: 1170.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; −11.83 DBM

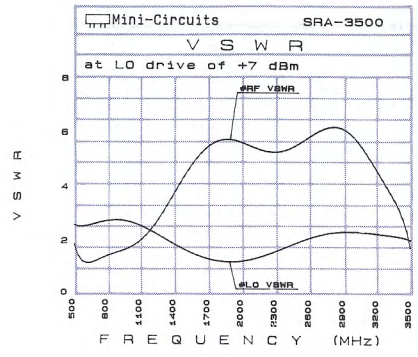
typical performance curves

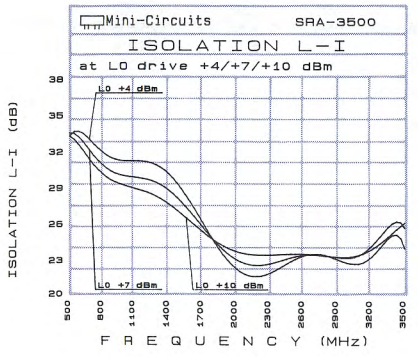
(production unit)

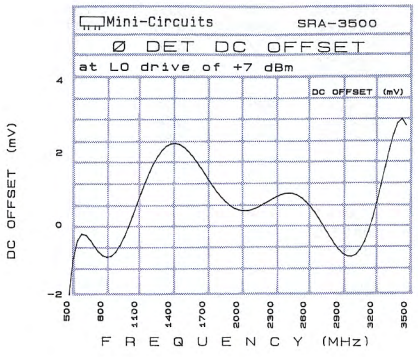












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most widely used

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
ZEM-4300
TFM-4300



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	Isolation L-R (dB) LO +4dBm	LO +7dBm	LO +10dBm	Isolation L-I (dB) LO +4dBm	LO +7dBm	LO +10dBm
300.000	400.000	8.07	7.36	7.06	300.000	48.11	51.34	55.13	31.70	31.66	33.32
414.286	514.286	6.69	6.29	6.02	414.286	61.86	64.83	58.27	31.56	33.69	36.28
528.571	428.571	5.38	5.08	4.94	528.571	48.93	49.72	49.68	34.05	36.96	38.78
757.143	657.143	5.15	4.96	4.84	757.143	39.89	41.17	41.55	43.20	38.13	35.24
1000.000	900.000	5.91	5.45	5.14	1000.000	36.14	37.81	39.15	30.00	30.37	30.57
1214.286	1114.286	6.68	6.11	5.78	1214.286	35.77	36.73	37.31	25.63	26.04	26.60
1442.857	1342.857	7.04	6.61	6.30	1442.857	35.56	35.66	35.36	22.57	22.90	23.13
1671.429	1571.429	7.19	6.86	6.70	1671.429	35.82	34.88	33.87	19.53	19.27	19.09
1900.000	1800.000	7.40	7.03	6.85	1900.000	35.33	33.74	32.59	17.85	17.66	17.57
2000.000	1900.000	7.61	7.13	6.96	2000.000	35.16	33.54	32.41	17.57	17.52	17.55
2128.571	2028.571	7.86	7.43	7.17	2128.571	35.54	33.70	32.37	17.79	17.76	17.79
2471.429	2371.429	8.47	8.04	7.80	2471.429	34.33	33.24	32.30	18.78	18.85	18.90
2700.000	2600.000	8.83	8.34	8.08	2700.000	34.36	33.45	32.60	19.73	19.52	19.31
2814.286	2714.286	9.07	8.52	8.20	2814.286	35.04	34.07	33.29	20.22	19.86	19.59
3000.000	2900.000	9.48	8.85	8.48	3000.000	34.97	33.99	33.06	20.43	19.95	19.43
3157.143	3057.143	9.71	9.03	8.65	3157.143	34.67	33.55	32.87	19.93	19.48	19.24
3500.000	3400.000	10.27	9.22	8.77	3500.000	33.07	32.04	30.96	18.35	18.72	18.78
3728.571	3628.571	10.47	9.04	8.55	3728.571	31.06	30.42	29.43	17.74	18.47	19.03
4000.000	3900.000	10.91	8.91	8.29	4000.000	29.92	29.46	28.86	19.87	20.82	22.16
4300.000	4200.000	10.70	8.41	7.87	4300.000	34.74	33.24	32.24	25.46	24.62	23.79

mixer VSWR

ϕ detection

freq. MHz	VSWR, RF port LO +4dBm	LO +7dBm	LO +10dBm	VSWR, LO port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	VSWR, IF port LO +4dBm	LO +7dBm	LO +10dBm	freq. (MHz)	max. DC output mV	DC offset mV
300.000	6.21	5.75	5.49	5.04	4.40	4.70	5.000	1.63	1.37	1.19	300.000	−228.32	+.38
421.212	3.55	3.35	3.22	2.52	2.89	3.61	10.000	1.63	1.36	1.19	414.286	−203.28	−.24
500.000	2.70	2.55	2.44	2.11	2.65	3.47	20.000	1.62	1.36	1.19	528.571	−194.47	−.21
784.848	1.94	1.71	1.55	1.70	2.19	2.81	35.152	1.63	1.37	1.19	757.143	−206.10	−.19
1000.000	2.78	2.55	2.37	1.76	2.08	2.48	50.000	1.63	1.36	1.20	1000.000	−152.68	+.63
1148.485	3.37	3.13	2.94	1.83	1.99	2.25	65.303	1.62	1.36	1.19	1214.286	−115.73	+1.41
1269.697	3.74	3.50	3.30	1.81	1.85	2.08	100.000	1.61	1.36	1.19	1442.857	−109.97	+1.83
1500.000	4.34	4.13	3.97	1.75	1.68	1.84	125.606	1.60	1.35	1.18	1671.429	−60.67	+1.78
1633.333	4.66	4.48	4.32	1.70	1.61	1.78	185.909	1.58	1.33	1.17	1900.000	−43.40	+2.68
1875.758	5.16	5.06	4.95	1.67	1.57	1.71	200.000	1.58	1.33	1.17	2000.000	−58.02	+2.71
2118.182	5.47	5.38	5.30	1.60	1.47	1.56	246.212	1.55	1.31	1.15	2128.571	−37.38	+2.83
2300.000	5.63	5.56	5.49	1.51	1.41	1.51	306.515	1.51	1.28	1.13	2471.429	+72.61	+2.81
2481.818	5.59	5.51	5.47	1.47	1.37	1.47	396.970	1.44	1.24	1.11	2700.000	+84.72	+3.15
2724.242	5.42	5.27	5.16	1.41	1.36	1.46	457.273	1.41	1.22	1.13	2814.286	+81.27	+2.78
3000.000	6.05	5.77	5.54	1.56	1.58	1.74	500.000	1.40	1.23	1.17	3000.000	+126.24	+3.40
3209.091	7.31	6.97	6.71	1.59	1.60	1.70	608.030	1.42	1.34	1.35	3157.143	+138.37	+3.86
3451.515	9.13	8.72	8.43	2.06	2.03	2.19	758.788	1.66	1.69	1.77	3500.000	+158.76	+4.77
3815.152	8.43	8.23	7.97	2.69	2.39	2.41	849.242	1.92	1.99	2.11	3728.571	+161.70	+4.01
4000.000	7.66	7.47	7.20	2.86	2.43	2.34	939.697	2.21	2.38	2.57	4000.000	+168.81	+1.97
4300.000	6.37	6.26	6.07	2.52	2.13	1.95	1000.000	2.39	2.61	2.85	4300.000	+186.07	+3.89

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	–	–	+11	29	8	35	14	51	34	53	37	57
	1	–	22	+0	37	33	46	34	62	55	55	47	56
	2	>94	67	50	56	60	>73	51	68	50	>63	61	>63
	3	>90	>68	72	71	66	>72	>73	>68	>67	>68	62	>64
	4	>91	>69	>68	73	>73	>75	>72	>73	>67	>69	>69	>63
	5	>91	>69	>68	>66	>74	>73	>74	72	73	>67	>69	66
	6	90	68	>69	68	>74	>75	>73	>74	>73	>72	>67	67
	7	>85	63	>68	>69	>68	>74	>74	>74	>75	>73	>74	>66
	8	>86	>64	>63	>68	>69	66	>74	>73	>74	>74	71	>74
	9	>84	>63	63	58	>68	66	>66	72	>73	>74	>74	>73
	10	>81	>59	>62	>63	>62	67	>69	68	>74	>74	>74	73
			0	1	2	3	4	5	6	7	8	9	10

LO Harmonic Order

test conditions: RF IN: 2000.10 MHZ; −14.97 DBM
LO IN: 2100.01 MHZ; +7.01 DBM
IF OUT: 99.91 MHZ; −22.13 DBM

RF CAL

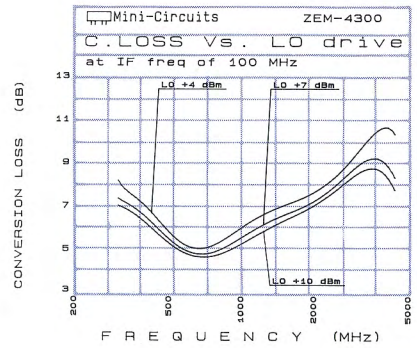
RF ORDER HARMONIC	0	–	–	+2	40	18	48	27	61	49	67	49	66
	1	–	22	+0	38	34	47	36	72	56	60	56	65
	2	>96	59	43	48	53	68	44	65	44	68	57	69
	3	>90	74	70	56	49	67	62	71	56	71	71	71
	4	89	>78	>77	>83	62	72	77	78	69	74	61	>73
	5	>91	>79	>78	>77	>85	77	69	>83	77	>77	74	77
	6	90	>79	77	77	>83	82	80	82	82	>83	>77	76
	7	>85	72	>77	77	>78	>84	82	>83	>84	82	>83	>76
	8	85	>73	>73	>77	>77	77	>83	>83	82	83	>82	>83
	9	84	>73	>73	>72	>77	>78	>78	82	>82	>84	82	81
	10	>80	65	>72	>73	69	>78	>79	>79	>83	>84	82	>83
			0	1	2	3	4	5	6	7	8	9	10

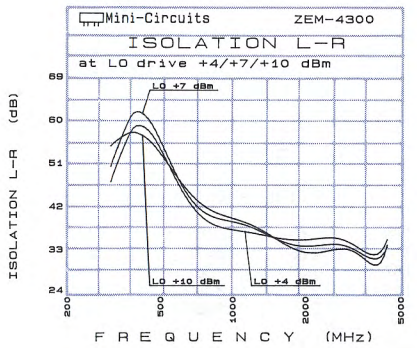
LO Harmonic Order

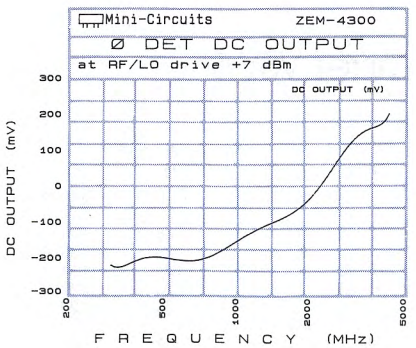
test conditions: RF IN: 2000.10 MHZ; −5.07 DBM
LO IN: 2100.01 MHZ; +7.01 DBM
IF OUT: 99.91 MHZ; −12.29 DBM

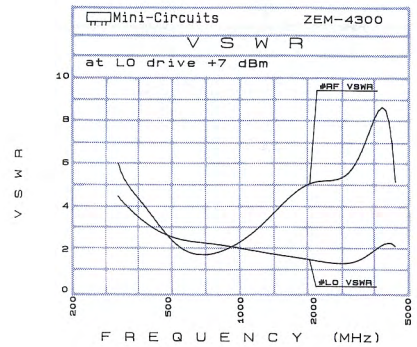
typical performance curves

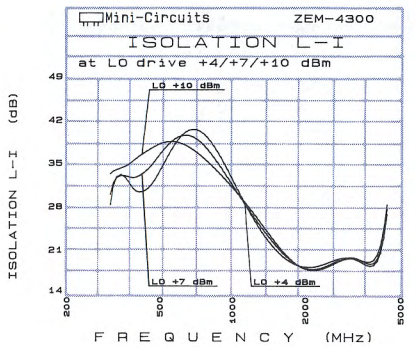
(production unit)

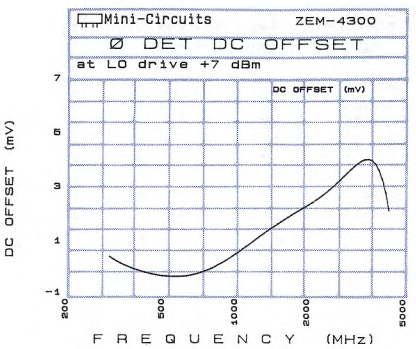












In Stock...Immediate Delivery

surface mount, plug-in

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models

ASK-2 (KK-81)
(W-38)
(X-65)

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	Conversion Loss (dB) LO +7 dBm	Conversion Loss (dB) LO +10 dBm	Isolation L-R (dB) LO +4 dBm	Isolation L-R (dB) LO +7 dBm	Isolation L-R (dB) LO +10 dBm	Isolation L-I (dB) LO +4 dBm	Isolation L-I (dB) LO +7 dBm	Isolation L-I (dB) LO +10 dBm
1.000	31.000	8.06	7.37	7.47	76.97	83.47	86.14	82.27	91.97	79.84
2.000	32.000	7.44	7.07	6.90	75.98	80.37	79.56	80.18	87.67	76.46
5.000	35.000	7.13	6.73	6.46	71.68	72.27	71.64	73.98	82.47	70.34
10.000	40.000	7.03	6.62	6.35	66.92	66.17	65.67	67.22	77.87	64.77
20.000	50.000	6.93	6.55	6.30	61.46	61.04	60.44	61.46	73.34	59.64
50.000	80.000	6.96	6.57	6.30	53.29	52.51	51.85	53.95	61.14	50.19
97.677	67.677	7.00	6.59	6.30	47.97	47.22	46.56	48.62	54.12	44.44
100.000	70.000	7.01	6.59	6.30	47.88	47.11	46.48	48.17	53.57	44.46
194.355	164.355	6.89	6.53	6.30	42.90	41.80	40.95	43.31	49.32	39.67
200.000	170.000	6.87	6.53	6.32	42.64	41.66	40.91	42.74	49.33	39.64
291.032	261.032	6.89	6.57	6.34	39.32	38.25	37.39	39.91	47.35	36.34
387.710	357.710	7.02	6.67	6.40	36.38	35.81	35.22	38.80	42.38	33.81
484.387	454.387	7.04	6.68	6.42	33.84	33.54	33.25	34.85	37.69	31.48
500.000	470.000	7.03	6.68	6.43	33.60	33.24	32.94	34.77	36.29	30.48
581.065	551.065	7.21	6.87	6.59	31.84	31.64	31.47	33.08	32.31	28.29
677.742	647.742	7.61	7.12	6.84	29.22	29.02	28.88	29.74	27.88	24.76
774.419	744.419	7.96	7.40	7.04	27.08	26.95	26.89	25.78	24.13	21.89
871.097	841.097	8.48	7.80	7.42	25.95	25.84	25.84	22.00	20.52	19.08
967.774	937.774	8.83	8.22	7.97	25.88	25.87	26.06	18.97	17.33	16.06
1000.000	970.000	9.01	8.38	8.10	25.88	25.95	26.18	17.92	16.29	14.78

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	VSWR RF port LO +7 dBm	VSWR RF port LO +10 dBm	VSWR LO port LO +4 dBm	VSWR LO port LO +7 dBm	VSWR LO port LO +10 dBm	VSWR IF port LO +4 dBm	VSWR IF port LO +7 dBm	VSWR IF port LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.33	1.38	1.43	1.86	2.66	3.59	1.36	1.19	1.07	1.000	221.50	-0.07
10.000	1.22	1.29	1.35	1.78	2.56	3.48	1.36	1.19	1.07	2.000	226.26	-0.06
20.000	1.17	1.24	1.31	1.87	2.67	3.66	1.36	1.19	1.07	5.000	226.60	-0.05
50.000	1.16	1.23	1.29	1.81	2.56	3.48	1.36	1.19	1.07	10.000	230.11	-0.05
95.454	1.15	1.23	1.29	1.79	2.51	3.45	1.37	1.20	1.08	20.000	227.70	-0.04
100.000	1.15	1.22	1.29	1.81	2.53	3.47	1.37	1.20	1.08	50.000	220.13	0.00
185.909	1.15	1.23	1.29	1.80	2.51	3.44	1.41	1.24	1.12	97.677	227.39	0.02
200.000	1.15	1.23	1.29	1.81	2.49	3.39	1.42	1.24	1.13	100.000	226.03	0.02
276.364	1.17	1.24	1.30	1.82	2.49	3.34	1.46	1.28	1.17	194.355	228.90	0.40
366.818	1.20	1.27	1.32	1.88	2.49	3.29	1.49	1.33	1.22	200.000	228.73	0.51
457.273	1.26	1.32	1.38	1.89	2.44	3.13	1.53	1.37	1.27	291.032	231.68	1.67
487.424	1.28	1.34	1.39	1.97	2.56	3.28	1.54	1.39	1.29	387.710	240.54	3.19
500.000	1.29	1.35	1.41	1.98	2.55	3.24	1.54	1.40	1.31	484.387	211.07	4.08
547.727	1.34	1.40	1.45	2.06	2.64	3.35	1.53	1.38	1.28	500.000	207.52	4.17
638.182	1.46	1.52	1.57	2.36	3.03	3.90	1.53	1.40	1.31	581.065	197.07	4.80
728.636	1.64	1.69	1.75	2.64	3.49	4.62	1.52	1.40	1.33	677.742	192.07	8.28
819.091	1.88	1.93	1.97	2.66	3.33	4.09	1.49	1.39	1.35	774.419	190.15	13.51
909.546	2.16	2.20	2.24	2.54	3.00	3.47	1.46	1.39	1.37	871.097	179.18	17.54
969.849	2.41	2.45	2.50	2.57	2.97	3.42	1.44	1.39	1.38	967.774	186.01	15.06
1000.000	2.54	2.58	2.62	2.58	2.98	3.40	1.44	1.39	1.39	1000.000	177.86	13.41

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	8	10	3	32	14	42	21	45	26	43
1	-	22	0	33	13	26	28	60	36	47	44	51
2	95	53	40	55	39	64	39	60	53	64	54	63
3	> 96	72	71	69	72	70	70	68	69	> 74	71	> 74
4	> 96	> 75	> 75	> 75	> 76	> 76	> 76	72	> 75	> 75	> 74	74
5	> 96	> 75	> 75	> 75	> 75	> 76	> 76	> 76	> 76	> 75	> 75	> 75
6	> 95	> 74	74	72	> 75	> 76	> 76	> 76	74	> 75	> 76	> 75
7	95	> 75	> 75	> 74	> 75	71	> 75	75	74	> 76	> 76	> 75
8	95	> 75	73	74	> 74	71	> 76	> 76	> 75	> 76	> 75	> 76
9	> 95	> 75	74	72	> 76	74	> 74	> 75	> 75	> 76	> 75	75
10	95	75	> 75	> 76	> 75	74	74	> 74	> 76	> 75	> 76	> 76

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; -14.01 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -20.68 DBM

RF ORDER HARMONIC

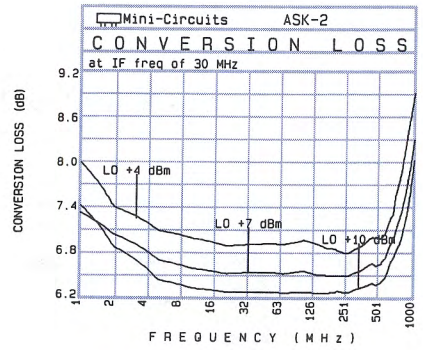
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	15	20	15	41	26	56	34	66	37	66
1	-	21	0	33	13	28	29	63	38	52	50	59
2	84	42	31	49	30	56	33	63	47	63	50	64
3	95	55	54	51	45	60	49	46	53	69	56	63
4	> 96	67	67	54	59	54	53	63	48	60	63	66
5	> 95	79	76	70	58	64	62	62	65	69	68	78
6	> 94	81	81	81	75	71	66	75	65	74	80	74
7	> 96	> 85	> 85	81	> 85	79	82	80	77	83	77	78
8	> 96	> 85	> 86	> 85	> 84	> 84	82	80	82	84	76	83
9	> 95	83	> 85	> 85	> 85	> 84	> 85	> 85	82	81	85	80
10	> 96	> 86	> 85	84	> 85	> 85	> 84	> 85	> 86	82	85	> 85

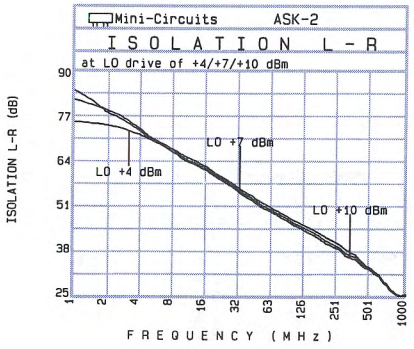
LO HARMONICS ORDER

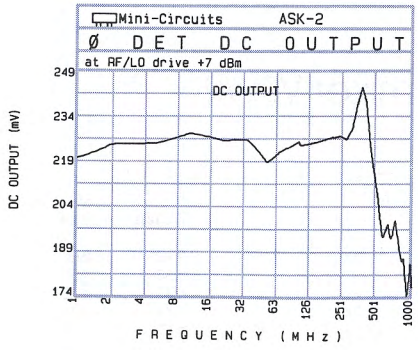
test condition RF IN: 500.10 MHZ; -3.97 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -10.70 DBM

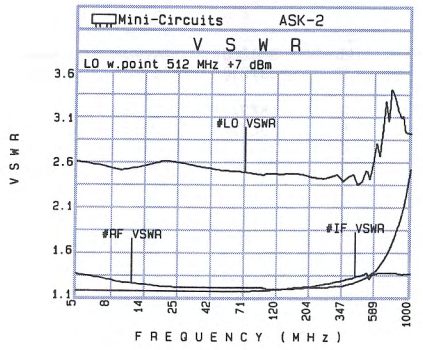
typical performance curves

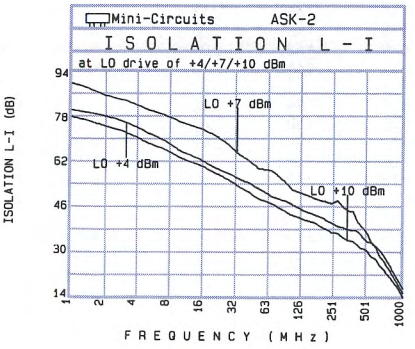
(production unit)

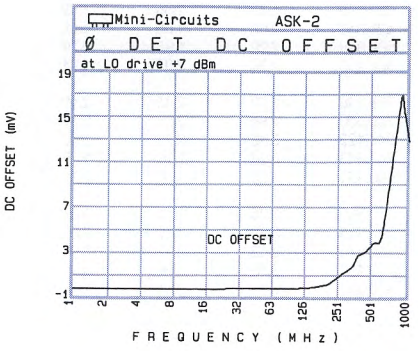












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17 dBm LO, up to +14 dBm RF)

Models
RMS-5H
LRMS-5H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
10.000	40.000	8.22	6.95	6.34	80.40	70.78	63.30	59.97	61.92	55.11
20.000	50.000	7.82	6.58	6.12	77.03	65.19	58.10	56.00	63.52	52.26
50.000	80.000	7.47	6.34	5.87	66.43	58.27	51.79	47.18	59.11	46.77
100.000	70.000	7.33	6.16	5.77	56.26	57.50	46.11	40.17	49.97	40.28
149.688	119.688	7.35	6.25	5.82	51.17	57.97	47.45	36.86	51.05	42.62
200.000	170.000	7.56	6.35	5.94	46.01	58.46	43.83	33.63	44.60	37.32
289.375	259.375	7.36	6.44	6.02	40.17	45.97	41.42	29.98	40.19	33.64
429.063	399.063	7.70	6.52	6.01	33.26	35.99	36.79	26.09	40.36	28.22
500.000	470.000	7.72	6.57	6.05	31.16	33.86	33.91	25.71	35.13	25.05
568.750	538.750	7.92	6.70	6.20	29.36	31.80	33.00	26.37	31.81	24.69
708.438	678.438	8.73	7.17	6.43	26.26	28.34	29.87	26.32	25.09	21.09
750.000	720.000	8.94	7.33	6.52	25.56	27.82	29.02	26.18	23.34	19.68
848.125	818.125	8.86	7.63	6.86	24.37	27.14	28.81	25.04	20.18	17.06
987.813	957.813	8.71	7.85	7.27	22.55	25.28	27.18	21.35	17.43	14.03
1000.000	970.000	8.75	7.86	7.29	22.40	25.09	27.05	20.73	16.91	13.91
1127.500	1097.500	8.58	7.96	7.64	21.17	23.28	24.71	17.06	14.89	13.10
1267.188	1237.188	8.51	8.09	7.78	19.82	21.51	22.88	14.45	13.36	12.00
1406.875	1376.875	8.92	8.10	7.92	19.11	20.40	21.42	12.21	11.73	11.17
1453.437	1423.438	9.40	8.28	8.06	18.88	20.09	20.78	11.96	11.57	11.34
1500.000	1470.000	10.05	8.50	8.17	18.43	19.62	20.42	11.53	11.46	11.38

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
10.000	2.32	2.20	2.06	1.21	1.53	2.24	2.06	1.48	1.17	10.000	851.20	-0.88
20.000	1.76	1.63	1.53	1.10	1.56	2.34	2.07	1.48	1.17	20.000	859.90	-0.92
50.000	1.62	1.47	1.35	1.03	1.51	2.27	2.05	1.47	1.17	50.000	888.20	-0.79
100.000	1.65	1.49	1.35	1.01	1.50	2.20	2.06	1.48	1.17	100.303	834.70	-0.99
149.688	1.70	1.52	1.38	1.02	1.49	2.22	2.05	1.47	1.17	145.455	840.20	-1.20
200.000	1.74	1.57	1.42	1.05	1.47	2.14	2.04	1.47	1.16	200.000	872.50	-0.79
289.375	1.86	1.66	1.52	1.08	1.45	2.13	1.99	1.46	1.18	280.909	902.50	0.12
429.063	2.04	1.85	1.68	1.15	1.48	2.08	1.87	1.44	1.22	416.364	815.00	5.39
500.000	2.20	1.96	1.79	1.19	1.52	2.05	1.81	1.43	1.25	500.000	741.90	5.34
568.750	2.34	2.07	1.91	1.27	1.65	2.26	1.74	1.42	1.30	551.818	754.20	9.82
708.438	2.70	2.42	2.19	1.37	1.79	2.42	1.67	1.46	1.43	687.273	732.10	14.79
750.000	2.85	2.56	2.32	1.40	1.80	2.40	1.64	1.46	1.46	732.424	700.80	14.73
848.125	3.12	2.79	2.56	1.53	1.94	2.49	1.76	1.68	1.72	867.879	704.70	22.92
987.813	3.24	2.98	2.77	1.67	2.02	2.53	1.90	1.89	1.96	1000.000	749.50	18.87
1000.000	3.25	3.00	2.79	1.73	2.12	2.69	1.90	1.90	1.97	1003.333	747.10	18.58
1127.500	3.35	3.16	3.01	1.92	2.21	2.75	2.11	2.26	2.40	1138.788	831.90	8.68
1267.188	3.30	3.15	3.07	2.40	2.57	3.07	2.72	2.85	2.93	1274.242	765.90	-12.15
1406.875	3.12	2.97	2.90	2.90	2.82	3.13	3.26	3.45	3.62	1409.697	747.80	-8.08
1453.437	3.16	2.99	2.90	3.11	2.97	3.20	3.99	4.20	4.30	1454.849	752.80	0.48
1500.000	3.12	2.94	2.86	3.34	3.15	3.31	3.74	3.81	3.86	1500.000	722.20	12.35

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	8	8	1	17	12	24	27	33	24	30
1	-	17	0	26	17	43	44	36	27	44	35	43
2	79	48	40	48	38	63	46	58	> 84	63	51	59
3	95	77	72	71	64	75	66	81	> 84	> 84	64	71
4	> 96	> 84	> 85	83	76	81	73	> 85	79	> 84	80	79
5	> 95	> 84	81	> 85	> 84	> 85	> 85	> 84	84	> 85	> 84	> 84
6	> 95	> 84	> 73	81	> 84	> 84	> 84	> 85	> 85	82	> 84	82
7	> 97	84	80	> 83	> 84	> 85	84	> 84	83	> 84	> 84	> 85
8	> 97	> 85	84	> 85	> 83	> 84	> 85	84	> 84	> 84	> 84	> 84
9	91	81	> 85	> 84	> 84	> 83	> 83	> 85	> 85	> 85	> 84	> 86
10	93	> 85	> 84	> 86	> 85	> 84	> 83	> 84	> 84	> 85	> 85	> 84

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; -4.97 DBM
LO IN: 470.01 MHZ; +16.94 DBM
IF OUT: 30.09 MHZ; -11.46 DBM

RF ORDER HARMONIC

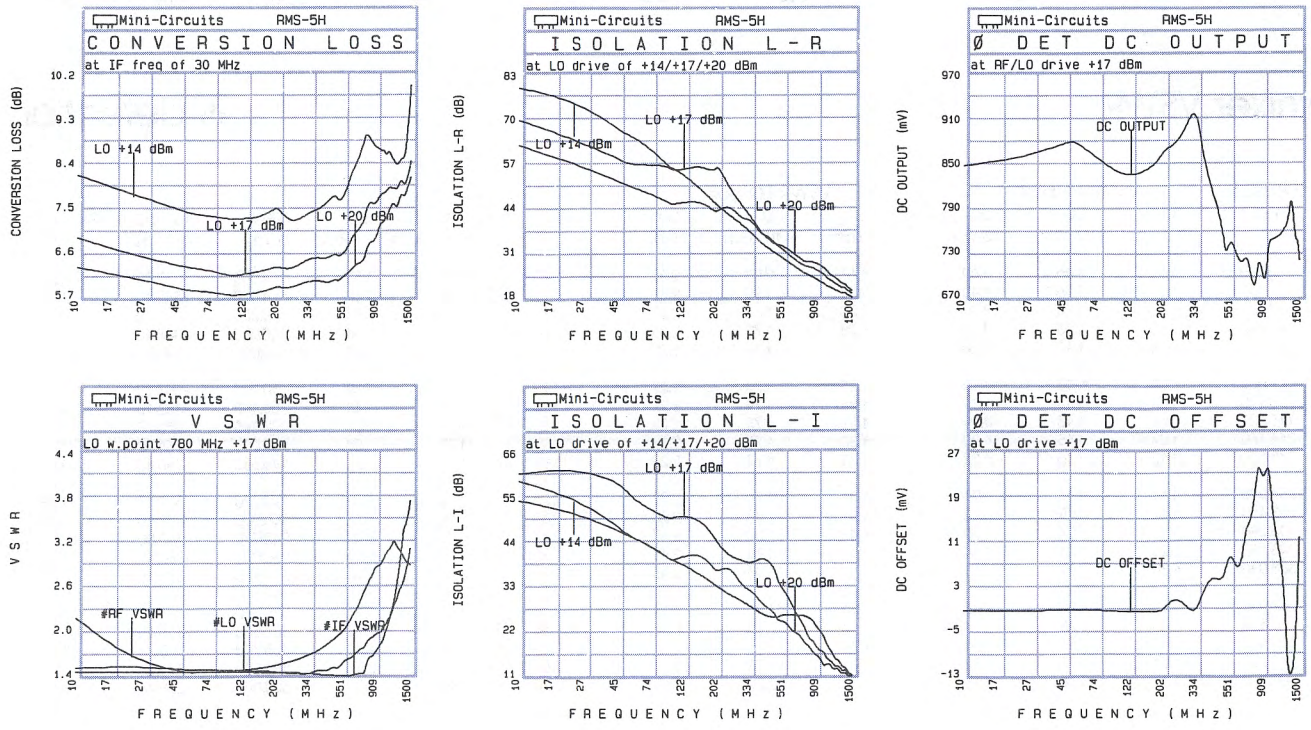
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	18	12	27	24	42	41	51	35	46
1	-	17	0	28	18	45	43	38	29	47	37	51
2	62	39	33	38	30	49	37	58	49	51	47	51
3	70	72	54	54	48	56	51	59	55	> 94	48	55
4	> 95	66	71	59	56	55	51	57	57	66	57	61
5	> 96	72	84	82	73	74	64	70	63	71	81	80
6	> 95	78	76	87	85	76	70	75	66	81	71	81
7	> 96	88	92	> 93	92	89	83	80	73	81	74	90
8	> 96	> 94	93	> 93	> 93	> 94	92	91	83	89	79	87
9	> 95	> 94	93	93	> 94	> 94	> 94	> 96	89	90	83	87
10	> 96	> 94	> 94	93	> 94	> 94	> 94	> 94	> 95	> 94	92	> 95

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; +4.92 DBM
LO IN: 470.01 MHZ; +16.94 DBM
IF OUT: 30.09 MHZ; -1.65 DBM

typical performance curves

(production unit)



In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-1LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
2.000	32.000	7.08	6.68	6.47	54.70	56.27	57.70	58.13	61.48	64.77
4.000	34.000	6.44	5.99	5.80	53.93	55.49	56.87	58.13	61.08	63.47
5.000	35.000	6.33	5.91	5.68	53.83	55.45	56.81	58.22	60.78	62.56
10.000	40.000	6.07	5.67	5.46	53.50	55.36	56.81	57.55	59.10	60.35
20.000	50.000	6.07	5.64	5.41	53.32	55.12	56.65	56.63	57.18	56.99
50.000	80.000	6.05	5.67	5.48	53.54	55.26	56.82	54.37	51.88	50.11
50.190	80.194	6.07	5.67	5.48	53.55	55.32	56.87	54.44	51.90	50.16
98.390	68.387	6.21	5.75	5.49	53.95	56.41	58.37	52.10	48.52	46.18
100.000	70.000	6.10	5.66	5.48	53.94	56.47	58.55	52.01	48.39	46.03
146.580	116.581	5.82	5.59	5.50	56.48	59.78	61.26	49.88	45.79	43.63
194.770	164.774	5.79	5.64	5.56	60.93	64.83	62.83	44.60	43.30	42.13
200.000	170.000	5.82	5.66	5.55	61.63	65.19	62.51	44.13	42.88	42.00
242.970	212.968	5.85	5.70	5.60	65.90	60.00	57.12	39.92	39.71	39.15
250.000	220.000	5.89	5.71	5.60	66.57	59.58	56.77	39.90	39.98	39.68
291.160	261.161	6.11	5.92	5.84	61.19	56.13	53.94	36.93	36.74	37.06
339.350	309.355	6.30	6.04	5.91	55.31	52.01	50.09	35.28	35.96	36.28
387.550	357.548	6.44	6.28	6.15	47.35	46.67	46.18	34.04	35.31	36.04
435.740	405.742	6.55	6.31	6.18	47.08	46.78	46.10	30.73	31.57	32.37
483.940	453.936	7.03	6.47	6.17	44.17	43.38	43.16	30.34	30.06	30.88
500.000	470.000	7.34	6.69	6.26	42.04	41.79	41.99	30.12	29.69	30.15

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
2.000	1.61	1.65	1.69	1.63	2.08	2.67	1.61	1.45	1.32	2.000	-337.00	1.55
4.490	1.32	1.36	1.40	1.48	1.99	2.60	1.62	1.45	1.32	4.000	-347.40	1.47
19.430	1.07	1.15	1.20	1.30	1.81	2.37	1.63	1.47	1.33	5.000	-348.50	1.49
49.310	1.04	1.13	1.19	1.28	1.79	2.36	1.65	1.48	1.34	10.000	-348.40	1.44
99.110	1.04	1.13	1.20	1.26	1.76	2.32	1.69	1.54	1.40	20.000	-346.80	1.45
119.030	1.04	1.13	1.20	1.25	1.74	2.28	1.73	1.56	1.42	50.000	-363.20	1.52
133.970	1.04	1.13	1.19	1.25	1.74	2.27	1.76	1.59	1.44	50.190	-363.10	1.50
171.320	1.05	1.13	1.19	1.27	1.73	2.22	1.81	1.64	1.51	98.390	-353.70	1.48
211.160	1.07	1.15	1.20	1.30	1.75	2.22	1.91	1.72	1.59	100.000	-351.90	1.48
238.550	1.10	1.16	1.22	1.33	1.77	2.25	1.98	1.79	1.65	146.580	-360.40	1.52
251.000	1.11	1.18	1.23	1.34	1.79	2.27	2.02	1.84	1.68	194.770	-369.10	1.73
263.450	1.12	1.19	1.24	1.36	1.80	2.28	2.07	1.87	1.72	200.000	-368.60	1.69
303.290	1.18	1.24	1.30	1.43	1.89	2.40	2.17	1.95	1.78	242.970	-361.00	1.51
343.130	1.25	1.31	1.38	1.48	1.94	2.45	2.30	2.07	1.88	250.000	-361.60	1.51
368.030	1.30	1.37	1.43	1.52	1.96	2.45	2.38	2.13	1.94	291.160	-378.40	2.13
382.970	1.32	1.40	1.47	1.54	1.95	2.43	2.42	2.17	1.98	339.350	-331.90	2.36
420.320	1.40	1.48	1.54	1.64	2.02	2.47	2.54	2.30	2.10	387.550	-304.60	2.41
460.160	1.47	1.54	1.61	1.76	2.16	2.57	2.65	2.40	2.22	435.740	-307.30	2.93
487.550	1.51	1.58	1.64	1.79	2.21	2.63	2.69	2.43	2.32	483.940	-271.86	2.52
500.000	1.51	1.58	1.64	1.80	2.22	2.65	2.74	2.49	2.31	500.000	-265.34	2.56

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	15	25	17	32	20	40	22	35	25	41
1	-	21	0	33	13	39	21	40	25	37	38	45
2	96	> 76	65	> 77	64	71	61	75	60	> 77	67	73
3	96	70	66	73	72	> 77	61	74	59	75	60	72
4	96	> 76	> 77	76	> 76	> 77	> 77	76	76	> 77	75	> 76
5	> 98	> 76	75	> 76	75	76	> 77	> 76	> 76	> 76	> 76	> 76
6	> 96	75	> 76	> 76	76	> 77	> 77	> 76	75	> 77	75	76
7	> 97	> 77	> 76	> 76	76	75	> 75	> 77	> 76	> 76	> 76	> 75
8	> 96	> 76	74	> 76	74	76	> 76	> 76	> 77	> 77	75	> 76
9	> 96	> 76	> 75	> 76	> 76	> 76	> 77	> 76	75	> 77	> 77	76
10	95	74	75	> 75	> 77	> 77	> 76	> 75	> 76	75	> 77	75

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -15.04 DBM
LO IN: 155.01 MHZ; +9.92 DBM
IF OUT: 30.09 MHZ; -21.02 DBM

RF CAL

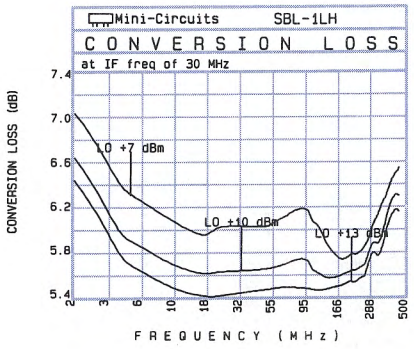
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	24	34	27	41	31	50	32	46	37	54
1	-	20	+0	32	12	38	20	42	23	36	36	45
2	83	74	59	69	57	70	55	74	53	79	66	66
3	96	57	48	58	57	63	48	69	46	63	46	60
4	96	85	72	> 86	71	> 86	74	83	72	80	69	83
5	96	77	67	75	70	74	70	77	61	77	59	82
6	> 96	> 85	> 86	84	83	> 86	85	> 86	84	> 86	83	> 86
7	> 96	> 85	84	83	83	85	80	84	76	84	73	85
8	> 97	84	> 86	> 85	> 86	> 86	> 86	> 86	85	> 86	> 86	> 86
9	95	> 85	85	85	> 85	> 87	> 85	85	84	85	84	85
10	> 96	> 85	> 85	> 86	84	> 86	> 85	> 85	> 84	> 85	85	> 86

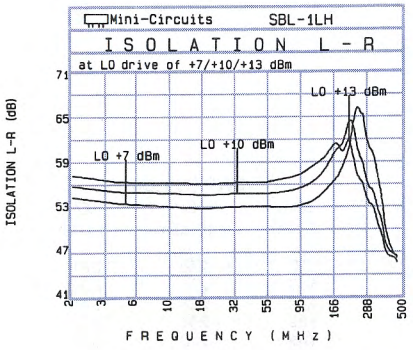
LO HARMONICS ORDER

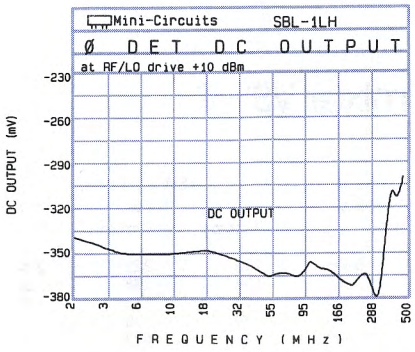
test condition RF IN: 185.10 MHZ; -5.00 DBM
LO IN: 155.01 MHZ; +9.96 DBM
IF OUT: 30.09 MHZ; -10.65 DBM

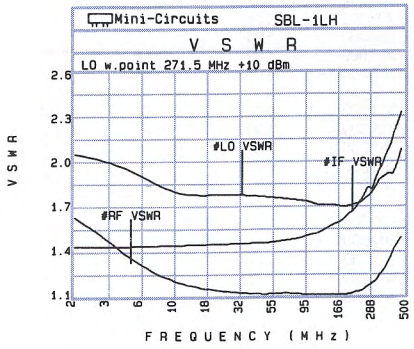
typical performance curves

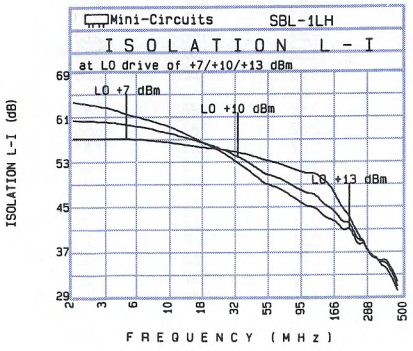
(production unit)

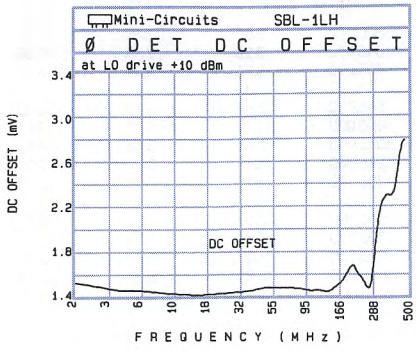












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-11LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
5.000	35.000	6.93	6.55	6.32	66.46	71.57	74.37	62.26	64.17	65.17
10.000	40.000	6.62	6.31	6.09	66.09	68.83	71.33	66.49	67.23	67.03
20.000	50.000	6.67	6.29	6.06	67.08	69.62	72.32	77.78	79.82	71.72
50.000	80.000	6.57	6.24	6.05	66.40	69.03	71.69	74.90	73.13	65.79
100.000	70.000	6.62	6.23	6.05	62.70	65.20	67.26	73.30	67.00	60.91
200.000	170.000	6.83	6.54	6.29	61.40	63.38	66.04	72.40	65.78	59.70
204.500	174.500	6.97	6.62	6.33	55.54	58.53	60.34	65.41	56.32	51.36
404.000	374.000	8.11	7.13	6.38	54.11	56.35	58.12	60.62	52.67	48.01
500.000	470.000	7.60	6.89	6.48	49.18	52.61	55.63	45.98	41.12	38.33
603.500	573.500	7.67	6.84	6.41	47.43	48.02	49.12	44.62	40.44	36.84
803.000	773.000	7.88	7.41	7.19	51.32	55.35	59.14	35.92	32.96	31.14
1000.000	970.000	7.79	7.38	7.14	50.26	58.31	56.22	47.73	44.18	36.60
1002.500	972.500	7.79	7.38	7.15	64.88	63.25	57.86	30.93	31.13	29.57
1200.000	1170.000	7.14	6.67	6.47	54.71	60.14	59.01	30.31	31.22	30.17
1335.000	1305.000	8.53	7.76	7.39	39.62	40.52	41.76	27.73	29.47	30.66
1500.000	1470.000	8.98	7.94	7.40	37.34	36.05	34.39	26.38	25.50	26.52
1667.500	1637.500	7.77	6.93	6.58	29.23	29.45	30.37	59.64	59.66	59.52
1867.000	1837.000	7.27	6.71	6.48	34.07	35.05	36.24	45.27	45.23	45.16
1933.500	1903.500	7.25	6.76	6.49	36.54	38.82	41.21	36.77	36.88	36.36
2000.000	1970.000	7.24	6.78	6.51	37.97	40.63	43.51	30.92	30.77	30.42

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm
5.000	2.26	2.22	2.14	2.07	2.66	3.61	10.000	1.82	1.81	1.84
10.000	1.86	1.78	1.69	1.63	2.35	3.36	20.000	1.39	1.45	1.54
20.000	1.74	1.65	1.57	1.59	2.38	3.41	50.000	1.19	1.27	1.39
50.000	1.79	1.68	1.58	1.52	2.31	3.30	86.000	1.12	1.20	1.33
100.000	1.86	1.73	1.62	1.46	2.20	3.14	100.000	1.10	1.19	1.32
200.000	2.04	1.89	1.76	1.47	2.12	2.96	146.000	1.05	1.14	1.30
325.270	2.35	2.13	1.95	1.51	2.05	2.83	192.000	1.04	1.13	1.26
500.000	3.00	2.65	2.40	1.55	1.95	2.63	200.000	1.04	1.13	1.27
545.450	3.23	2.85	2.59	1.55	1.92	2.59	252.000	1.02	1.12	1.26
705.590	3.76	3.45	3.20	1.80	1.85	2.33	300.000	1.01	1.13	1.24
865.720	3.89	3.77	3.62	2.11	1.86	2.17	313.000	1.01	1.12	1.27
1000.000	3.72	3.72	3.67	2.42	1.84	1.95	328.000	1.00	1.13	1.27
1085.900	3.48	3.46	3.42	2.47	1.81	1.81	358.000	1.01	1.14	1.28
1246.040	3.12	3.01	2.96	2.81	1.78	1.53	403.000	1.04	1.16	1.31
1406.170	3.10	2.88	2.70	2.83	1.71	1.27	449.000	1.08	1.20	1.35
1566.300	3.53	3.22	2.94	2.71	1.57	1.09	500.000	1.14	1.27	1.42
1733.110	3.63	3.29	2.94	2.35	1.40	1.22	509.000	1.15	1.28	1.43
1893.240	3.05	2.77	2.54	1.73	1.32	1.48	555.000	1.23	1.37	1.52
1946.620	3.21	3.01	2.77	1.63	1.32	1.58	585.000	1.30	1.44	1.59
2000.000	3.20	3.01	2.79	1.47	1.34	1.65	600.000	1.34	1.48	1.64

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+7	15	4	26	15	33	35	34	30	32
1	-	16	+0	28	52	25	29	40	56	41	59	41
2	89	53	42	57	42	68	44	67	62	68	>65	65
3	95	71	>72	69	65	72	70	67	>73	>72	>73	64
4	>96	>74	>73	>73	>73	>74	>74	>72	>74	>73	>73	>73
5	>96	>73	>73	>73	71	>74	72	>73	>73	71	>74	>72
6	>91	66	>73	72	>73	71	72	>74	>74	>73	>72	>74
7	>89	65	>67	>72	>73	>73	70	>73	73	71	>72	>73
8	91	>69	>67	>67	>72	>73	>72	71	>73	>73	72	71
9	>91	>68	>68	>68	66	>73	>71	72	71	>73	>74	72
10	>92	67	>68	>68	>67	>66	>73	>72	>74	71	>73	72

LO HARMONICS ORDER

test condition RF IN: 1000.10 MHZ; -15.09 DBM
LO IN: 970.01 MHZ; +10.03 DBM
IF OUT: 30.09 MHZ; -22.97 DBM

RF CAL

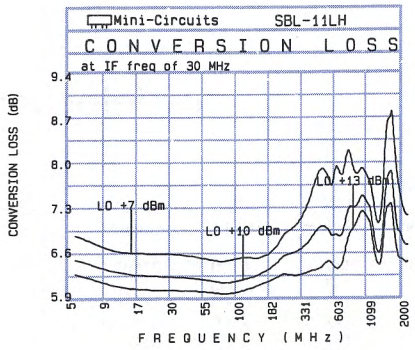
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	3	25	15	37	26	45	47	47	45	47
1	-	17	+0	28	52	25	30	43	60	43	61	44
2	70	46	35	49	34	61	36	61	55	62	59	58
3	>96	57	63	55	45	54	71	51	57	65	80	62
4	>96	82	68	64	58	69	54	>83	57	77	73	81
5	95	>82	>83	82	>82	80	71	76	>83	72	78	>82
6	89	>77	>83	>84	83	81	79	83	72	>84	77	>84
7	89	>77	>78	>83	>84	>84	81	>83	>84	>84	>83	>83
8	90	78	>77	>77	>83	>84	82	>82	82	>84	>85	>82
9	>91	>79	>79	>77	76	82	>83	82	>83	82	>84	>83
10	>91	>79	77	77	>78	>77	>83	>82	>83	>82	>83	>84

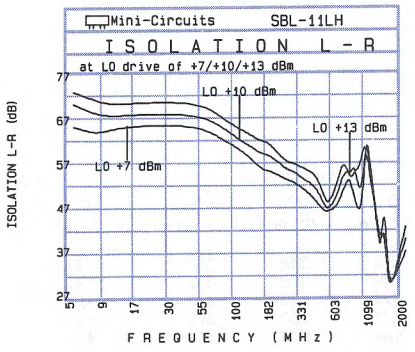
LO HARMONICS ORDER

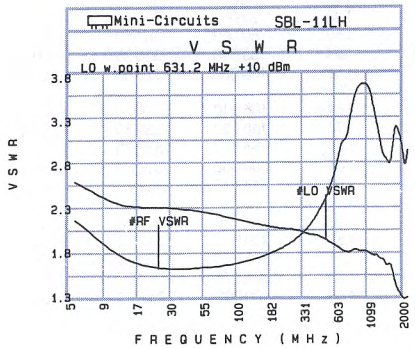
test condition RF IN: 1000.10 MHZ; -4.97 DBM
LO IN: 970.01 MHZ; +10.03 DBM
IF OUT: 30.09 MHZ; -12.65 DBM

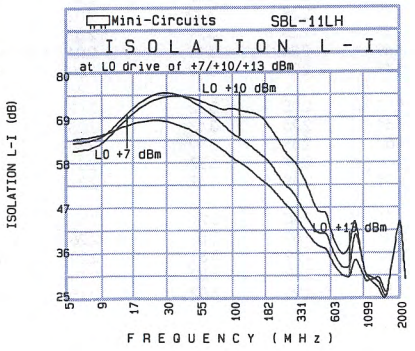
typical performance curves

(production unit)









broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-1-1LH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
0.200	30.200	5.41	5.14	5.02	62.99	63.24	63.23	56.72	56.21	55.79
0.400	30.400	5.30	5.04	4.93	63.07	62.95	62.65	56.39	55.99	55.49
0.500	30.500	5.29	5.03	4.93	63.12	62.91	62.56	56.36	55.96	55.42
1.000	31.000	5.21	4.96	4.85	62.80	62.77	62.50	56.22	55.82	55.32
2.000	32.000	5.10	4.83	4.73	62.73	62.68	62.43	56.21	55.70	55.30
5.000	35.000	5.14	4.81	4.68	63.11	62.88	62.54	56.73	56.04	55.51
10.000	40.000	5.06	4.75	4.66	62.85	63.10	62.85	56.90	56.40	55.89
20.000	50.000	5.14	4.80	4.68	62.28	62.46	62.41	56.51	55.88	55.36
43.040	73.036	4.97	4.78	4.70	60.66	60.74	60.33	53.66	52.44	51.71
50.000	80.000	5.10	4.82	4.72	60.37	60.54	60.05	53.68	52.16	51.47
100.000	70.000	4.92	4.74	4.70	56.18	56.37	56.44	47.81	48.05	47.63
100.150	70.150	4.92	4.75	4.71	56.20	56.27	56.42	47.82	48.06	47.63
157.260	127.264	5.00	4.85	4.81	53.20	53.73	54.43	46.03	46.11	44.44
200.000	170.000	5.18	5.04	4.97	54.16	53.86	54.67	42.56	42.06	41.13
214.380	184.379	5.28	5.12	5.02	55.80	56.47	58.16	40.19	40.53	39.50
271.490	241.493	5.48	5.37	5.42	47.03	47.24	47.04	34.56	34.08	33.16
328.610	298.607	5.80	5.46	5.41	47.37	46.10	43.10	36.30	31.84	30.14
371.440	341.443	6.73	5.88	5.29	46.03	43.35	40.46	34.41	33.03	29.13
385.720	355.721	7.04	6.06	5.36	48.02	46.26	45.69	32.83	32.39	30.57
400.000	370.000	7.47	6.80	5.95	51.42	51.85	53.36	31.30	31.17	29.78

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
0.300	1.42	1.36	1.33	1.83	2.66	3.77	1.97	1.72	1.47	0.200	-371.60	-0.51
0.400	1.34	1.28	1.25	1.79	2.62	3.73	1.97	1.72	1.47	0.410	-377.40	-0.51
1.000	1.27	1.19	1.14	1.74	2.58	3.68	1.98	1.72	1.47	0.500	-377.40	-0.51
2.000	1.29	1.19	1.11	1.71	2.53	3.62	1.98	1.72	1.47	2.000	-373.60	-0.49
5.000	1.30	1.19	1.10	1.67	2.49	3.57	1.99	1.73	1.47	5.000	-364.40	-0.48
10.000	1.31	1.20	1.10	1.53	2.33	3.37	2.01	1.74	1.47	10.000	-375.00	-0.49
20.000	1.31	1.20	1.11	1.57	2.38	3.42	2.02	1.75	1.48	20.000	-370.10	-0.48
50.000	1.27	1.16	1.08	1.53	2.30	3.29	2.02	1.75	1.50	50.000	-361.80	-0.49
60.870	1.26	1.16	1.08	1.49	2.24	3.19	2.04	1.76	1.51	53.510	-373.30	-0.51
100.000	1.18	1.09	1.07	1.49	2.25	3.19	2.09	1.82	1.56	100.000	-379.60	-0.40
121.440	1.15	1.09	1.10	1.52	2.28	3.22	2.12	1.86	1.61	106.810	-378.60	-0.41
171.910	1.15	1.17	1.21	1.54	2.25	3.13	2.23	1.97	1.74	160.120	-359.30	0.09
200.000	1.19	1.24	1.29	1.60	2.31	3.19	2.30	2.04	1.82	186.770	-360.70	0.31
207.250	1.20	1.26	1.30	1.64	2.37	3.27	2.31	2.05	1.84	200.000	-368.80	0.63
232.480	1.25	1.31	1.36	1.71	2.48	3.42	2.34	2.10	1.90	213.430	-366.50	0.42
277.910	1.33	1.39	1.43	1.71	2.40	3.29	2.31	2.08	1.92	266.730	-342.90	1.10
328.390	1.34	1.39	1.40	2.00	2.69	3.56	2.26	2.03	1.88	320.040	-312.50	0.64
373.810	1.24	1.27	1.28	2.12	2.89	3.81	2.20	1.95	1.77	373.350	-265.84	2.32
388.960	1.20	1.22	1.23	2.12	2.90	3.82	2.15	1.90	1.73	386.670	-257.09	0.14
400.000	1.14	1.16	1.18	2.13	2.90	3.82	2.15	1.87	1.68	400.000	-248.23	0.39

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	13	28	18	34	15	39	19	33	43	40
1	-	20	0	37	13	33	17	41	34	41	37	45
2	> 97	75	57	77	57	72	57	66	54	> 77	58	68
3	> 97	66	61	65	65	65	61	65	60	65	68	72
4	> 97	77	> 77	> 77	> 77	> 78	> 77	77	> 77	> 78	> 77	> 77
5	> 97	> 77	> 77	76	> 77	> 77	> 77	77	> 77	76	> 78	> 78
6	95	76	> 78	76	> 77	> 77	> 78	> 78	> 77	> 78	> 77	> 77
7	96	> 77	> 78	76	> 78	> 77	> 77	> 77	> 78	> 78	> 78	> 78
8	95	> 77	76	> 78	> 78	> 78	> 77	> 77	77	77	76	> 77
9	96	76	> 77	76	> 77	> 78	> 77	> 78	> 78	> 78	> 78	77
10	> 96	75	> 76	> 76	76	> 77	> 77	> 77	> 78	> 76	> 78	77

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -15.03 DBM
LO IN: 155.01 MHZ; +9.96 DBM
IF OUT: 30.09 MHZ; -20.08 DBM

RF CAL

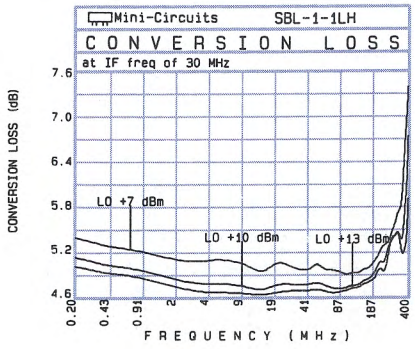
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	23	37	28	45	26	49	29	43	49	49
1	-	19	0	34	12	33	16	37	32	44	36	47
2	83	68	53	77	53	69	53	64	48	71	50	65
3	96	53	45	51	48	52	46	53	46	51	57	59
4	96	81	64	> 86	64	77	66	77	65	73	62	79
5	96	83	69	67	62	63	65	64	61	65	59	61
6	> 96	85	85	> 87	81	86	78	> 87	78	82	77	84
7	> 96	85	85	84	84	78	75	76	78	77	72	76
8	> 97	> 86	> 86	> 86	> 86	> 87	> 86	> 86	> 86	85	83	> 87
9	95	> 85	> 86	84	> 86	83	> 87	86	85	86	> 86	> 86
10	> 96	> 85	> 85	85	> 86	85	> 87	> 86	> 86	86	85	> 86

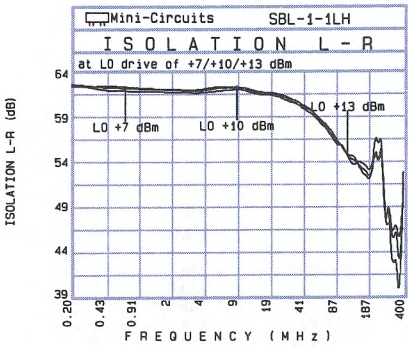
LO HARMONICS ORDER

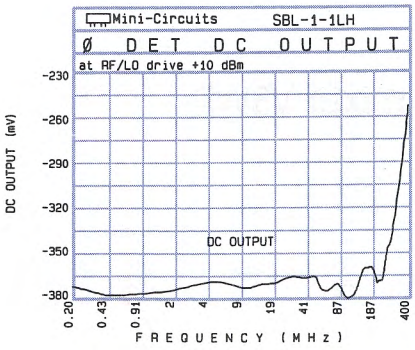
test condition RF IN: 185.10 MHZ; -5.00 DBM
LO IN: 155.01 MHZ; +9.96 DBM
IF OUT: 30.09 MHZ; -9.98 DBM

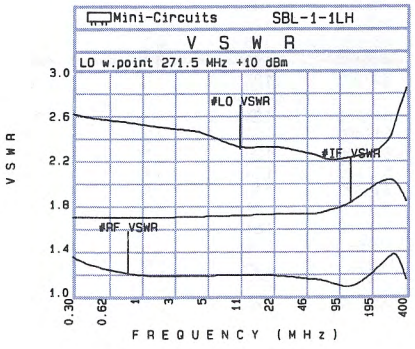
typical performance curves

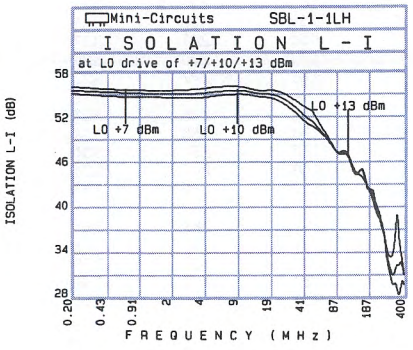
(production unit)

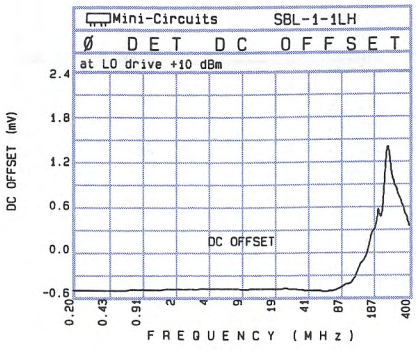












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-1XLH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
10.000	40.000	6.35	5.85	5.56	60.73	60.92	60.58	64.53	69.32	78.42
20.000	50.000	6.33	5.87	5.62	60.20	59.64	59.04	64.10	68.52	74.90
50.000	80.000	6.33	5.85	5.60	57.72	55.05	53.35	64.62	69.14	71.80
97.350	67.353	6.62	6.04	5.76	56.12	53.39	51.55	63.95	67.92	68.38
100.000	70.000	6.54	5.99	5.72	55.74	52.17	49.84	63.83	67.58	66.04
184.710	154.706	6.63	5.97	5.68	55.57	51.00	47.48	62.03	63.99	60.28
200.000	170.000	6.50	5.87	5.62	57.94	49.50	45.90	60.84	61.64	57.15
272.060	242.059	6.35	5.80	5.60	59.80	49.51	44.55	58.40	58.13	53.55
359.410	329.412	6.39	5.84	5.61	51.29	48.18	44.62	58.35	58.17	54.40
446.760	416.765	6.72	6.15	5.93	43.83	42.66	41.63	53.41	55.71	58.55
475.880	445.882	6.83	6.35	6.07	42.34	41.14	39.67	52.89	54.61	57.62
500.000	470.000	6.80	6.42	6.17	40.40	40.14	38.94	53.02	54.24	56.22
534.120	504.118	6.78	6.41	6.19	38.39	38.47	38.23	52.34	52.89	52.78
621.470	591.471	6.30	5.84	5.58	35.93	35.48	34.82	53.33	54.95	55.92
708.820	678.824	5.93	5.49	5.30	34.22	34.84	34.09	69.33	58.37	57.76
796.180	766.177	6.17	5.70	5.38	32.27	33.30	34.42	63.55	60.05	57.05
883.530	853.529	6.14	5.56	5.28	32.43	33.02	33.44	52.29	50.50	49.19
941.760	911.765	5.96	5.51	5.25	33.25	33.99	34.56	48.98	48.29	48.98
970.880	940.882	6.14	5.67	5.35	33.71	34.84	35.71	47.84	47.00	48.00
1000.000	970.000	6.12	5.70	5.43	34.19	35.36	36.19	47.33	45.65	45.87

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm
10.000	2.56	2.25	1.89	2.29	2.96	4.01	10.000	1.15	1.19	1.26
20.000	2.55	2.25	1.89	1.72	2.54	3.65	20.000	1.09	1.15	1.23
50.000	2.57	2.26	1.90	1.68	2.48	3.54	50.000	1.09	1.15	1.23
100.000	2.61	2.31	1.95	1.61	2.38	3.38	100.000	1.12	1.18	1.25
165.130	2.65	2.37	2.04	1.59	2.34	3.32	165.130	1.16	1.22	1.29
200.000	2.68	2.40	2.09	1.57	2.29	3.24	200.000	1.19	1.24	1.32
265.220	2.72	2.47	2.18	1.61	2.36	3.31	265.220	1.23	1.29	1.36
338.610	2.78	2.54	2.26	1.64	2.37	3.27	338.610	1.25	1.32	1.40
418.680	2.78	2.56	2.30	1.70	2.40	3.26	418.680	1.28	1.35	1.41
500.000	2.73	2.50	2.25	1.80	2.47	3.27	500.000	1.27	1.32	1.36
518.760	2.72	2.48	2.24	1.82	2.48	3.27	518.760	1.26	1.31	1.34
545.450	2.71	2.46	2.20	1.86	2.55	3.34	545.450	1.24	1.29	1.32
592.160	2.65	2.39	2.13	1.90	2.57	3.34	592.160	1.20	1.24	1.27
672.220	2.50	2.22	1.94	2.00	2.61	3.34	672.220	1.14	1.19	1.26
745.620	2.40	2.10	1.81	2.12	2.69	3.39	745.620	1.28	1.32	1.41
819.010	2.30	1.99	1.69	2.29	2.88	3.51	819.010	1.61	1.63	1.70
899.080	2.23	1.92	1.62	2.41	3.00	3.63	899.080	2.14	2.13	2.16
952.460	2.17	1.89	1.61	2.51	3.08	3.71	952.460	2.55	2.52	2.51
972.470	2.13	1.87	1.61	2.52	3.07	3.68	972.470	2.71	2.66	2.63
1000.000	2.11	1.87	1.63	2.53	3.06	3.67	1000.000	2.92	2.86	2.81

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	LO HARMONICS ORDER 0	1	2	3	4	5	6	7	8	9	10
0	-	-	24	13	26	24	21	29	12	34	30	46
1	-	18	0	35	20	24	29	33	47	36	37	41
2	95	57	58	53	63	50	62	64	67	58	54	55
3	96	64	58	65	56	68	55	66	70	69	> 75	72
4	95	74	> 75	> 75	75	> 76	> 76	> 76	> 76	73	> 75	> 76
5	> 97	> 76	> 75	> 76	> 75	> 75	> 75	> 76	> 76	> 76	> 75	73
6	> 96	> 74	75	72	> 74	74	72	> 75	> 76	> 75	> 75	> 74
7	> 97	> 76	> 74	> 76	> 74	> 75	> 76	> 76	> 75	> 76	75	> 75
8	> 97	> 75	74	> 75	73	74	> 75	75	> 75	> 75	> 76	75
9	> 97	> 75	> 75	75	74	73	73	> 75	> 75	> 76	> 76	> 76
10	> 97	74	74	> 75	> 76	> 76	> 75	> 74	74	> 75	> 75	74

test condition RF IN: 500.10 MHZ; -15.02 DBM
LO IN: 470.01 MHZ; +9.99 DBM
IF OUT: 30.09 MHZ; -21.88 DBM

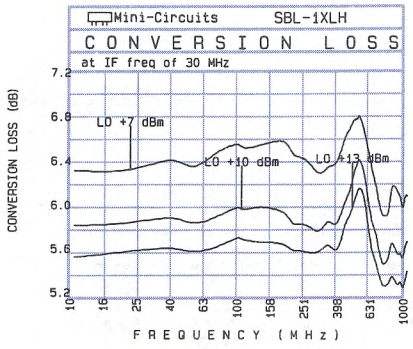
RF CAL

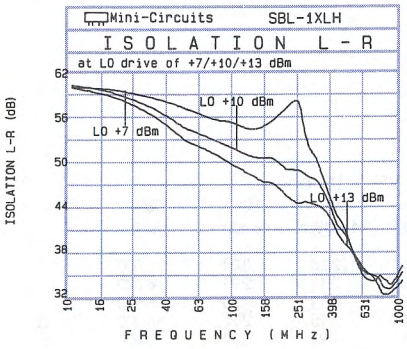
RF ORDER HARMONIC	LO HARMONICS ORDER 0	1	2	3	4	5	6	7	8	9	10
0	-	-	34	15	31	32	33	43	27	44	41	55
1	-	19	0	36	18	26	33	36	45	37	47	43
2	77	45	50	41	66	36	45	54	54	60	46	58
3	> 97	48	46	53	46	60	42	50	59	58	66	66
4	> 97	81	66	72	65	58	67	55	70	67	75	74
5	> 96	80	> 85	77	81	73	66	71	63	79	75	82
6	94	83	> 86	> 84	81	81	80	78	79	75	79	> 84
7	> 98	> 86	83	85	> 85	> 85	> 86	> 85	> 85	85	> 86	> 85
8	96	> 86	84	> 86	> 85	83	84	85	85	> 86	> 85	85
9	> 96	83	84	> 85	> 85	84	> 85	> 84	84	> 86	> 86	> 85
10	> 97	84	84	> 85	84	> 86	> 85	> 83	84	> 86	84	> 86

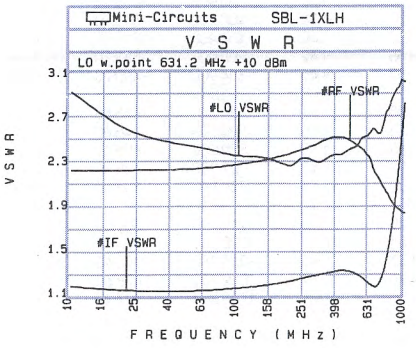
test condition RF IN: 500.10 MHZ; -4.91 DBM
LO IN: 470.01 MHZ; +10.04 DBM
IF OUT: 30.09 MHZ; -11.71 DBM

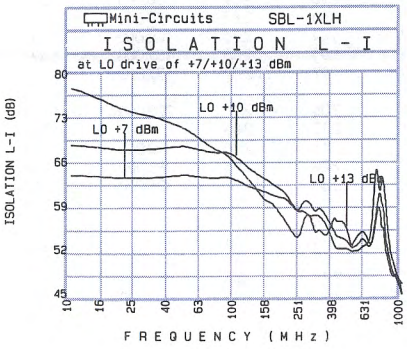
typical performance curves

(production unit)









In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
SBL-1ZMH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
2.000	32.000	7.97	7.47	7.16	69.98	70.78	73.30	63.48	65.58	66.90
4.000	34.000	7.33	6.83	6.51	69.28	70.28	73.22	58.22	59.74	60.82
5.000	35.000	7.20	6.65	6.34	69.38	70.18	72.99	56.42	57.88	59.08
10.000	40.000	6.84	6.27	5.98	69.20	70.01	72.74	50.76	52.36	53.57
20.000	50.000	6.73	6.18	5.87	68.66	69.85	72.60	44.64	46.22	47.65
50.000	80.000	6.64	6.15	5.89	68.34	69.63	73.30	37.42	39.08	40.28
100.000	70.000	6.63	6.15	5.91	66.42	67.71	73.85	31.64	33.80	35.87
119.640	89.643	6.43	6.08	5.84	64.26	67.73	75.30	30.50	32.85	34.65
200.000	170.000	6.86	6.34	6.10	63.39	74.27	61.33	27.21	29.38	30.91
276.500	246.500	7.15	6.71	6.50	69.84	67.53	51.69	26.05	27.35	28.56
433.360	403.357	7.68	6.85	6.14	52.91	51.02	47.32	24.31	25.68	26.93
500.000	470.000	6.54	6.21	5.95	48.26	49.19	46.80	24.67	26.25	27.35
550.000	520.000	6.28	5.99	5.85	52.20	53.13	48.53	25.06	26.35	26.94
590.210	560.214	6.08	5.95	5.95	55.02	51.95	44.26	25.41	27.35	27.83
747.070	717.071	7.05	6.91	6.77	45.33	45.36	39.98	29.35	31.35	29.04
903.930	873.929	8.95	7.63	7.05	47.76	45.31	44.35	36.55	33.05	30.37
1000.000	970.000	8.38	7.69	7.24	43.61	42.04	42.61	31.70	30.24	28.96
1021.570	991.571	8.53	7.87	7.42	41.84	40.76	41.67	31.51	30.36	29.27
1060.790	1030.786	8.79	8.11	7.73	36.61	35.87	36.58	31.09	30.40	29.57
1100.000	1070.000	9.10	8.49	8.09	32.15	31.32	31.45	34.18	34.03	33.76

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
2.000	1.78	1.79	1.79	1.72	2.25	3.01	2.000	1.49	1.39	1.29	2.000	-487.70	0.32
4.000	1.72	1.74	1.75	1.56	2.13	2.91	4.000	1.50	1.41	1.29	4.000	-506.80	0.32
5.000	1.71	1.74	1.75	1.52	2.10	2.88	5.000	1.51	1.41	1.30	5.000	-514.40	0.32
10.000	1.79	1.81	1.81	1.35	1.95	2.72	10.000	1.60	1.47	1.34	10.000	-516.40	0.32
20.000	1.73	1.76	1.78	1.36	1.97	2.78	20.000	1.58	1.45	1.33	20.000	-513.90	0.30
50.000	1.74	1.77	1.78	1.33	1.93	2.69	50.000	1.61	1.48	1.36	50.000	-535.20	0.31
100.000	1.73	1.75	1.75	1.28	1.86	2.61	83.000	1.65	1.51	1.38	100.000	-510.90	0.18
200.000	1.57	1.59	1.59	1.27	1.84	2.56	100.000	1.66	1.52	1.40	153.450	-516.40	0.24
246.000	1.51	1.53	1.55	1.31	1.91	2.65	137.000	1.69	1.55	1.42	200.000	-533.70	0.34
368.000	1.41	1.50	1.58	1.39	1.97	2.69	177.000	1.71	1.57	1.45	304.900	-490.70	1.38
490.000	1.51	1.68	1.84	1.51	2.06	2.79	200.000	1.73	1.58	1.46	456.340	-445.50	-0.09
550.000	1.63	1.83	2.03	1.61	2.12	2.83	231.000	1.73	1.58	1.46	500.000	-446.00	-0.38
581.000	1.69	1.90	2.10	1.66	2.16	2.86	250.000	1.73	1.58	1.46	550.000	-496.40	-1.31
642.000	1.76	1.95	2.13	1.76	2.29	2.98	285.000	1.72	1.57	1.45	607.790	-535.90	-3.43
764.000	1.71	1.82	1.93	1.85	2.36	3.04	325.000	1.66	1.54	1.43	759.240	-381.30	-4.07
886.000	1.49	1.52	1.58	1.78	2.24	2.91	365.000	1.60	1.49	1.41	910.690	-385.60	-5.84
1000.000	1.87	1.80	1.77	1.91	2.24	2.83	406.000	1.58	1.53	1.46	1000.000	-410.40	-6.53
1039.000	2.14	2.02	1.95	2.01	2.28	2.81	446.000	1.62	1.58	1.58	1024.280	-395.10	-5.62
1069.000	2.37	2.24	2.13	2.07	2.25	2.71	487.000	1.76	1.78	1.84	1062.140	-428.60	-6.27
1100.000	2.72	2.55	2.43	2.10	2.16	2.53	500.000	1.82	1.87	1.96	1100.000	-427.40	-11.09

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+9	25	15	17	19	22	30	46	41	46
1	-	25	+0	45	24	38	26	41	36	40	46	53
2	96	71	50	> 75	50	> 75	59	69	64	65	72	> 75
3	> 97	> 75	> 76	74	64	> 75	72	> 75	69	> 74	> 74	> 75
4	95	> 74	74	> 74	> 76	> 75	> 75	74	> 75	> 74	> 74	> 75
5	> 98	> 75	> 74	74	> 74	> 75	> 76	> 76	> 76	> 75	> 75	72
6	> 95	> 75	74	> 74	> 75	> 75	> 75	> 75	74	> 76	> 75	> 74
7	96	74	72	> 75	> 74	> 74	73	> 75	> 75	74	> 76	> 75
8	96	> 75	> 76	> 76	> 74	73	> 74	74	74	> 76	> 75	> 75
9	> 96	> 75	> 75	> 75	> 75	74	72	73	> 75	> 75	> 75	74
10	96	> 74	> 74	> 74	> 75	> 75	74	> 74	> 74	74	> 76	> 75

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; -14.96 DBM
LO IN: 470.01 MHZ; + 12.95 DBM
IF OUT: 30.09 MHZ; -21.27 DBM

RF CAL

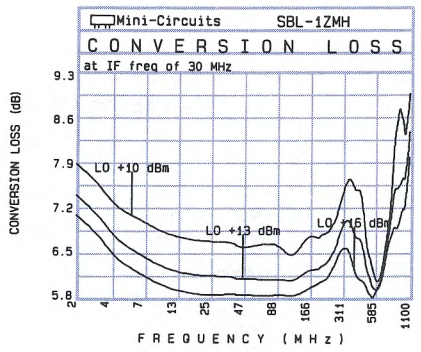
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	2	37	24	28	31	33	41	58	51	62
1	-	26	0	44	24	39	27	43	37	41	49	56
2	78	68	45	66	49	67	59	63	57	58	67	79
3	96	65	64	68	45	64	54	67	50	76	59	64
4	> 96	78	64	83	60	75	56	78	73	71	69	71
5	96	85	82	> 85	> 87	83	70	82	77	84	74	81
6	> 95	> 85	85	> 85	80	> 87	77	85	71	85	> 86	81
7	> 97	> 86	> 85	> 86	> 85	85	85	> 86	80	85	83	85
8	> 96	85	> 86	> 86	> 85	> 85	> 85	> 86	> 86	> 86	85	85
9	> 97	> 85	85	> 87	> 86	> 86	83	84	> 86	> 86	> 86	> 86
10	> 97	82	> 86	84	> 85	> 86	> 85	> 85	> 85	> 86	> 86	> 86

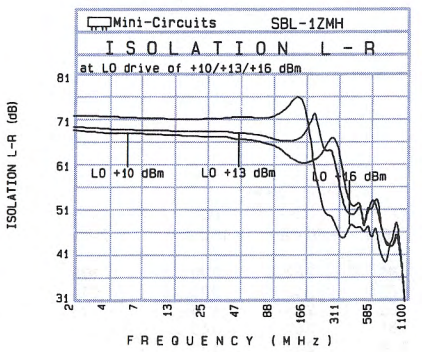
LO HARMONICS ORDER

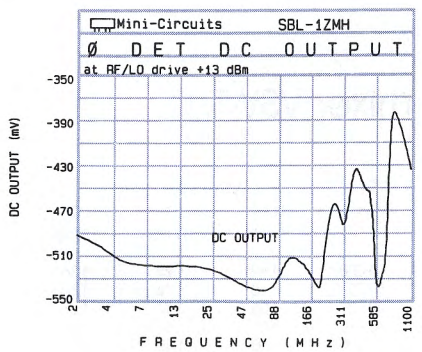
test condition RF IN: 500.10 MHZ; -5.05 DBM
LO IN: 470.01 MHZ; + 12.95 DBM
IF OUT: 30.09 MHZ; -11.38 DBM

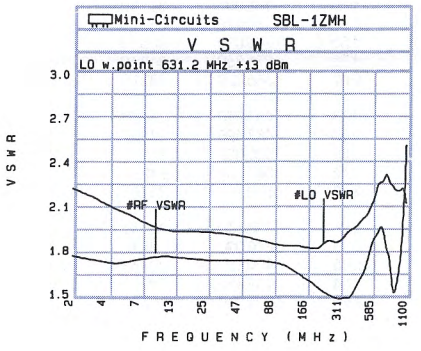
typical performance curves

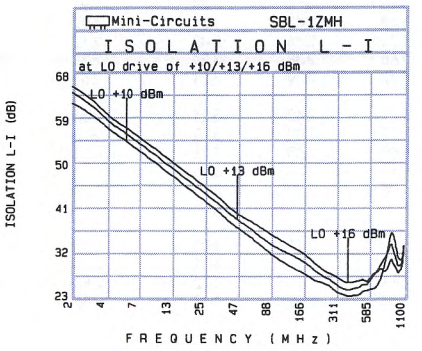
(production unit)

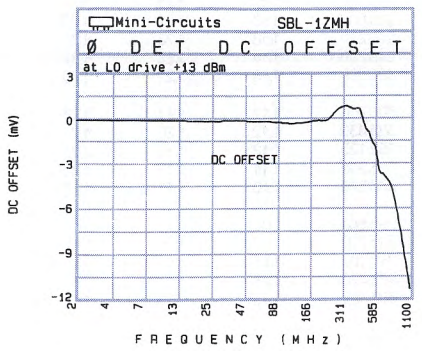












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-2LH
TFM-2LH
TUF-2LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
5.000	35.000	6.35	5.97	5.79	50.42	52.74	55.33	92.39	87.33	84.57
10.000	40.000	6.27	5.89	5.71	50.26	52.59	55.18	88.15	81.78	79.01
20.000	50.000	6.25	5.90	5.72	50.09	52.51	55.01	82.91	76.47	73.93
50.000	80.000	6.35	5.96	5.78	50.26	52.73	55.34	75.29	68.83	65.98
95.450	65.454	6.45	6.01	5.81	50.20	52.59	55.11	76.31	68.37	65.72
100.000	70.000	6.47	6.04	5.81	49.96	52.35	55.06	76.24	67.59	63.42
185.910	155.909	6.23	5.82	5.71	49.37	52.03	55.00	64.85	63.99	60.35
200.000	170.000	6.06	5.77	5.70	48.99	52.24	55.94	56.89	62.23	57.60
276.360	246.364	5.99	5.75	5.69	48.39	51.93	56.47	53.30	58.87	57.65
366.820	336.818	6.00	5.81	5.75	48.15	52.59	58.42	50.00	53.25	55.12
457.270	427.273	6.15	5.88	5.79	45.89	47.42	48.34	53.50	55.40	52.82
487.420	457.424	6.12	5.91	5.82	43.82	45.90	47.93	48.88	49.79	48.91
500.000	470.000	6.15	5.94	5.88	45.19	48.30	51.48	45.61	46.54	46.57
547.730	517.727	6.24	6.07	6.00	54.75	57.22	57.14	39.24	40.10	40.86
638.180	608.182	6.79	6.63	6.52	49.32	48.69	47.24	37.98	37.95	38.10
728.640	698.636	7.42	7.20	6.92	42.97	42.92	42.20	37.56	36.76	35.98
819.090	789.091	7.81	7.24	6.94	39.80	41.04	42.19	32.89	32.27	31.54
909.550	879.546	8.19	7.27	6.94	39.91	41.87	45.54	30.39	29.47	28.88
969.850	939.849	8.82	7.69	7.15	41.20	44.77	52.60	29.06	28.21	27.71
1000.000	970.000	8.86	7.81	7.32	42.93	50.08	45.94	28.12	26.90	26.19

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.19	1.25	1.36	2.01	2.82	3.90	1.73	1.46	1.19	5.000	-332.70	-2.03
10.000	1.10	1.18	1.30	1.82	2.63	3.70	1.74	1.47	1.19	10.000	-332.60	-1.99
20.000	1.06	1.16	1.28	1.85	2.68	3.75	1.73	1.46	1.19	20.000	-329.10	-1.95
50.000	1.08	1.18	1.30	1.81	2.62	3.65	1.76	1.48	1.21	50.000	-343.10	-2.00
100.000	1.10	1.19	1.31	1.74	2.50	3.48	1.82	1.54	1.25	95.450	-338.30	-2.06
165.130	1.12	1.21	1.32	1.73	2.50	3.48	1.91	1.63	1.35	100.000	-331.90	-2.02
200.000	1.13	1.22	1.33	1.68	2.40	3.31	1.97	1.69	1.42	185.910	-357.00	-1.98
265.220	1.13	1.23	1.33	1.72	2.48	3.42	2.12	1.84	1.56	200.000	-356.20	-1.92
345.280	1.14	1.23	1.32	1.68	2.38	3.24	2.38	2.08	1.78	276.360	-342.60	-1.81
425.350	1.13	1.22	1.30	1.72	2.39	3.21	2.62	2.33	2.02	366.820	-332.00	-1.45
500.000	1.12	1.21	1.28	1.77	2.42	3.21	2.86	2.55	2.23	457.270	-287.51	-1.36
525.430	1.12	1.20	1.26	1.77	2.42	3.20	2.92	2.61	2.30	487.420	-273.52	-1.14
552.120	1.12	1.19	1.25	1.80	2.43	3.18	3.01	2.68	2.36	500.000	-271.37	-1.18
605.500	1.11	1.18	1.23	1.84	2.44	3.16	3.12	2.79	2.46	547.730	-272.60	-1.49
685.570	1.10	1.15	1.17	1.90	2.49	3.19	3.15	2.80	2.48	638.180	-282.98	-1.28
765.640	1.08	1.11	1.14	1.93	2.47	3.13	3.13	2.76	2.44	728.640	-235.17	-0.97
845.700	1.02	1.05	1.12	1.99	2.47	3.05	3.06	2.67	2.31	819.090	-205.55	-0.81
919.100	1.13	1.15	1.24	2.10	2.57	3.11	2.95	2.53	2.15	909.550	-207.63	-0.31
972.470	1.28	1.30	1.39	2.13	2.60	3.12	2.88	2.45	2.04	969.850	-209.87	-0.06
1000.000	1.35	1.38	1.47	2.12	2.59	3.12	2.86	2.42	1.99	1000.000	-204.55	0.27

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	20	17	31	15	35	29	31	48	48
1	-	23	0	41	12	47	20	41	38	39	54	44
2	95	70	65	72	66	68	65	> 76	62	> 75	69	75
3	96	74	70	75	74	73	67	73	72	73	> 75	75
4	95	> 75	73	> 76	> 77	75	> 77	73	74	> 75	> 75	> 76
5	> 97	> 76	> 75	> 76	> 76	> 76	> 76	> 76	> 77	75	74	74
6	> 96	73	76	> 76	> 75	75	76	75	> 76	> 77	> 76	> 76
7	> 97	75	> 75	> 76	> 75	> 75	> 76	> 76	> 77	75	> 76	> 76
8	> 97	> 76	> 77	75	> 76	> 75	> 76	> 76	> 76	> 76	75	74
9	> 97	75	75	75	> 76	> 76	> 76	> 76	> 76	75	75	75
10	> 97	> 76	> 75	> 75	> 75	> 76	> 76	74	74	75	> 76	> 77

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; -15.02 DBM
LO IN: 470.01 MHZ; +9.99 DBM
IF OUT: 30.09 MHZ; -21.16 DBM

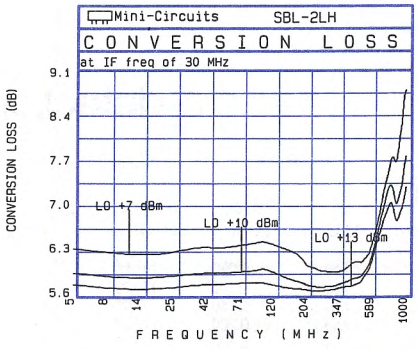
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	24	30	16	36	23	50	45	42	54	56
1	-	22	+0	38	12	42	21	45	38	40	48	46
2	80	57	49	58	48	59	48	68	51	68	64	67
3	95	57	49	57	54	56	48	56	57	68	71	62
4	> 95	> 84	71	81	70	76	70	79	67	75	77	79
5	> 97	> 85	83	76	73	77	71	77	70	74	72	> 85
6	> 95	83	> 85	> 85	> 84	> 85	> 85	> 85	84	> 85	> 85	84
7	> 96	84	> 85	83	83	84	> 85	> 85	> 86	> 85	> 85	> 85
8	95	> 85	> 85	> 85	> 84	> 84	> 85	> 85	84	> 85	> 85	> 85
9	> 96	83	> 85	85	> 86	> 84	83	84	> 86	> 86	83	83
10	> 96	> 85	83	> 85	> 85	> 85	84	> 83	84	> 85	> 85	> 85

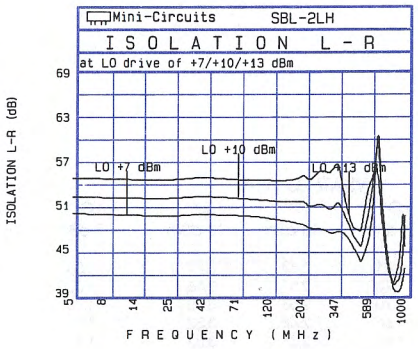
LO HARMONICS ORDER

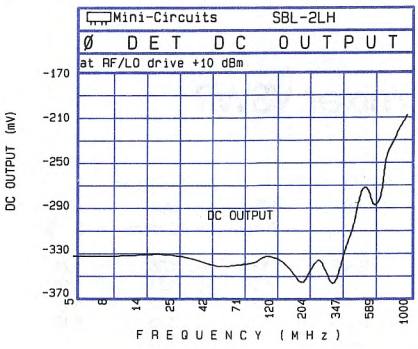
test condition RF IN: 500.10 MHZ; -5.04 DBM
LO IN: 470.01 MHZ; +10.05 DBM
IF OUT: 30.09 MHZ; -11.20 DBM

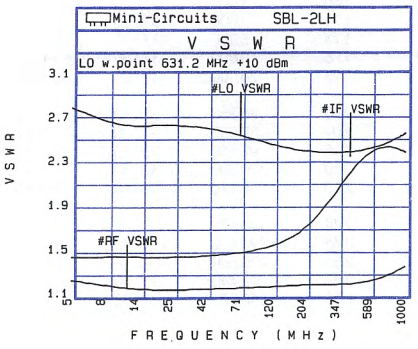
typical performance curves

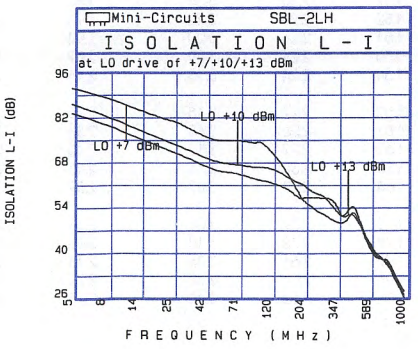
(production unit)

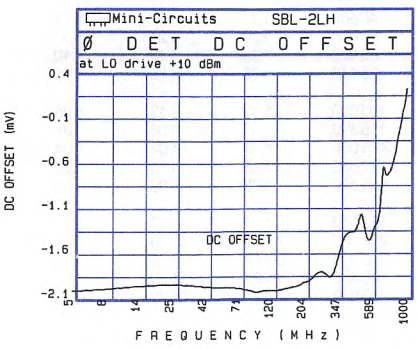












broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
SBL-3LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
0.070	30.070	5.39	5.17	5.00	69.51	63.65	64.89	67.21	61.05	61.21
0.100	30.100	5.19	4.97	4.83	66.52	62.95	64.78	64.62	60.16	61.05
0.140	30.140	5.09	4.87	4.74	65.02	62.75	64.47	63.02	59.80	60.95
0.200	30.200	5.03	4.81	4.68	64.07	62.58	64.50	62.27	59.57	60.90
0.500	30.500	4.95	4.75	4.59	63.42	62.45	64.37	61.42	59.40	60.82
0.700	30.700	4.92	4.70	4.56	63.12	62.25	64.29	61.32	59.30	60.80
1.000	31.000	4.90	4.69	4.53	62.82	62.23	64.36	60.92	59.23	60.83
2.000	32.000	4.90	4.65	4.48	62.62	62.11	64.23	60.82	59.10	60.74
5.000	35.000	4.98	4.67	4.48	62.57	62.06	64.19	60.57	59.04	60.61
10.000	40.000	4.77	4.59	4.47	62.36	62.16	64.39	59.66	58.62	60.22
20.000	50.000	4.81	4.59	4.50	62.30	62.19	64.12	57.00	56.98	58.81
50.000	80.000	4.80	4.63	4.54	60.57	62.43	64.50	51.32	52.55	54.82
56.870	86.872	4.79	4.59	4.49	60.24	62.48	64.54	50.33	51.76	53.87
100.000	70.000	4.72	4.59	4.54	59.42	61.09	62.81	45.76	47.12	49.54
113.670	83.674	4.80	4.66	4.56	59.15	61.20	63.52	44.80	45.91	48.77
125.000	95.000	4.74	4.64	4.59	58.81	60.48	66.36	44.06	45.00	48.08
170.480	140.477	5.07	4.98	4.87	56.29	54.87	58.41	42.58	43.50	45.66
200.000	170.000	5.16	5.06	4.96	55.37	54.73	53.64	42.40	48.86	48.09
238.640	208.640	5.44	5.25	5.13	57.78	61.90	62.52	41.28	43.43	45.52
250.000	220.000	5.75	5.40	5.22	58.04	64.06	72.95	40.83	41.51	42.53

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
0.300	1.31	1.25	1.21	1.81	2.63	3.74	1.83	1.74	1.62	0.070	-286.89	-0.16
1.000	1.29	1.21	1.14	1.74	2.57	3.66	1.83	1.74	1.62	0.100	-370.80	-0.22
2.000	1.31	1.22	1.14	1.70	2.53	3.60	1.83	1.75	1.62	0.140	-370.90	-0.25
5.000	1.32	1.23	1.15	1.66	2.48	3.52	1.84	1.75	1.63	0.200	-372.80	-0.24
10.000	1.33	1.23	1.15	1.53	2.31	3.32	1.85	1.77	1.64	0.500	-372.40	-0.25
20.000	1.32	1.23	1.15	1.57	2.35	3.36	1.87	1.78	1.66	1.000	-373.80	-0.25
40.680	1.30	1.22	1.14	1.52	2.28	3.22	1.93	1.84	1.71	2.000	-373.60	-0.24
50.000	1.29	1.21	1.13	1.51	2.26	3.20	1.94	1.86	1.73	5.000	-375.40	-0.24
65.920	1.26	1.18	1.10	1.50	2.21	3.09	2.09	1.99	1.86	10.000	-374.60	-0.24
86.110	1.22	1.15	1.08	1.54	2.24	3.13	2.16	2.07	1.93	20.000	-371.00	-0.23
100.000	1.19	1.12	1.06	1.57	2.27	3.15	2.25	2.17	2.03	46.350	-376.80	-0.21
116.390	1.15	1.08	1.04	1.57	2.26	3.13	2.33	2.24	2.09	50.000	-377.60	-0.17
125.000	1.13	1.07	1.04	1.62	2.27	3.12	2.40	2.31	2.15	92.640	-380.80	0.15
141.630	1.10	1.06	1.08	1.65	2.30	3.12	2.43	2.34	2.20	100.000	-378.50	0.20
161.820	1.08	1.09	1.13	1.64	2.27	3.07	2.59	2.50	2.35	120.410	-368.10	0.13
182.010	1.10	1.14	1.19	1.72	2.29	3.08	2.63	2.56	2.44	148.180	-372.10	0.38
202.200	1.15	1.20	1.25	1.77	2.32	3.10	2.65	2.57	2.46	194.460	-367.80	1.20
222.390	1.19	1.25	1.31	1.97	2.61	3.36	2.73	2.66	2.56	200.000	-365.10	1.44
242.580	1.24	1.29	1.34	1.96	2.64	3.38	2.73	2.67	2.57	240.740	-302.49	2.04
250.000	1.25	1.30	1.36	1.95	2.63	3.41	2.71	2.65	2.56	250.000	-289.82	2.56

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	35	23	36	36	40	22	40	25	47
1	-	16	+0	31	11	32	18	34	24	39	27	42
2	79	> 76	57	> 77	59	73	59	71	60	70	66	71
3	> 97	65	68	65	69	70	61	76	59	73	57	69
4	> 97	> 76	> 76	> 77	75	> 77	> 76	> 77	> 77	> 77	> 77	> 77
5	97	> 77	75	76	> 76	76	> 77	> 77	74	> 76	> 77	> 77
6	> 97	75	> 77	> 77	76	> 76	> 77	> 77	76	> 77	> 77	> 77
7	> 97	> 76	76	> 76	> 76	> 77	75	> 77	> 76	> 77	> 77	> 76
8	> 97	75	> 77	> 76	> 77	> 76	76	> 77	> 77	> 77	> 77	> 77
9	> 97	76	> 77	> 76	> 77	> 77	> 77	> 76	> 77	75	> 77	> 77
10	> 97	> 76	> 76	> 77	76	> 77	76	> 77	> 77	> 77	> 77	76

LO HARMONICS ORDER

test condition RF IN: 100.10 MHZ; -14.95 DBM
LO IN: 70.01 MHZ; + 10.07 DBM
IF OUT: 30.09 MHZ; -19.73 DBM

RF ORDER HARMONIC

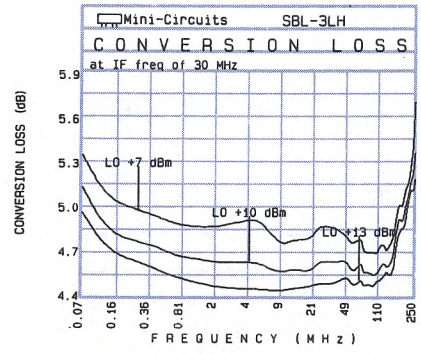
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	29	45	33	48	44	52	33	51	37	60
1	-	16	+0	30	11	33	18	36	23	40	28	44
2	69	69	60	76	60	70	58	66	60	65	64	69
3	94	52	52	52	54	56	61	67	53	58	50	55
4	> 97	82	70	84	69	83	69	80	70	77	70	77
5	> 97	67	69	70	80	66	74	68	63	69	58	77
6	> 97	> 88	80	82	79	86	78	> 86	78	84	80	> 87
7	> 97	> 87	80	82	74	78	82	79	76	79	72	81
8	96	> 87	83	85	85	> 87	> 86	> 88	85	> 87	85	> 86
9	> 97	> 88	> 87	86	84	> 87	84	83	83	> 86	83	86
10	> 96	> 86	86	> 87	> 87	> 86	86	85	> 87	> 87	> 87	86

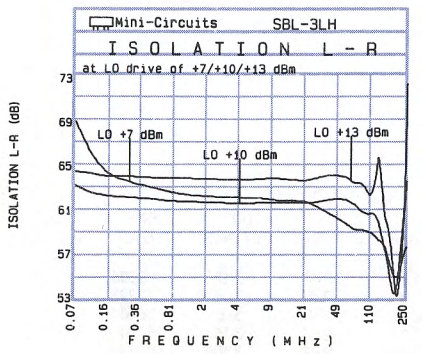
LO HARMONICS ORDER

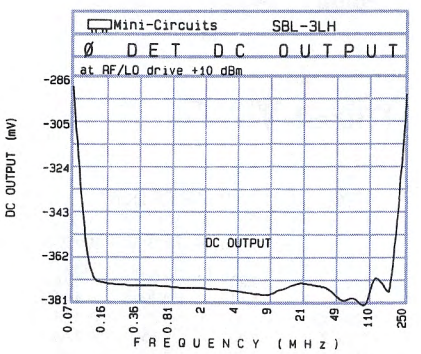
test condition RF IN: 100.10 MHZ; -4.99 DBM
LO IN: 70.01 MHZ; + 10.07 DBM
IF OUT: 30.09 MHZ; -9.66 DBM

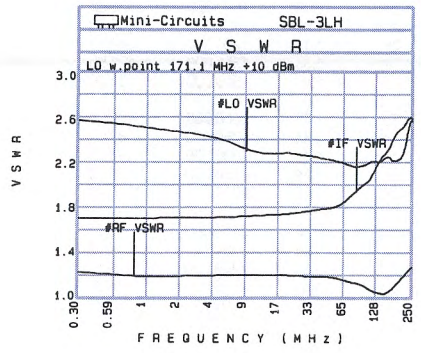
typical performance curves

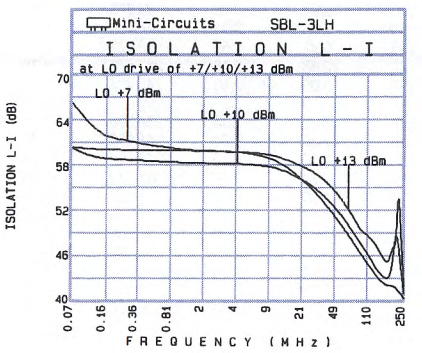
(production unit)

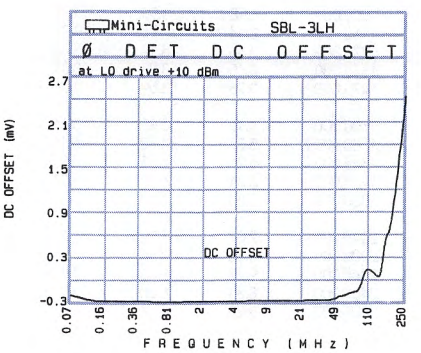












In Stock...Immediate Delivery

surface mount

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
SCM-2500
SRA-2400
TFM-2400



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
500.000	530.000	6.00	5.45	5.04	49.21	54.10	55.53	25.07	25.42	25.56
650.000	680.000	5.66	5.24	4.95	64.22	46.72	42.65	23.93	24.17	24.06
800.000	830.000	5.99	5.18	4.77	44.60	50.53	48.39	23.74	24.04	24.22
950.000	980.000	6.52	5.34	4.76	36.03	39.92	44.68	23.09	22.92	22.65
1000.000	1030.000	6.81	5.61	4.88	35.03	38.68	42.76	22.19	21.93	21.78
1100.000	1070.000	7.24	6.52	5.96	33.19	35.67	38.72	19.42	19.02	18.65
1150.000	1120.000	7.18	6.54	6.04	33.02	35.25	37.71	18.27	17.69	17.18
1250.000	1220.000	6.82	6.21	5.74	33.03	35.47	37.46	16.86	16.09	15.42
1350.000	1320.000	6.73	6.10	5.72	34.35	38.09	41.06	15.58	15.24	14.81
1500.000	1470.000	6.69	6.10	5.77	35.63	40.51	44.16	16.76	17.24	17.45
1650.000	1620.000	7.85	6.97	6.57	35.05	39.61	44.83	18.61	20.00	21.30
1750.000	1720.000	8.54	7.73	7.30	35.48	40.56	44.31	19.47	21.79	24.24
1800.000	1770.000	8.62	7.87	7.44	37.40	41.20	42.00	20.74	23.27	25.98
1950.000	1920.000	8.54	7.91	7.51	37.18	37.08	36.46	25.05	25.63	25.24
2000.000	1970.000	8.42	7.83	7.45	36.34	36.28	35.82	25.43	24.82	23.85
2150.000	2120.000	8.47	7.95	7.54	34.39	34.61	34.62	22.93	21.63	20.76
2300.000	2270.000	8.54	8.12	7.71	33.49	34.07	34.05	19.89	19.31	18.98
2400.000	2370.000	8.80	8.32	8.05	33.16	33.85	33.96	18.43	18.30	18.27
2450.000	2420.000	8.46	7.93	7.63	32.94	33.63	33.72	17.72	17.81	17.79
2500.000	2470.000	8.55	7.98	7.65	34.48	34.92	35.16	18.77	18.95	19.01

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
500.000	2.28	1.90	1.74	1.87	2.44	3.12	0.300	1.32	1.05	1.09	500.000	167.74	8.15
655.000	1.41	1.19	1.12	1.95	2.42	3.01	12.793	1.34	1.06	1.09	650.000	184.27	8.20
800.000	1.30	1.21	1.24	2.32	2.60	3.06	26.534	1.34	1.08	1.09	800.000	134.66	8.17
910.000	1.60	1.56	1.63	2.71	2.84	3.16	64.012	1.35	1.11	1.13	950.000	117.18	8.19
960.000	1.79	1.74	1.83	2.84	2.92	3.18	102.739	1.37	1.17	1.19	1000.000	126.83	8.21
1000.000	1.98	1.90	1.99	2.93	2.94	3.16	128.973	1.37	1.21	1.24	1100.000	128.25	8.13
1165.000	2.94	2.78	2.74	3.30	2.95	2.93	141.465	1.37	1.22	1.25	1150.000	145.00	8.12
1270.000	3.36	3.17	3.08	3.50	2.82	2.62	180.192	1.38	1.28	1.31	1250.000	142.86	8.22
1370.000	3.45	3.20	3.01	3.77	2.88	2.48	217.670	1.38	1.32	1.38	1350.000	127.85	8.16
1475.000	3.93	3.59	3.36	4.26	3.05	2.40	243.904	1.39	1.35	1.40	1500.000	135.60	8.18
1500.000	4.19	3.82	3.61	4.18	3.00	2.34	256.396	1.38	1.36	1.41	1650.000	109.05	8.20
1680.000	5.77	4.92	5.12	3.80	2.60	1.91	268.889	1.38	1.38	1.44	1750.000	87.01	8.14
1835.000	6.21	5.75	5.81	2.86	2.00	1.53	307.615	1.38	1.41	1.48	1800.000	91.37	8.11
1935.000	6.61	6.73	6.01	2.31	1.71	1.48	346.342	1.36	1.41	1.51	1950.000	55.13	8.18
2000.000	7.80	6.63	6.39	1.96	1.59	1.54	371.327	1.38	1.45	1.52	2000.000	20.20	8.18
2040.000	7.87	7.22	6.71	1.77	1.54	1.60	385.069	1.38	1.46	1.55	2150.000	-17.99	8.22
2200.000	8.35	7.66	7.17	1.40	1.68	2.00	422.546	1.37	1.50	1.61	2300.000	-38.56	8.14
2345.000	9.33	8.43	7.73	1.69	2.03	2.40	461.273	1.36	1.51	1.64	2400.000	-56.65	8.12
2450.000	8.81	8.60	7.70	2.19	2.45	2.78	487.507	1.38	1.55	1.68	2450.000	-41.33	8.12
2500.000	9.28	8.16	7.34	2.48	2.65	2.94	500.000	1.36	1.53	1.67	2500.000	-48.78	8.23

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	22	12	35	40	43	26	40	34	47
1	-	17	+0	28	26	47	37	64	48	59	52	53
2	92	63	43	49	41	69	53	66	67	72	50	60
3	94	69	61	69	47	64	71	74	65	> 75	71	65
4	96	> 76	> 76	74	75	74	73	> 74	> 75	> 75	73	> 76
5	> 97	75	> 75	> 76	75	75	> 77	> 75	73	75	> 76	> 75
6	> 97	> 75	> 54	75	> 76	> 74	> 76	74	> 76	74	> 75	74
7	> 90	> 70	> 74	> 75	76	73	> 76	> 77	74	> 76	74	> 75
8	> 91	69	> 69	> 75	74	74	74	> 76	> 76	> 77	> 76	74
9	> 91	69	> 70	69	74	> 75	> 77	75	> 75	> 75	> 76	75
10	91	> 70	69	67	> 70	> 75	> 75	> 75	75	> 76	> 77	> 75

LO HARMONICS ORDER

test condition RF IN: 910.10 MHZ; -15.01 DBM
LO IN: 940.01 MHZ; +6.98 DBM
IF OUT: 29.91 MHZ; -20.69 DBM

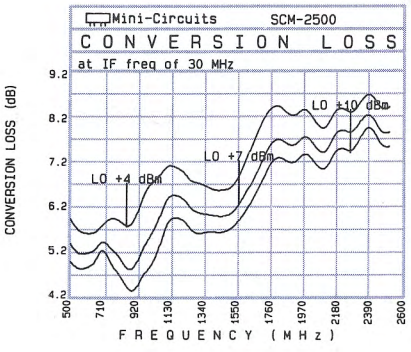
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	36	23	47	48	56	40	59	47	71
1	-	19	0	32	28	50	41	80	58	67	63	73
2	76	51	31	43	31	59	48	60	71	74	54	64
3	94	45	39	37	33	50	57	62	55	75	68	76
4	96	65	63	58	53	48	53	76	71	74	75	76
5	> 96	81	70	63	60	52	44	60	65	79	62	83
6	94	81	71	73	79	76	56	58	62	> 84	80	75
7	84	> 79	> 85	79	82	83	67	67	56	70	77	84
8	> 90	> 80	76	> 85	82	84	> 85	82	74	66	75	81
9	91	77	> 80	> 80	> 85	> 86	83	85	> 86	69	63	72
10	91	> 81	> 80	> 79	79	> 85	> 86	84	> 86	84	75	70

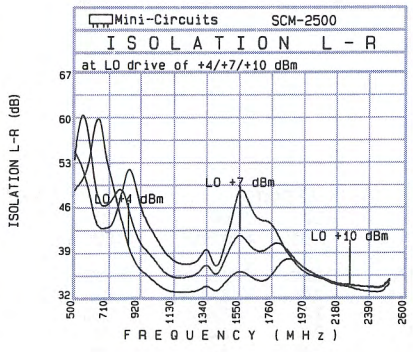
LO HARMONICS ORDER

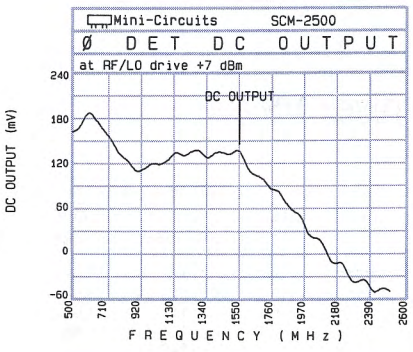
test condition RF IN: 910.10 MHZ; -5.00 DBM
LO IN: 940.01 MHZ; +6.98 DBM
IF OUT: 29.91 MHZ; -10.70 DBM

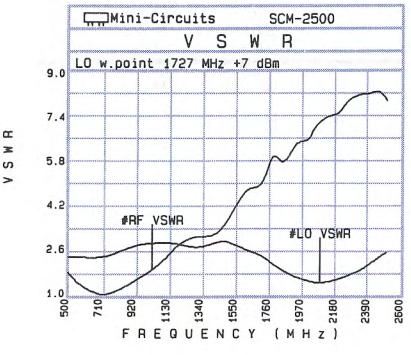
typical performance curves

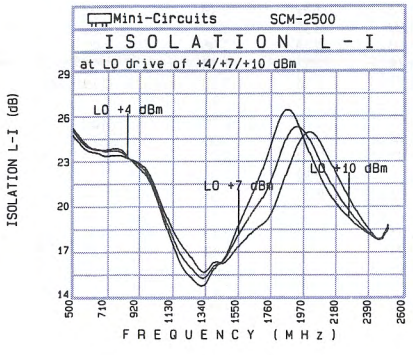
(production unit)

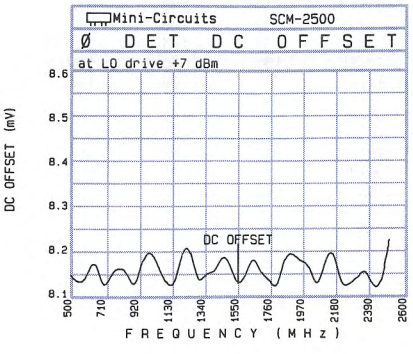












In Stock...Immediate Delivery

plug-in

Frequency Mixers

LEVEL 7 (+7 dBm LO, up to +1 dBm RF)

Models
TFM-5
TSM-5



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
5.000	35.000	7.34	6.85	6.66	64.17	64.43	64.40	68.87	68.03	67.20
10.000	40.000	7.18	6.72	6.54	62.80	62.97	62.64	64.30	63.27	62.24
20.000	50.000	7.21	6.72	6.56	61.05	61.20	60.90	60.45	59.10	57.87
50.000	80.000	7.26	6.78	6.59	56.25	56.26	56.27	53.37	52.02	50.94
100.000	70.000	7.19	6.73	6.55	51.44	51.61	51.66	47.98	46.56	45.40
149.677	119.677	7.13	6.66	6.48	48.59	48.85	48.96	45.14	43.67	42.84
200.000	170.000	6.97	6.55	6.44	46.18	46.50	46.66	42.63	41.59	40.88
294.355	264.355	6.79	6.45	6.36	43.36	43.79	43.77	40.03	39.07	38.18
439.032	409.032	6.67	6.37	6.28	40.49	40.94	40.99	36.09	35.50	34.82
500.000	470.000	6.67	6.37	6.29	39.43	39.83	39.78	34.67	34.23	33.50
583.710	553.710	6.66	6.39	6.31	37.97	38.25	38.66	32.62	32.42	32.40
728.387	698.387	6.90	6.62	6.55	37.93	38.35	38.55	29.85	30.32	30.37
750.000	720.000	6.99	6.71	6.62	37.93	38.31	38.41	29.42	30.01	30.25
873.065	843.065	7.63	7.17	6.90	36.59	36.81	36.75	27.49	27.56	27.60
1000.000	970.000	7.94	7.24	6.78	35.14	35.43	35.15	25.91	26.60	27.07
1017.742	987.742	7.99	7.30	6.79	34.96	35.41	35.28	25.52	26.40	26.98
1162.419	1132.419	8.56	7.47	6.96	33.03	33.52	33.88	23.46	24.70	26.08
1307.097	1277.097	8.89	7.96	7.35	32.61	33.37	34.03	21.91	23.40	25.14
1451.774	1421.774	9.23	8.45	7.93	32.56	33.96	34.75	22.49	24.78	26.81
1500.000	1470.000	9.22	8.50	7.98	32.87	34.28	35.09	23.23	25.75	27.73

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.49	1.58	1.65	1.86	2.54	3.50	1.50	1.31	1.17	5.000	-222.66	0.28
10.000	1.42	1.53	1.60	1.74	2.45	3.32	1.51	1.31	1.18	10.000	-222.67	0.28
20.000	1.40	1.51	1.58	1.77	2.54	3.44	1.51	1.31	1.18	20.000	-220.72	0.28
50.000	1.41	1.51	1.58	1.72	2.42	3.26	1.51	1.32	1.19	50.000	-232.00	0.31
100.000	1.40	1.49	1.57	1.73	2.39	3.21	1.56	1.37	1.24	100.000	-224.70	0.33
149.677	1.39	1.47	1.54	1.73	2.39	3.22	1.63	1.43	1.31	149.677	-227.68	0.34
200.000	1.37	1.45	1.52	1.69	2.36	3.14	1.72	1.52	1.39	200.000	-247.26	0.34
294.355	1.35	1.41	1.47	1.68	2.33	3.06	1.92	1.71	1.57	294.355	-244.77	0.38
439.032	1.35	1.36	1.39	1.71	2.23	2.78	2.22	1.99	1.85	439.032	-255.70	0.85
500.000	1.35	1.34	1.36	1.79	2.25	2.80	2.34	2.11	1.96	500.000	-224.65	0.82
583.710	1.35	1.32	1.32	1.90	2.25	2.79	2.50	2.25	2.10	583.710	-223.35	1.09
728.387	1.33	1.27	1.26	1.94	2.40	3.00	2.72	2.43	2.25	728.387	-227.74	1.44
750.000	1.33	1.26	1.25	1.97	2.43	3.02	2.77	2.47	2.28	750.000	-219.12	1.33
873.065	1.33	1.23	1.21	2.01	2.32	2.75	2.86	2.54	2.31	873.065	-203.66	1.40
1000.000	1.42	1.29	1.28	2.04	2.25	2.55	2.91	2.57	2.33	1000.000	-178.88	1.53
1017.742	1.44	1.30	1.30	2.03	2.23	2.53	2.91	2.57	2.32	1017.742	-177.35	1.90
1162.419	1.73	1.46	1.47	2.09	2.24	2.48	2.75	2.44	2.24	1162.419	-174.30	1.73
1307.097	1.99	1.60	1.60	1.87	1.91	2.06	2.50	2.24	2.08	1307.097	-178.51	2.27
1451.774	2.23	1.67	1.72	1.55	1.54	1.68	2.27	2.05	1.92	1451.774	-181.34	0.69
1500.000	2.33	1.73	1.78	1.56	1.55	1.69	2.19	2.00	1.89	1500.000	-190.31	-1.72

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	7	22	14	32	26	47	34	43	30	39
1	-	21	0	27	13	32	17	37	37	50	57	45
2	96	74	54	65	52	72	52	69	57	74	64	> 75
3	> 96	66	65	68	65	70	62	69	61	72	73	> 75
4	93	74	75	> 76	> 76	75	> 76	> 77	> 76	> 74	> 75	> 74
5	> 95	> 75	> 76	> 76	> 77	> 75	> 76	> 76	75	> 76	> 75	74
6	> 95	74	> 75	75	> 76	75	> 76	> 77	73	76	> 76	> 75
7	> 97	> 77	74	> 74	> 75	75	> 75	> 76	> 76	> 76	> 76	72
8	> 96	75	> 75	74	> 75	> 76	> 76	75	> 76	> 76	> 76	76
9	> 96	74	> 76	> 77	> 74	> 75	> 75	> 76	> 76	> 76	> 77	> 76
10	> 96	> 76	> 76	> 76	> 75	74	> 75	> 75	> 76	75	> 77	> 76

LO HARMONICS ORDER

test condition RF IN: 500.10 MHZ; -13.99 DBM
LO IN: 470.01 MHZ; +7.02 DBM
IF OUT: 30.09 MHZ; -20.34 DBM

RF ORDER HARMONIC

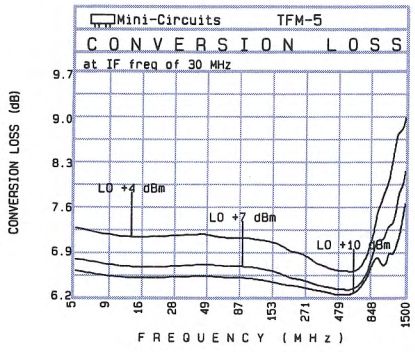
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	17	36	26	41	37	59	48	57	45	56
1	-	21	0	29	13	32	18	39	37	58	55	55
2	82	64	47	57	46	69	46	61	52	76	61	70
3	95	50	45	52	46	50	44	55	42	55	63	66
4	94	78	71	80	66	77	64	73	61	72	64	78
5	95	74	75	72	64	72	59	75	57	68	57	78
6	94	> 84	84	> 85	> 85	> 86	> 86	85	81	83	75	82
7	> 96	> 86	> 85	> 84	82	82	> 86	82	84	81	80	82
8	> 95	> 86	> 87	> 85	> 84	> 84	82	> 85	> 86	> 86	> 86	> 87
9	> 96	> 85	81	> 86	85	> 85	81	> 86	> 86	> 86	85	> 87
10	> 96	> 86	> 86	> 85	> 86	> 86	> 84	81	> 85	> 87	> 86	> 86

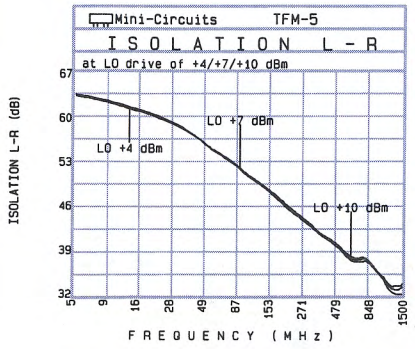
LO HARMONICS ORDER

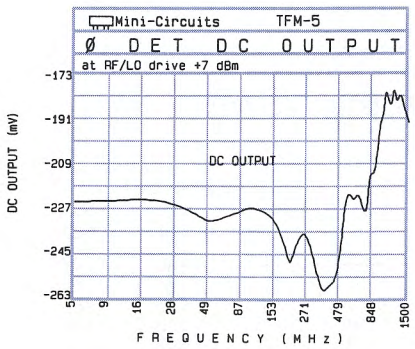
test condition RF IN: 500.10 MHZ; -3.92 DBM
LO IN: 470.01 MHZ; +7.02 DBM
IF OUT: 30.09 MHZ; -10.23 DBM

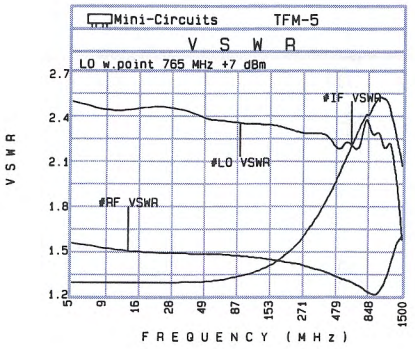
typical performance curves

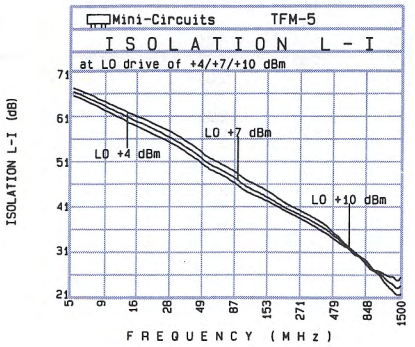
(production unit)

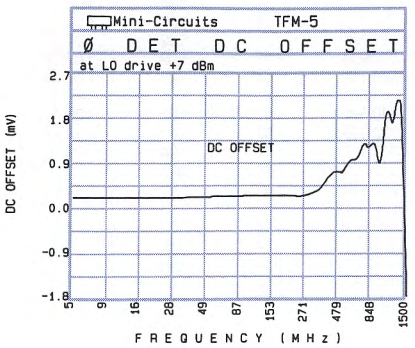












In Stock...Immediate Delivery

active, low LO drive

Frequency Mixers

UNCL-L1H (+6 dBm LO, up to +14 dBm RF)

Model
UNCL-L1H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Gain (dB) LO + 3 dBm	LO + 6 dBm	LO + 9 dBm	Isolation L-R (dB) LO + 3 dBm	LO + 6 dBm	LO + 9 dBm	Isolation L-I (dB) LO + 3 dBm	LO + 6 dBm	LO + 9 dBm
10.000	40.000	6.57	6.14	5.97	44.39	44.45	45.36	37.16	37.68	39.06
20.000	50.000	6.48	6.09	5.94	44.82	44.60	44.98	34.75	36.60	38.51
50.000	80.000	6.58	6.15	5.96	43.96	42.60	41.22	28.24	31.75	34.83
53.240	83.235	6.64	6.19	6.00	43.93	42.54	41.01	27.73	31.32	34.51
96.470	66.471	6.51	6.09	5.94	41.95	39.39	36.79	22.88	27.03	30.89
100.000	70.000	6.56	6.12	5.95	41.74	38.82	36.30	22.61	26.75	30.66
139.710	109.706	6.56	6.08	5.90	39.80	36.47	33.50	19.94	24.55	28.41
182.940	152.941	6.57	6.04	5.91	37.55	33.97	30.54	17.94	22.60	26.77
200.000	170.000	6.46	6.01	5.89	36.69	32.86	29.41	17.28	22.00	26.13
226.180	196.177	6.45	6.05	5.92	35.98	31.55	27.51	16.25	21.33	25.17
240.590	210.588	6.33	6.01	5.90	35.47	31.07	27.11	15.82	20.98	24.77
250.000	220.000	6.32	5.99	5.88	34.86	31.07	26.60	15.51	20.64	24.42
269.410	239.412	6.29	6.03	5.90	33.70	29.74	25.65	15.07	20.00	24.05
312.650	282.647	6.29	6.06	5.93	32.81	29.04	25.42	13.96	18.97	23.44
355.880	325.882	6.31	6.07	5.91	32.10	29.44	25.99	13.02	17.86	23.05
399.120	369.118	6.34	6.05	5.89	31.65	28.97	26.12	12.34	17.51	23.67
442.350	412.353	6.43	6.13	5.95	30.69	28.43	26.21	11.60	16.75	23.67
471.180	441.177	6.54	6.22	6.04	29.65	27.40	26.05	11.64	16.76	23.93
485.590	455.588	6.61	6.26	6.07	28.77	26.90	26.47	11.61	16.94	24.01
500.000	470.000	6.62	6.26	6.07	28.19	26.42	26.36	11.65	17.47	24.45

mixer VSWR

FREQ. (MHz)	VSWR RF port LO + 3 dBm	LO + 6 dBm	LO + 9 dBm	VSWR LO port LO + 3 dBm	LO + 6 dBm	LO + 9 dBm	VSWR IF port LO + 3 dBm	LO + 6 dBm	LO + 9 dBm
10.000	1.10	1.08	1.10	1.28	1.39	1.61	1.45	1.32	1.21
20.000	1.08	1.04	1.07	1.18	1.29	1.54	1.45	1.32	1.21
50.000	1.07	1.02	1.07	1.15	1.32	1.58	1.44	1.31	1.21
53.240	1.07	1.02	1.07	1.15	1.32	1.58	1.44	1.31	1.21
96.470	1.07	1.01	1.06	1.21	1.38	1.66	1.46	1.32	1.21
100.000	1.07	1.01	1.06	1.22	1.39	1.67	1.46	1.32	1.21
139.710	1.07	1.01	1.06	1.29	1.49	1.78	1.46	1.33	1.22
182.940	1.07	1.02	1.06	1.37	1.61	1.91	1.47	1.34	1.22
200.000	1.07	1.02	1.07	1.39	1.65	1.95	1.48	1.34	1.22
226.180	1.07	1.03	1.07	1.41	1.72	2.03	1.48	1.34	1.23
240.590	1.07	1.03	1.08	1.42	1.76	2.06	1.48	1.34	1.23
250.000	1.07	1.04	1.08	1.43	1.78	2.08	1.48	1.34	1.23
269.410	1.07	1.04	1.09	1.45	1.82	2.15	1.49	1.35	1.23
312.650	1.08	1.06	1.10	1.50	1.93	2.29	1.50	1.36	1.24
355.880	1.09	1.08	1.11	1.58	2.04	2.48	1.52	1.37	1.26
399.120	1.11	1.09	1.13	1.65	2.14	2.69	1.52	1.37	1.26
442.350	1.14	1.12	1.15	1.74	2.25	2.89	1.53	1.38	1.27
471.180	1.15	1.14	1.17	1.81	2.33	2.97	1.54	1.39	1.28
485.590	1.16	1.15	1.18	1.83	2.32	2.95	1.54	1.39	1.28
500.000	1.18	1.16	1.19	1.86	2.35	3.00	1.54	1.39	1.29

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	4	+6	6	+5	11	+0	8	8	10
1	-	27	+0	27	15	27	23	27	26	31	28	32
2	> 97	60	53	63	54	65	59	68	61	60	62	58
3	> 97	> 75	> 76	75	> 75	> 76	74	> 76	74	> 75	72	> 76
4	96	> 76	> 75	> 75	> 75	> 75	> 75	> 75	75	> 75	> 76	> 75
5	96	> 75	> 75	> 75	> 76	> 75	> 76	> 75	74	75	75	> 75
6	> 97	> 76	> 75	75	> 75	75	74	> 75	75	> 76	75	> 76
7	> 97	74	> 75	> 75	75	> 75	> 75	> 76	> 76	> 76	> 76	> 74
8	> 96	> 74	> 75	> 75	74	> 75	74	> 75	> 75	> 75	> 75	> 76
9	> 95	> 75	> 75	> 75	> 75	> 75	75	> 76	> 75	75	> 76	> 75
10	> 96	> 74	> 75	> 75	> 75	> 75	> 76	> 75	74	> 75	72	> 76

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -14.94 DBM
LO IN: 155.01 MHZ; +6.08 DBM
IF OUT: 30.09 MHZ; -21.00 DBM

RF CAL

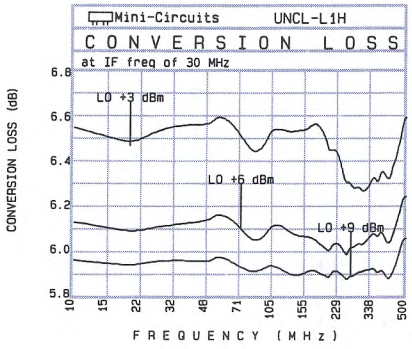
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	14	4	16	5	21	10	18	18	21
1	-	27	+0	27	15	27	23	27	27	32	28	32
2	83	53	45	56	46	56	50	59	52	53	54	51
3	95	71	71	68	61	67	59	67	58	67	58	67
4	> 97	78	74	81	74	85	> 85	77	75	74	73	73
5	> 96	> 85	> 85	> 85	> 85	85	> 86	> 85	> 85	84	85	85
6	> 96	> 85	85	85	> 86	85	> 86	> 85	> 86	85	85	85
7	> 96	> 85	> 86	85	> 85	84	> 86	> 85	> 85	> 87	> 86	83
8	> 96	> 85	84	> 85	> 85	> 85	> 86	> 86	> 85	84	> 86	> 84
9	> 96	> 85	84	85	> 85	> 85	> 85	> 86	> 86	> 85	> 86	> 86
10	> 96	84	> 85	> 85	> 86	> 85	> 85	> 85	> 85	> 85	> 86	85

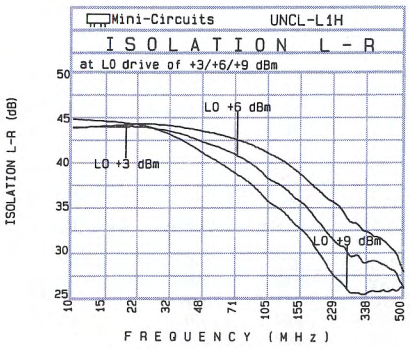
LO HARMONICS ORDER

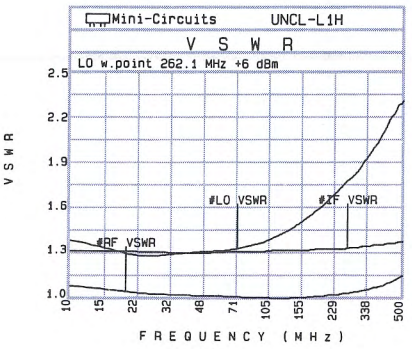
test condition RF IN: 185.10 MHZ; -5.08 DBM
LO IN: 155.01 MHZ; +6.08 DBM
IF OUT: 30.09 MHZ; -10.96 DBM

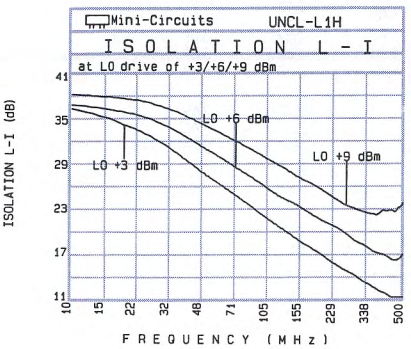
typical performance curves

(production unit)









active, low noise

Frequency Mixers

UNCL-R1 (+7 dBm LO, up to -10 dBm RF)

Model
UNCL-R1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion gain and isolation

RF MHz	LO MHz	Conversion Gain (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
10.000	40.000	5.36	5.61	5.76	77.58	77.62	76.77	59.38	57.99	57.05
20.000	50.000	5.21	5.49	5.63	72.82	72.32	72.13	53.58	52.25	51.33
50.000	80.000	5.10	5.36	5.59	66.45	66.36	66.15	46.88	45.67	44.91
53.240	83.235	5.13	5.37	5.60	66.08	65.76	65.65	46.42	45.21	44.46
96.470	66.471	5.03	5.30	5.51	60.90	60.66	60.16	41.72	40.46	39.45
100.000	70.000	5.07	5.32	5.52	60.52	60.05	59.85	41.40	40.13	39.11
139.710	109.706	5.10	5.35	5.48	57.65	57.13	56.98	39.07	37.51	36.30
182.940	152.941	5.09	5.31	5.49	55.49	55.10	54.95	37.48	35.92	34.76
200.000	170.000	5.14	5.34	5.51	54.79	54.43	54.09	36.40	35.12	34.06
226.180	196.177	5.11	5.30	5.49	53.60	53.30	53.03	35.45	34.24	33.08
240.590	210.588	5.08	5.28	5.46	53.08	52.81	52.45	34.80	33.69	32.57
250.000	220.000	5.11	5.29	5.46	52.72	52.43	52.12	34.50	33.48	32.36
269.410	239.412	5.08	5.27	5.45	51.99	51.67	51.32	33.83	33.07	32.02
312.650	282.647	5.03	5.22	5.40	50.57	50.11	49.82	31.85	31.62	30.90
355.880	325.882	4.97	5.17	5.36	49.43	48.93	48.67	30.05	30.30	30.14
399.120	369.118	4.92	5.12	5.33	48.44	47.95	47.66	28.75	29.10	29.20
442.350	412.353	4.86	5.02	5.28	47.07	46.61	46.33	27.57	27.98	28.06
471.180	441.177	4.83	4.99	5.25	46.68	46.28	46.09	26.61	27.35	27.63
485.590	455.588	4.73	4.94	5.13	46.61	46.20	46.00	26.80	27.50	27.87
500.000	470.000	4.70	4.93	5.13	46.15	45.76	45.58	26.20	26.91	27.26

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
10.000	1.52	1.56	1.59	1.88	2.78	3.94	1.20	1.06	1.03
20.000	1.39	1.44	1.47	1.92	2.84	4.01	1.20	1.06	1.02
50.000	1.34	1.39	1.42	1.85	2.73	3.86	1.19	1.06	1.03
53.240	1.34	1.39	1.42	1.82	2.69	3.78	1.19	1.06	1.03
96.470	1.34	1.39	1.42	1.81	2.67	3.75	1.20	1.07	1.03
100.000	1.34	1.39	1.42	1.81	2.68	3.76	1.20	1.07	1.03
139.710	1.35	1.40	1.43	1.80	2.63	3.68	1.21	1.08	1.03
182.940	1.36	1.41	1.44	1.77	2.57	3.58	1.23	1.10	1.04
200.000	1.38	1.42	1.45	1.80	2.62	3.63	1.23	1.11	1.05
226.180	1.39	1.44	1.47	1.85	2.69	3.73	1.25	1.12	1.06
240.590	1.40	1.45	1.48	1.84	2.67	3.69	1.26	1.13	1.07
250.000	1.41	1.45	1.48	1.84	2.65	3.65	1.27	1.15	1.08
269.410	1.42	1.46	1.49	1.83	2.60	3.55	1.29	1.15	1.06
312.650	1.46	1.51	1.55	1.87	2.64	3.60	1.31	1.18	1.09
355.880	1.51	1.55	1.58	1.92	2.70	3.65	1.35	1.21	1.11
399.120	1.56	1.60	1.63	1.94	2.68	3.60	1.40	1.25	1.15
442.350	1.61	1.66	1.68	1.98	2.71	3.61	1.44	1.29	1.20
471.180	1.66	1.70	1.73	2.02	2.75	3.65	1.48	1.33	1.23
485.590	1.68	1.72	1.75	2.04	2.77	3.66	1.50	1.34	1.24
500.000	1.70	1.73	1.76	2.04	2.77	3.65	1.51	1.35	1.25

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	20	37	26	56	27	58	32	51	40	52
1	-	24	+0	37	11	42	20	49	26	58	31	46
2	> 97	74	45	73	44	70	43	69	42	71	43	61
3	> 97	51	45	55	46	59	53	62	50	56	47	59
4	> 97	80	62	80	61	79	59	80	58	77	56	82
5	> 97	71	63	70	57	72	57	69	55	70	54	80
6	95	85	76	> 87	74	> 86	73	> 87	79	83	80	83
7	> 97	83	81	84	> 87	83	75	84	74	81	73	80
8	94	> 86	83	> 87	> 87	> 86	86	> 87	> 87	> 87	85	85
9	> 96	> 86	81	83	77	> 86	79	86	81	> 86	85	> 87
10	> 96	85	> 86	> 86	> 86	85	85	> 87	> 87	> 87	> 87	> 86

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -15.03 DBM
LO IN: 155.01 MHZ; +7.03 DBM
IF OUT: 30.09 MHZ; -9.71 DBM

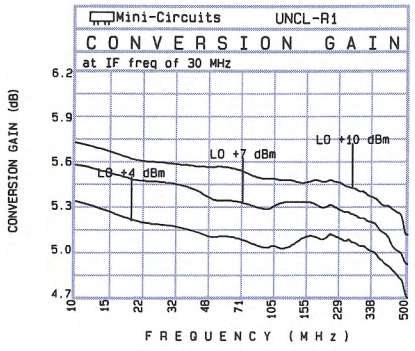
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	23	15	34	15	37	17	37	22	34
1	-	26	+0	37	11	40	20	41	24	49	27	43
2	> 97	> 77	49	76	50	75	49	69	48	> 78	47	> 76
3	> 97	71	71	71	74	74	65	> 77	59	76	59	72
4	96	> 76	76	76	> 77	> 76	74	76	> 76	> 77	> 76	76
5	> 97	> 77	> 77	> 78	76	> 76	> 77	> 77	> 77	> 77	> 77	76
6	> 96	> 76	74	> 76	> 77	> 77	> 78	> 77	> 78	76	76	> 77
7	> 97	74	75	> 76	> 77	> 78	> 77	> 77	76	76	> 77	> 77
8	> 96	75	74	76	> 77	> 77	> 77	> 77	> 77	> 78	> 77	> 77
9	> 96	> 76	> 77	76	> 78	> 77	75	76	> 77	> 77	> 77	> 77
10	94	> 77	> 76	> 77	> 77	> 76	> 77	> 77	75	76	76	> 76

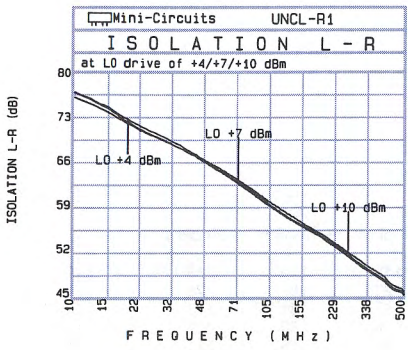
LO HARMONICS ORDER

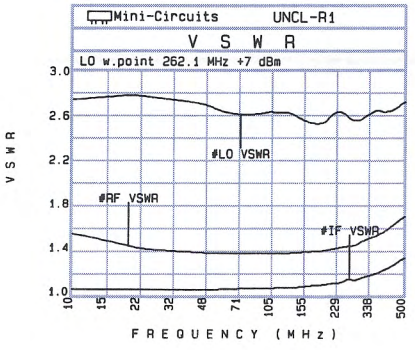
test condition RF IN: 185.10 MHZ; -25.02 DBM
LO IN: 155.01 MHZ; +7.02 DBM
IF OUT: 30.09 MHZ; -19.41 DBM

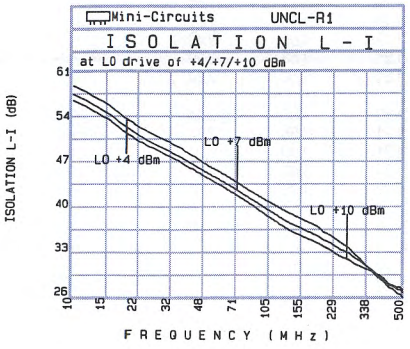
typical performance curves

(production unit)









In Stock...Immediate Delivery

active, low noise

Frequency Mixers

UNCL-R1H (+17 dBm LO, up to +1 dBm RF)

Model
UNCL-R1H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion gain and isolation

RF MHz	LO MHz	Conversion Gain (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
10.000	40.000	5.58	6.33	6.58	72.44	71.50	70.35	57.77	57.52	56.95
20.000	50.000	5.54	6.22	6.50	70.03	69.22	68.35	56.30	54.07	52.18
50.000	80.000	5.52	6.18	6.48	65.16	64.69	64.55	51.96	48.29	46.04
53.240	83.235	5.49	6.17	6.47	64.56	64.24	64.15	51.60	47.86	45.57
96.470	66.471	5.48	6.12	6.41	59.34	59.19	58.65	47.75	43.67	40.75
100.000	70.000	5.49	6.13	6.41	58.96	58.66	58.27	47.58	43.42	40.47
139.710	109.706	5.39	6.09	6.41	56.06	55.56	55.47	45.86	41.18	38.85
182.940	152.941	5.28	6.06	6.39	53.36	53.10	53.16	44.31	40.77	38.10
200.000	170.000	5.43	6.16	6.40	52.62	52.49	52.67	42.61	39.69	36.99
226.180	196.177	5.35	6.09	6.37	51.44	51.44	51.70	41.51	39.10	36.45
240.590	210.588	5.35	6.11	6.34	50.98	51.08	51.41	39.98	38.11	35.78
250.000	220.000	5.16	6.01	6.32	50.74	50.87	51.23	39.23	37.62	35.50
269.410	239.412	5.50	6.11	6.32	50.15	50.21	50.37	37.59	36.75	35.25
312.650	282.647	5.43	5.99	6.17	49.19	49.32	49.26	33.47	34.04	33.41
355.880	325.882	5.24	5.83	5.97	48.40	48.66	48.59	30.83	31.86	32.37
399.120	369.118	5.10	5.73	5.91	47.64	47.79	47.69	28.85	30.03	30.87
442.350	412.353	5.08	5.49	5.77	47.09	46.94	46.68	26.91	28.23	29.32
471.180	441.177	5.08	5.46	5.62	46.92	46.83	46.62	25.67	27.18	28.25
485.590	455.588	4.83	5.33	5.53	46.87	46.88	46.72	25.46	27.21	28.61
500.000	470.000	4.86	5.31	5.54	46.79	46.71	46.34	25.23	27.14	28.44

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm
10.000	1.57	1.49	1.45	1.15	1.80	2.68	1.47	1.19	1.04
20.000	1.39	1.30	1.25	1.22	1.87	2.78	1.47	1.19	1.04
50.000	1.35	1.24	1.18	1.17	1.81	2.73	1.46	1.19	1.06
53.240	1.35	1.24	1.17	1.16	1.80	2.72	1.46	1.19	1.06
96.470	1.34	1.24	1.18	1.14	1.75	2.61	1.48	1.20	1.08
100.000	1.34	1.24	1.18	1.16	1.74	2.63	1.48	1.21	1.08
139.710	1.33	1.24	1.20	1.16	1.73	2.57	1.49	1.23	1.11
182.940	1.31	1.25	1.22	1.19	1.65	2.42	1.53	1.27	1.14
200.000	1.31	1.25	1.23	1.21	1.63	2.39	1.55	1.28	1.15
226.180	1.30	1.25	1.25	1.21	1.60	2.34	1.57	1.31	1.17
240.590	1.29	1.26	1.27	1.20	1.57	2.34	1.59	1.32	1.19
250.000	1.29	1.26	1.28	1.21	1.56	2.34	1.62	1.35	1.21
269.410	1.28	1.27	1.29	1.21	1.50	2.25	1.61	1.33	1.16
312.650	1.27	1.29	1.33	1.24	1.42	2.08	1.67	1.39	1.21
355.880	1.26	1.31	1.37	1.29	1.39	1.93	1.73	1.43	1.23
399.120	1.26	1.34	1.42	1.30	1.31	1.85	1.79	1.47	1.26
442.350	1.28	1.38	1.48	1.31	1.27	1.78	1.84	1.51	1.26
471.180	1.29	1.40	1.51	1.30	1.22	1.73	1.88	1.54	1.27
485.590	1.30	1.42	1.53	1.32	1.22	1.69	1.89	1.54	1.27
500.000	1.31	1.43	1.55	1.31	1.22	1.68	1.87	1.53	1.26

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	17	14	36	16	36	20	41	27	58
1	-	30	0	40	13	46	31	36	24	38	26	39
2	96	61	47	61	50	56	52	54	51	58	50	56
3	94	63	62	68	56	71	51	68	50	67	50	69
4	>97	83	79	79	78	75	71	76	69	79	68	79
5	>97	84	82	85	78	85	76	84	76	>87	82	86
6	>97	>88	86	>87	>88	86	>87	87	>86	86	86	87
7	>96	>87	>87	>87	>88	>87	>88	>87	>88	87	87	>87
8	95	86	87	86	>87	86	>87	>86	>88	>88	>87	86
9	>96	>87	>87	>87	>88	>87	>88	>88	87	>88	>87	>87
10	>96	>86	>87	>86	>87	>87	>87	87	>87	>88	>88	>87

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -15.00 DBM
LO IN: 155.01 MHZ; +17.02 DBM
IF OUT: 30.09 MHZ; -9.01 DBM

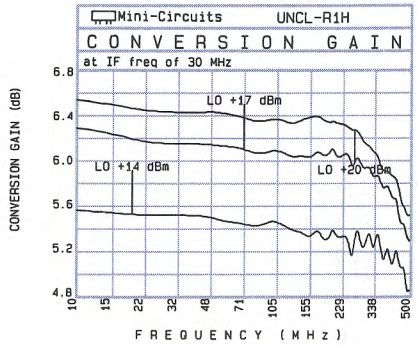
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	24	28	27	54	30	46	38	53	53	50
1	-	30	0	40	13	49	30	40	32	44	41	46
2	83	53	42	63	44	58	43	56	43	60	46	60
3	95	53	51	56	49	58	43	66	38	61	38	59
4	96	81	59	77	65	71	70	68	67	70	60	70
5	96	67	67	68	60	73	54	74	53	69	55	67
6	96	79	69	82	72	78	78	73	67	73	64	74
7	>96	74	71	76	71	79	68	83	66	77	69	75
8	94	85	88	80	82	78	81	78	73	81	71	85
9	>96	89	84	92	78	93	76	85	75	82	83	82
10	>96	92	95	87	89	86	84	87	82	92	79	93

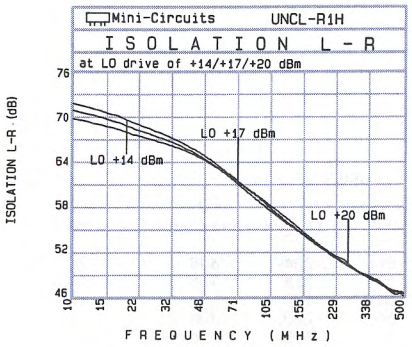
LO HARMONICS ORDER

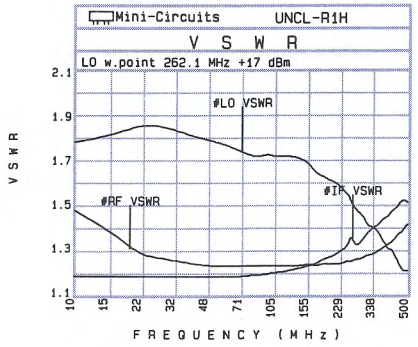
test condition RF IN: 185.10 MHZ; -5.08 DBM
LO IN: 155.01 MHZ; +16.93 DBM
IF OUT: 30.09 MHZ; +1.16 DBM

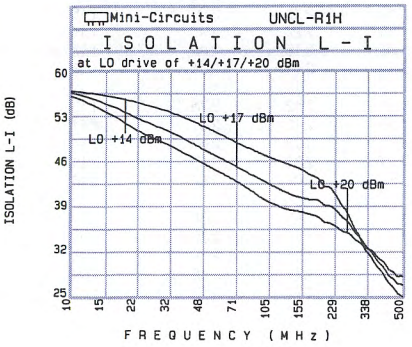
typical performance curves

(production unit)









active, load insensitive

Frequency Mixers

UNCL-X1MH (+13 dBm LO, up to +9 dBm RF)

Model
UNCL-X1MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion gain and isolation

RF MHz	LO MHz	Conversion Gain (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
1.000	31.000	0.98	1.40	1.66	79.91	78.21	77.14	45.37	42.19	42.17
2.000	32.000	1.50	1.90	2.13	77.02	75.39	74.33	45.07	42.84	42.87
5.000	35.000	1.89	2.23	2.47	69.76	68.33	67.42	45.56	43.38	43.44
10.000	40.000	1.98	2.31	2.55	64.70	63.00	61.99	45.51	43.25	43.19
20.000	50.000	1.99	2.33	2.55	58.76	57.49	56.45	44.22	42.06	41.74
49.290	79.290	1.99	2.34	2.56	52.53	51.34	50.41	41.98	39.86	39.01
50.000	80.000	1.99	2.33	2.56	52.42	51.23	50.30	41.90	39.78	38.93
97.580	67.581	1.97	2.28	2.53	47.06	46.25	45.49	38.52	36.14	35.04
100.000	70.000	1.99	2.29	2.54	46.84	46.06	45.30	38.41	35.99	34.89
145.870	115.871	2.03	2.36	2.55	44.56	43.51	42.24	36.31	34.10	32.60
194.160	164.161	2.05	2.32	2.49	42.73	41.46	40.30	34.92	32.58	31.14
200.000	170.000	2.05	2.33	2.50	42.47	41.16	39.92	34.76	32.28	30.77
242.450	212.452	2.04	2.28	2.46	40.57	39.33	38.14	32.42	30.88	29.36
250.000	220.000	2.09	2.30	2.49	40.21	39.00	37.82	32.06	30.57	29.17
290.740	260.742	1.98	2.23	2.43	38.61	37.30	36.15	29.52	28.88	27.94
339.030	309.032	1.95	2.20	2.40	37.10	35.93	34.80	27.11	27.10	26.60
387.320	357.323	1.88	2.15	2.38	35.56	34.50	33.47	25.51	25.78	25.66
435.610	405.613	1.76	2.06	2.29	33.68	32.60	31.83	23.60	24.57	24.69
483.900	453.903	1.69	2.01	2.27	32.86	32.13	31.45	22.37	23.77	24.28
500.000	470.000	1.74	2.04	2.28	32.70	31.94	31.20	21.96	23.28	23.61

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
5.000	1.15	1.17	1.20	1.69	2.34	3.14	1.24	1.22	1.19
10.000	1.08	1.10	1.14	1.62	2.28	3.05	1.23	1.20	1.17
20.000	1.05	1.07	1.12	1.68	2.37	3.17	1.19	1.16	1.14
50.000	1.03	1.06	1.12	1.61	2.30	3.08	1.16	1.13	1.11
57.500	1.03	1.06	1.12	1.59	2.28	3.06	1.16	1.13	1.10
95.000	1.03	1.06	1.12	1.57	2.24	2.93	1.15	1.12	1.09
100.000	1.03	1.06	1.12	1.59	2.23	2.95	1.15	1.12	1.09
140.000	1.03	1.06	1.12	1.58	2.22	2.95	1.14	1.11	1.09
185.000	1.03	1.06	1.12	1.55	2.15	2.80	1.13	1.11	1.10
200.000	1.03	1.06	1.12	1.56	2.11	2.81	1.13	1.11	1.10
230.000	1.04	1.05	1.11	1.56	2.12	2.76	1.12	1.10	1.10
245.000	1.08	1.05	1.09	1.55	2.10	2.69	1.11	1.10	1.10
250.000	1.12	1.09	1.10	1.55	2.08	2.67	1.11	1.10	1.10
275.000	1.12	1.11	1.14	1.53	2.03	2.60	1.11	1.10	1.11
320.000	1.09	1.11	1.15	1.51	1.97	2.50	1.10	1.10	1.11
365.000	1.10	1.12	1.17	1.51	1.93	2.38	1.09	1.10	1.12
410.000	1.11	1.14	1.18	1.49	1.87	2.30	1.08	1.11	1.13
455.000	1.13	1.16	1.20	1.45	1.79	2.19	1.08	1.11	1.14
485.000	1.15	1.17	1.22	1.44	1.79	2.18	1.09	1.12	1.15
500.000	1.16	1.18	1.22	1.44	1.79	2.17	1.09	1.13	1.15

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	9	14	10	33	12	23	14	40	20	30
1	-	19	+0	32	13	36	20	43	28	52	36	45
2	96	55	55	69	53	65	57	62	59	64	58	66
3	95	79	77	80	73	82	67	80	67	79	65	81
4	>97	>84	>84	>84	82	>83	>84	82	>84	>84	>83	83
5	>97	82	>84	>84	>84	83	>83	>83	83	>83	>84	>84
6	>96	>84	82	82	>85	>84	>84	82	>84	>84	>84	>84
7	>96	>83	>84	>83	>83	82	>84	83	>84	>84	83	83
8	>95	>83	82	>83	>83	>84	>84	>83	83	>84	83	83
9	94	>83	82	>84	83	>84	83	83	>84	82	>83	>83
10	>97	>83	>83	>83	>83	>84	>84	>84	>83	>84	>84	>84

LO HARMONICS ORDER

test condition RF IN: 185.10 MHZ; -14.97 DBM
LO IN: 155.01 MHZ; + 12.96 DBM
IF OUT: 30.09 MHZ; -12.82 DBM

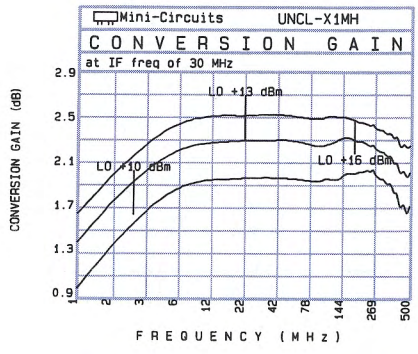
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	18	24	20	42	22	34	25	50	31	42
1	-	19	+0	32	13	36	20	45	29	53	39	46
2	84	45	46	60	45	59	48	55	49	57	49	63
3	96	64	57	70	55	82	54	67	51	66	49	65
4	>97	77	72	84	72	82	73	78	71	74	71	74
5	>97	91	83	88	83	87	72	86	71	82	69	83
6	>97	>93	92	>94	91	>94	>93	>93	86	92	85	93
7	>97	92	>93	>93	>93	>93	>93	>93	87	>94	88	>94
8	>96	91	>93	>93	>94	93	>94	93	>93	>93	93	>93
9	95	>92	91	>93	93	>93	>94	93	>93	92	93	>94
10	94	>93	>93	>93	>93	>94	92	>94	>93	>94	>93	92

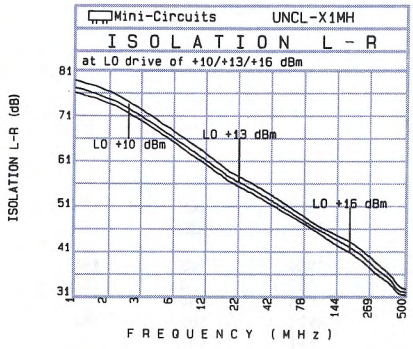
LO HARMONICS ORDER

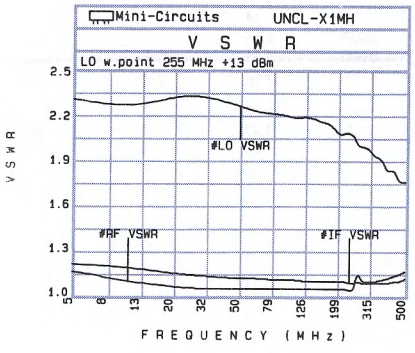
test condition RF IN: 185.10 MHZ; -5.07 DBM
LO IN: 155.01 MHZ; + 12.92 DBM
IF OUT: 30.09 MHZ; -3.01 DBM

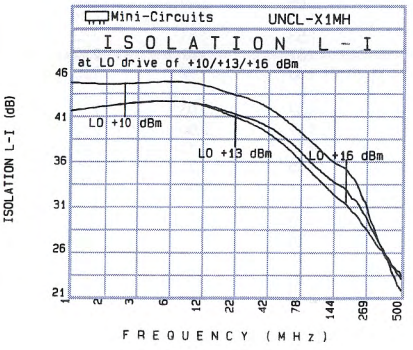
typical performance curves

(production unit)









In Stock...Immediate Delivery

active, low LO drive

Frequency Mixers

(-4dBm LO, up to +1dBm RF)

Model
UNCL-L1

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

		Conversion Loss (dB)				Isolation L-R (dB)			Isolation L-I (dB)		
RF MHz	LO MHz	LO -7 dBm	LO -4 dBm	LO -1 dBm	FREQ. (MHz)	LO -7 dBm	LO -4 dBm	LO -1 dBm	LO -7 dBm	LO -4 dBm	LO -1 dBm
10.000	40.000	5.94	5.70	5.59	10.000	61.95	62.39	61.41	45.95	50.19	54.81
20.000	50.000	5.95	5.67	5.57	20.000	56.83	57.15	55.87	40.27	44.63	49.97
50.000	80.000	5.95	5.70	5.58	50.000	49.01	49.25	48.20	32.14	36.60	42.63
53.240	83.235	5.96	5.70	5.58	53.240	48.39	48.94	47.64	31.61	36.12	42.31
96.470	66.471	5.94	5.69	5.57	96.470	43.97	44.45	43.14	27.01	31.86	37.72
100.000	70.000	5.96	5.69	5.58	100.000	43.73	44.16	42.80	26.80	31.79	37.33
139.710	109.706	5.94	5.68	5.58	139.710	41.86	42.08	39.99	24.47	29.24	34.58
182.940	152.941	5.91	5.68	5.59	182.940	40.21	39.66	37.14	22.54	26.97	32.12
200.000	170.000	5.93	5.70	5.61	200.000	39.78	38.64	35.16	21.86	26.20	31.27
226.180	196.177	5.91	5.69	5.60	226.180	38.86	37.39	33.65	20.81	25.18	30.06
240.590	210.588	5.92	5.70	5.62	240.590	39.24	37.10	32.26	20.37	24.79	29.78
250.000	220.000	5.91	5.70	5.60	250.000	38.52	36.64	31.91	20.01	24.38	29.26
269.410	239.412	5.90	5.69	5.60	269.410	37.74	35.64	31.10	19.52	23.95	28.83
312.650	282.647	5.92	5.71	5.61	312.650	36.62	34.48	29.56	18.54	23.15	27.91
355.880	325.882	5.92	5.70	5.59	355.880	34.96	33.01	28.51	17.84	22.80	27.34
399.120	369.118	5.96	5.74	5.62	399.120	35.84	32.87	28.18	17.65	23.17	27.44
442.350	412.353	5.96	5.72	5.60	442.350	34.82	32.64	28.53	17.76	23.55	27.86
471.180	441.177	6.01	5.77	5.65	471.180	32.45	30.96	27.56	18.50	25.05	27.73
485.590	455.588	6.00	5.77	5.64	485.590	31.49	30.40	27.51	18.39	25.57	27.28
500.000	470.000	6.01	5.77	5.65	500.000	30.14	29.18	26.15	18.87	26.74	26.51

mixer VSWR

FREQ.	VSWR RF port			VSWR LO port			VSWR IF port			
(MHz)	LO -7 dBm	LO -4 dBm	LO -1 dBm	LO -7 dBm	LO -4 dBm	LO -1 dBm	FREQ. (MHz)	LO -7 dBm	LO -4 dBm	LO -1 dBm
10.000	1.09	1.11	1.13	1.04	1.43	1.61	10.000	1.32	1.20	1.11
20.000	1.04	1.07	1.10	1.03	1.34	1.54	20.000	1.33	1.20	1.12
50.000	1.01	1.06	1.10	1.03	1.39	1.58	50.000	1.32	1.19	1.11
53.240	1.01	1.06	1.09	1.03	1.39	1.58	53.240	1.32	1.19	1.11
96.470	1.02	1.05	1.09	1.04	1.49	1.69	96.470	1.31	1.19	1.11
100.000	1.02	1.06	1.09	1.04	1.50	1.70	100.000	1.31	1.19	1.11
139.710	1.04	1.07	1.10	1.05	1.62	1.85	139.710	1.31	1.19	1.12
182.940	1.07	1.09	1.12	1.53	1.81	2.03	182.940	1.31	1.19	1.13
200.000	1.08	1.10	1.13	1.57	1.87	2.12	200.000	1.31	1.19	1.12
226.180	1.10	1.11	1.14	1.63	1.97	2.23	226.180	1.32	1.20	1.13
240.590	1.10	1.13	1.15	1.67	2.03	2.30	240.590	1.32	1.20	1.14
250.000	1.11	1.13	1.15	1.69	2.06	2.33	250.000	1.32	1.20	1.14
269.410	1.12	1.14	1.16	1.75	2.15	2.42	269.410	1.30	1.18	1.12
312.650	1.16	1.17	1.19	1.85	2.26	2.60	312.650	1.32	1.21	1.15
355.880	1.19	1.21	1.22	1.94	2.36	2.74	355.880	1.33	1.22	1.17
399.120	1.24	1.25	1.27	2.03	2.43	2.82	399.120	1.35	1.24	1.19
442.350	1.29	1.30	1.31	2.10	2.46	2.83	442.350	1.37	1.26	1.22
471.180	1.33	1.34	1.35	2.13	2.48	2.78	471.180	1.38	1.28	1.23
485.590	1.35	1.36	1.36	2.14	2.48	2.79	485.590	1.39	1.29	1.24
500.000	1.36	1.38	1.39	2.17	2.48	2.78	500.000	1.39	1.29	1.25

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	18	13	26	19	36	21	31	22	28
1	-	29	+0	44	12	45	16	39	24	32	27	33
2	> 97	74	62	72	59	74	58	71	59	70	55	66
3	> 97	73	74	> 76	71	> 75	69	> 75	65	> 76	64	> 75
4	96	74	75	> 76	> 76	> 76	> 76	74	> 76	> 76	> 75	> 76
5	96	> 76	> 76	> 75	> 76	> 75	> 76	74	> 76	> 76	> 76	> 76
6	> 97	75	75	> 75	> 76	74	74	> 76	75	75	> 76	> 76
7	> 97	> 75	> 75	> 75	> 76	> 75	> 76	> 76	> 77	> 76	> 76	> 76
8	> 96	> 75	> 75	75	> 76	> 76	> 76	> 75	> 76	> 77	> 75	> 77
9	> 95	> 75	> 75	> 75	> 76	> 76	> 75	74	75	74	> 77	> 76
10	> 96	74	> 74	> 76	> 75	> 76	> 75	> 76	> 76	> 76	74	> 75

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -14.94 DBM
LO IN: 155.01 MHZ; -3.99 DBM
IF OUT: 30.09 MHZ; -20.75 DBM

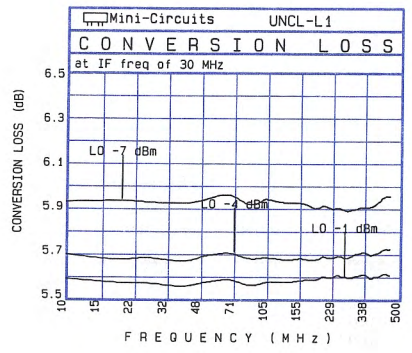
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	20	28	24	36	30	48	33	43	35	41
1	-	28	+0	44	12	43	17	39	23	33	27	34
2	83	63	55	65	51	65	49	71	51	69	49	64
3	94	56	53	61	60	64	59	68	50	72	53	56
4	> 96	> 86	80	77	80	81	78	75	74	71	71	73
5	> 98	76	74	80	66	74	64	71	60	71	59	70
6	> 97	84	81	84	84	> 87	85	> 87	> 86	84	84	83
7	> 96	83	81	85	80	> 86	79	> 86	80	> 86	81	> 86
8	> 96	> 86	> 86	> 85	> 86	> 86	> 86	> 87	> 86	> 86	85	> 86
9	> 95	> 86	> 85	> 85	84	84	> 86	85	> 87	> 86	84	> 86
10	95	> 85	> 86	85	> 85	> 85	> 85	> 86	> 86	> 85	85	> 86

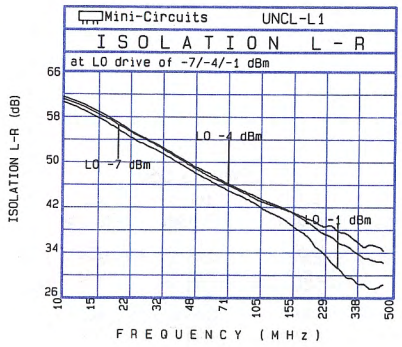
Harmonic LO Order

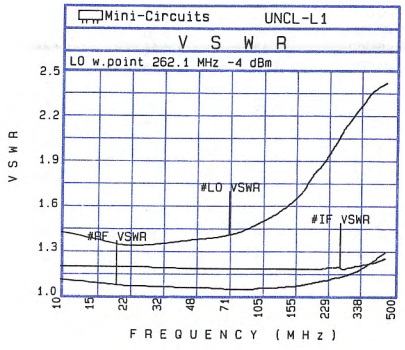
test condition: RF IN: 185.10 MHZ; -5.07 DBM
LO IN: 155.01 MHZ; -3.99 DBM
IF OUT: 30.09 MHZ; -10.78 DBM

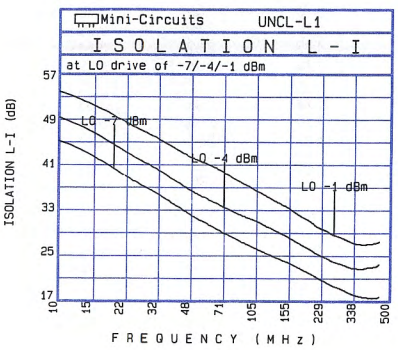
typical performance curves

(production unit)









In Stock...Immediate Delivery

active, load insensitive

Frequency Mixers

(+7dBm LO, up to +1dBm RF)

Model
UNCL-X1



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion gain and isolation

		Conversion Gain (dB)				Isolation L-R (dB)			Isolation L-I (dB)		
RF MHz	LO MHz	LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	LO +4 dBm	LO +7 dBm	LO +10 dBm	LO +4 dBm	LO +7 dBm	LO +10 dBm
1.000	31.000	0.09	0.39	0.54	1.000	81.05	78.82	78.70	68.45	69.42	70.10
2.000	32.000	0.75	1.03	1.16	2.000	76.35	75.82	74.88	67.75	67.62	67.68
5.000	35.000	1.16	1.47	1.57	5.000	69.55	69.01	68.48	65.65	63.91	62.88
10.000	40.000	1.28	1.56	1.64	10.000	63.85	63.44	63.11	61.15	59.14	57.66
20.000	50.000	1.25	1.55	1.63	20.000	58.72	58.30	58.09	56.72	54.05	52.43
49.290	79.290	1.22	1.50	1.59	49.290	50.72	50.42	50.03	48.78	46.06	44.54
50.000	80.000	1.22	1.51	1.58	50.000	50.59	50.30	49.93	48.68	45.99	44.44
97.580	67.581	1.24	1.53	1.60	97.580	44.67	44.42	44.20	43.12	41.15	39.83
100.000	70.000	1.26	1.54	1.60	100.000	44.54	44.31	44.10	43.09	41.11	39.78
145.870	115.871	1.34	1.59	1.63	145.870	41.67	41.37	41.05	41.24	39.17	37.66
194.160	164.161	1.43	1.64	1.67	194.160	39.25	38.80	38.51	39.33	37.41	35.66
200.000	170.000	1.43	1.63	1.67	200.000	38.88	38.58	38.28	38.93	37.17	35.55
242.450	212.452	1.47	1.66	1.69	242.450	37.45	37.16	36.89	36.51	35.54	34.34
250.000	220.000	1.45	1.65	1.68	250.000	37.23	36.95	36.80	36.20	35.36	34.30
290.740	260.742	1.46	1.66	1.68	290.740	36.01	35.68	35.33	34.02	33.50	32.53
339.030	309.032	1.42	1.62	1.66	339.030	35.08	34.78	34.64	31.46	31.73	31.54
387.320	357.323	1.39	1.59	1.63	387.320	34.17	33.69	33.22	29.16	29.47	29.02
435.610	405.613	1.31	1.52	1.57	435.610	33.53	33.06	32.74	27.79	28.42	28.41
483.900	453.903	1.18	1.42	1.48	483.900	32.95	32.50	32.12	26.45	27.25	27.54
500.000	470.000	1.16	1.39	1.47	500.000	33.03	32.58	32.23	26.11	27.02	27.40

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
5.000	1.20	1.21	1.23	2.21	2.96	3.93	5.000	1.21	1.19	1.18
10.000	1.11	1.12	1.14	2.09	2.86	3.84	10.000	1.19	1.16	1.15
20.000	1.06	1.06	1.09	1.97	2.77	3.74	20.000	1.18	1.16	1.14
50.000	1.03	1.05	1.09	1.83	2.61	3.58	50.000	1.19	1.16	1.15
57.500	1.03	1.05	1.09	1.86	2.65	3.62	57.500	1.19	1.16	1.15
95.000	1.03	1.05	1.09	1.82	2.59	3.54	95.000	1.18	1.16	1.15
100.000	1.03	1.05	1.09	1.76	2.50	3.40	100.000	1.18	1.16	1.15
140.000	1.02	1.05	1.09	1.76	2.49	3.40	140.000	1.18	1.16	1.15
185.000	1.01	1.06	1.11	1.77	2.52	3.44	185.000	1.18	1.16	1.15
200.000	1.01	1.07	1.11	1.74	2.46	3.32	200.000	1.18	1.16	1.15
230.000	1.03	1.08	1.13	1.74	2.46	3.33	230.000	1.18	1.16	1.15
245.000	1.05	1.10	1.14	1.79	2.54	3.43	245.000	1.17	1.16	1.15
250.000	1.09	1.12	1.15	1.83	2.58	3.47	250.000	1.17	1.15	1.14
275.000	1.07	1.11	1.16	1.82	2.54	3.40	275.000	1.18	1.16	1.16
320.000	1.09	1.15	1.19	1.85	2.56	3.42	320.000	1.17	1.16	1.16
365.000	1.13	1.19	1.24	1.92	2.65	3.52	365.000	1.16	1.16	1.16
410.000	1.18	1.24	1.28	1.95	2.66	3.52	410.000	1.15	1.15	1.15
455.000	1.23	1.29	1.34	2.01	2.72	3.56	455.000	1.14	1.15	1.15
485.000	1.27	1.33	1.38	2.10	2.82	3.66	485.000	1.14	1.15	1.15
500.000	1.30	1.36	1.41	2.11	2.82	3.67	500.000	1.13	1.15	1.16

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF \ LO	0	1	2	3	4	5	6	7	8	9	10
CAL	-	-	19	20	26	39	27	30	24	38	29	50
0	-	23	+0	39	12	41	18	41	24	42	30	50
1	96	47	60	59	59	68	65	72	67	68	63	70
2	95	75	64	79	69	82	67	> 82	62	77	61	76
3	> 97	> 83	> 83	> 83	82	82	> 83	> 82	> 83	> 83	> 84	> 82
4	> 97	> 83	82	> 83	> 83	> 83	> 83	82	> 82	> 83	> 83	> 83
5	> 96	81	> 82	82	> 83	> 83	> 83	> 83	> 82	81	> 83	82
6	> 96	> 82	82	> 82	> 82	> 83	> 83	82	79	82	> 83	> 83
7	> 95	> 82	> 83	82	> 83	> 83	82	82	82	81	82	> 81
8	94	> 82	> 82	> 83	81	82	> 82	> 83	> 83	> 83	> 83	> 83
9	> 97	> 82	> 81	> 82	> 81	> 83	> 83	> 82	> 84	> 83	> 83	82
10												

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -14.97 DBM
LO IN: 155.01 MHZ; -6.93 DBM
IF OUT: 30.09 MHZ; -13.81 DBM

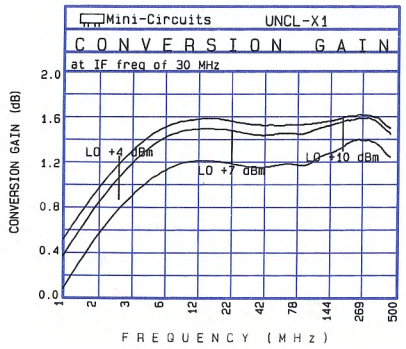
RF \ LO	0	1	2	3	4	5	6	7	8	9	10
CAL	-	-	35	31	36	43	38	40	36	47	43	56
0	-	20	+0	41	12	44	19	45	26	48	31	52
1	84	36	57	48	53	54	55	62	55	62	52	60
2	96	53	43	57	54	57	56	61	48	56	50	56
3	> 97	69	67	79	67	79	68	74	69	72	68	73
4	> 97	77	82	85	70	89	66	> 92	62	80	60	77
5	> 97	86	90	89	84	> 93	81	> 92	81	86	88	83
6	> 97	91	79	91	78	89	81	> 92	81	90	77	89
7	> 96	91	91	92	88	91	89	90	91	> 93	> 92	> 93
8	95	> 92	91	> 92	89	92	89	91	88	91	> 93	91
9	94	> 91	91	> 92	91	> 92	> 92	> 93	> 93	92	> 92	91
10												

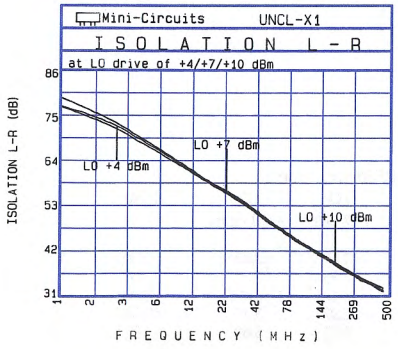
Harmonic LO Order

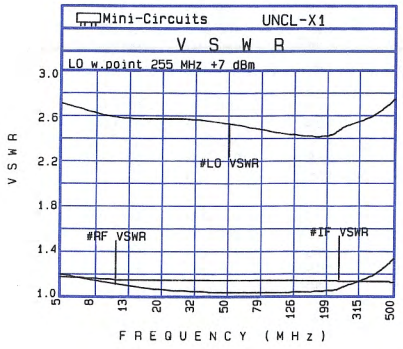
test condition: RF IN: 185.10 MHZ; -5.07 DBM
LO IN: 155.01 MHZ; +7.01 DBM
IF OUT: 30.09 MHZ; -3.94 DBM

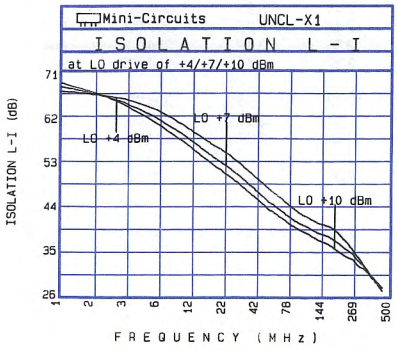
typical performance curves

(production unit)









In Stock...Immediate Delivery

surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
RMS-1W
LRMS-1W



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
2.000	32.000	6.44	6.15	6.06	2.000	76.36	77.45	78.57	61.46	62.05	62.37
4.000	34.000	6.24	5.93	5.84	4.000	76.01	77.30	78.72	61.31	61.60	61.92
5.000	35.000	6.20	5.89	5.82	5.000	75.18	76.89	78.20	61.28	61.49	61.60
10.000	40.000	6.24	5.90	5.79	10.000	71.36	74.36	77.17	60.46	60.26	59.90
20.000	50.000	6.17	5.87	5.77	20.000	66.06	69.48	73.30	57.66	56.77	56.07
50.000	80.000	6.26	5.90	5.81	50.000	58.75	62.05	65.98	51.88	50.51	49.44
100.000	70.000	6.19	5.85	5.77	100.000	51.91	55.01	58.44	46.87	45.08	44.04
101.730	71.733	6.21	5.87	5.79	101.730	51.82	55.00	58.41	46.80	44.99	43.91
200.000	170.000	6.12	5.82	5.76	200.000	44.72	46.91	49.09	41.98	40.52	39.41
201.470	171.467	6.12	5.83	5.77	201.470	44.65	46.83	48.96	41.78	40.31	39.24
301.200	271.200	6.22	5.81	5.76	301.200	40.17	42.24	43.95	37.77	36.71	35.57
351.070	321.067	6.18	5.79	5.74	351.070	38.48	40.24	41.71	35.63	34.89	33.94
375.000	345.000	6.19	5.79	5.73	375.000	38.02	39.86	41.46	34.69	34.22	33.37
400.930	370.933	6.11	5.74	5.69	400.930	37.46	39.23	40.69	34.11	33.67	32.76
500.000	470.000	6.24	5.85	5.75	500.000	35.94	37.51	38.57	30.47	30.15	29.95
500.670	470.667	6.24	5.84	5.76	500.670	35.90	37.49	38.55	30.49	30.16	29.93
600.400	570.400	6.24	5.98	5.92	600.400	34.35	36.08	37.07	28.72	29.20	28.65
700.130	670.133	6.66	6.31	6.15	700.130	32.13	33.78	34.96	25.77	27.21	28.17
725.070	695.067	6.78	6.49	6.24	725.070	31.86	33.46	34.58	25.18	26.43	27.38
750.000	720.000	6.88	6.55	6.29	750.000	31.63	33.11	34.29	24.61	25.85	27.10

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.14	1.16	1.20	1.68	2.41	3.33	5.000	1.39	1.24	1.14	2.000	242.34	0.03
10.000	1.06	1.10	1.15	1.64	2.36	3.28	10.000	1.40	1.25	1.15	4.000	242.36	0.03
20.000	1.01	1.08	1.14	1.70	2.47	3.42	20.000	1.40	1.25	1.15	5.000	241.55	0.03
50.000	1.03	1.09	1.14	1.64	2.39	3.32	50.000	1.40	1.25	1.15	10.000	244.73	0.03
74.840	1.06	1.10	1.15	1.66	2.40	3.30	74.840	1.41	1.26	1.17	20.000	241.66	0.02
100.000	1.08	1.11	1.16	1.65	2.40	3.29	100.000	1.43	1.28	1.18	50.000	233.71	-0.03
144.690	1.14	1.15	1.19	1.66	2.41	3.26	144.690	1.47	1.32	1.23	79.380	231.96	-0.10
200.000	1.20	1.21	1.24	1.70	2.41	3.29	200.000	1.52	1.38	1.29	100.000	239.28	-0.17
214.530	1.22	1.23	1.25	1.68	2.36	3.19	214.530	1.54	1.39	1.31	182.550	241.57	-0.67
284.370	1.31	1.31	1.33	1.74	2.37	3.19	284.370	1.64	1.49	1.40	200.000	243.93	-0.77
354.220	1.40	1.39	1.41	1.78	2.32	3.06	354.220	1.72	1.58	1.50	285.720	238.36	-1.65
375.000	1.43	1.42	1.43	1.81	2.34	3.08	375.000	1.76	1.61	1.54	337.310	253.06	-2.09
424.060	1.49	1.49	1.49	1.90	2.46	3.27	424.060	1.81	1.67	1.58	375.000	259.54	-2.94
493.910	1.60	1.58	1.59	1.98	2.54	3.27	493.910	1.92	1.77	1.68	388.900	257.48	-3.25
500.000	1.61	1.59	1.60	2.00	2.56	3.32	500.000	1.93	1.78	1.69	492.070	231.45	-5.24
563.750	1.73	1.70	1.69	2.09	2.57	3.28	563.750	2.01	1.87	1.78	500.000	227.96	-5.37
633.590	1.87	1.83	1.84	2.34	2.92	3.83	633.590	2.08	1.95	1.86	595.240	215.31	-6.99
703.440	2.04	2.01	2.01	2.57	3.30	4.26	703.440	2.14	2.03	1.96	698.410	211.97	-9.04
726.720	2.10	2.07	2.07	2.62	3.35	4.39	726.720	2.15	2.04	1.98	724.210	216.32	-10.11
750.000	2.17	2.13	2.14	2.69	3.43	4.51	750.000	2.17	2.07	2.00	750.000	208.56	-10.96

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF \ LO	0	1	2	3	4	5	6	7	8	9	10
0	-	-	3	13	9	23	18	30	28	35	28	54
1	-	20	+0	22	12	25	22	46	52	47	41	47
2	94	56	47	53	47	60	46	54	58	71	62	69
3	96	70	71	70	71	68	63	71	72	> 74	> 75	75
4	> 96	> 74	> 75	> 75	73	> 76	> 76	74	> 76	> 74	> 75	74
5	> 97	> 76	74	> 75	75	> 76	75	75	> 75	> 76	74	> 75
6	94	> 75	75	73	> 75	> 76	> 76	75	75	> 75	74	73
7	> 96	> 76	> 75	> 75	> 75	> 75	74	75	74	75	> 75	> 76
8	> 97	> 76	> 76	> 76	> 75	> 75	> 75	73	> 75	> 76	> 76	72
9	95	> 75	75	> 76	> 75	> 76	> 74	> 74	75	> 76	> 76	75
10	95	74	> 75	74	> 76	74	> 76	> 74	> 75	> 76	> 76	> 76

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -14.91 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -20.59 DBM

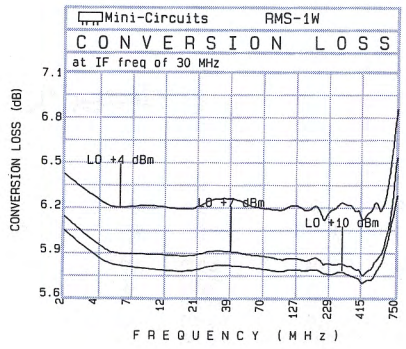
RF \ LO	0	1	2	3	4	5	6	7	8	9	10
0	-	-	13	23	20	34	29	41	41	47	41	63
1	-	20	+0	23	12	26	22	50	50	51	45	50
2	78	49	38	49	38	60	39	49	52	64	54	65
3	95	61	58	51	55	50	48	53	55	66	66	64
4	94	70	65	62	73	59	72	60	59	59	68	78
5	> 97	83	74	71	70	67	61	65	60	77	61	82
6	> 96	> 85	> 86	84	> 85	80	77	76	73	73	71	> 84
7	96	84	84	> 86	84	84	> 85	84	85	80	> 86	82
8	95	> 86	> 85	> 86	83	> 85	> 85	> 86	> 85	84	> 86	84
9	> 95	> 85	84	> 86	> 86	> 85	83	> 85	> 85	> 86	> 86	85
10	96	> 85	> 85	> 85	> 85	> 85	84	> 84	> 85	> 85	> 86	85

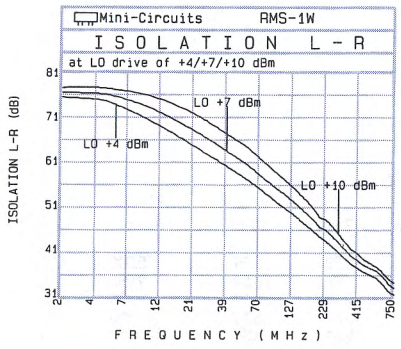
Harmonic LO Order

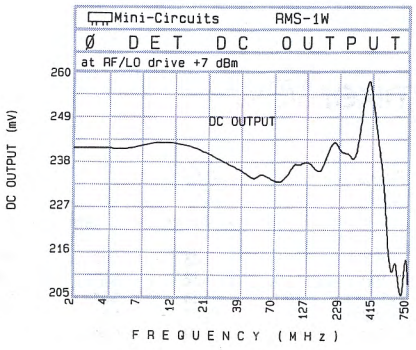
test condition: RF IN: 500.10 MHZ; -4.92 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -10.64 DBM

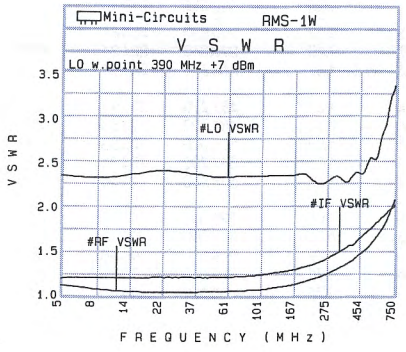
typical performance curves

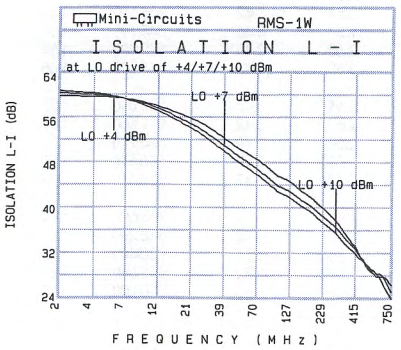
(production unit)

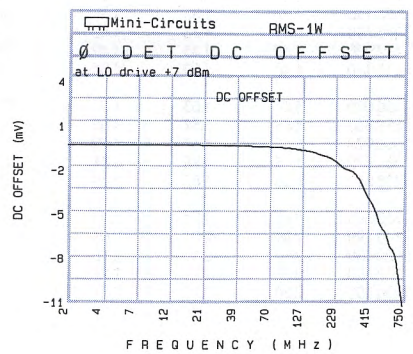












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
RMS-2D
LRMS-2D



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

R MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
5.000	35.000	7.57	7.12	6.85	5.000	75.52	75.17	72.21	66.42	69.37	72.91
10.000	40.000	7.41	7.00	6.73	10.000	68.33	69.29	68.74	66.13	68.39	69.44
20.000	50.000	7.47	7.00	6.76	20.000	62.08	62.94	63.81	64.48	64.44	64.11
50.000	80.000	7.49	7.04	6.77	50.000	54.62	55.85	56.74	59.32	57.67	56.43
95.450	65.454	7.47	7.03	6.77	95.450	49.13	50.26	51.30	54.08	52.12	50.87
100.000	70.000	7.43	7.00	6.77	100.000	48.68	49.77	50.89	53.59	51.68	50.50
185.910	155.909	7.38	6.96	6.74	185.910	43.74	44.92	45.78	49.15	47.38	46.16
200.000	170.000	7.36	6.95	6.73	200.000	43.19	44.30	45.16	48.60	46.93	45.62
276.360	246.364	7.30	6.93	6.71	276.360	40.71	41.76	42.47	46.12	44.24	43.04
366.820	336.818	7.28	6.92	6.71	366.820	38.50	39.46	40.12	42.80	41.10	40.13
457.270	427.273	7.22	6.84	6.63	457.270	37.24	38.05	38.54	39.29	38.81	38.35
487.420	457.424	7.23	6.90	6.65	487.420	36.81	37.64	38.08	38.11	37.61	37.22
500.000	470.000	7.21	6.87	6.65	500.000	36.76	37.67	38.17	37.99	37.54	37.12
547.730	517.727	7.23	6.89	6.67	547.730	36.32	37.15	37.61	37.19	36.85	36.06
638.180	608.182	7.28	6.96	6.75	638.180	35.02	35.79	36.05	34.64	35.08	35.39
728.640	698.636	7.45	7.11	6.91	728.640	33.75	34.44	35.04	33.29	33.63	33.23
819.090	789.091	7.90	7.48	7.20	819.090	33.28	33.73	34.29	31.03	32.36	33.06
909.550	879.546	8.32	7.84	7.54	909.550	33.67	34.09	34.40	29.33	30.24	31.10
969.850	939.849	8.79	8.11	7.79	969.850	33.27	33.57	33.58	27.75	28.96	29.97
1000.000	970.000	8.94	8.28	7.93	1000.000	33.51	34.04	34.27	27.65	28.80	30.03

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.38	1.43	1.48	2.09	2.92	3.99	5.000	1.29	1.14	1.04	5.000	223.48	-0.04
9.980	1.25	1.32	1.37	1.95	2.76	3.81	9.980	1.30	1.14	1.04	10.000	220.86	-0.05
49.770	1.20	1.28	1.34	1.94	2.74	3.77	49.770	1.30	1.15	1.05	20.000	221.95	-0.08
99.520	1.20	1.28	1.33	1.90	2.69	3.70	99.520	1.32	1.18	1.09	50.000	229.96	-0.07
199.020	1.22	1.29	1.34	1.87	2.57	3.51	199.020	1.37	1.23	1.16	95.450	226.75	-0.17
248.770	1.27	1.31	1.37	1.86	2.52	3.43	248.770	1.43	1.27	1.20	100.000	225.04	-0.22
266.190	1.27	1.33	1.38	1.87	2.53	3.42	266.190	1.43	1.31	1.23	185.910	231.28	-0.50
345.790	1.33	1.38	1.42	1.93	2.57	3.46	345.790	1.52	1.38	1.32	200.000	233.82	-0.55
422.900	1.40	1.46	1.49	1.99	2.60	3.48	422.900	1.59	1.47	1.40	276.360	221.21	-0.88
475.140	1.46	1.50	1.54	2.02	2.60	3.45	475.140	1.65	1.53	1.47	366.820	245.81	-1.18
500.010	1.49	1.53	1.57	2.06	2.61	3.45	500.010	1.57	1.44	1.36	457.270	235.91	-1.44
529.860	1.53	1.57	1.60	2.07	2.60	3.42	529.860	1.69	1.56	1.48	487.420	228.58	-1.74
606.970	1.63	1.67	1.70	2.17	2.69	3.49	606.970	1.76	1.63	1.55	500.000	225.33	-1.93
686.570	1.75	1.78	1.81	2.23	2.67	3.42	686.570	1.80	1.68	1.62	547.730	204.71	-1.87
738.810	1.83	1.87	1.89	2.26	2.67	3.37	738.810	1.84	1.72	1.65	638.180	211.10	-2.28
763.690	1.87	1.91	1.93	2.26	2.65	3.34	763.690	1.84	1.75	1.68	728.640	216.27	-2.95
843.290	2.01	2.03	2.06	2.41	2.77	3.45	843.290	1.87	1.75	1.70	819.090	208.57	-3.50
920.400	2.13	2.16	2.18	2.52	2.86	3.50	920.400	1.86	1.76	1.69	909.550	196.48	-4.04
972.640	2.23	2.26	2.27	2.57	2.89	3.52	972.640	1.86	1.76	1.71	969.850	173.79	-4.08
1000.000	2.28	2.30	2.31	2.57	2.88	3.50	1000.000	1.85	1.76	1.71	1000.000	181.46	-3.70

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	29	12	26	16	63	49	66	51	66
1	-	19	+0	27	12	33	22	58	69	72	68	> 72
2	95	62	55	59	54	62	53	61	57	> 73	> 73	> 73
3	95	> 74	72	> 74	70	> 74	62	> 73	64	72	71	> 73
4	> 96	> 73	> 73	> 74	> 75	> 74	> 75	> 74	73	72	70	> 72
5	> 94	> 73	> 73	72	> 74	> 74	> 73	73	73	73	> 73	> 73
6	> 94	> 72	> 72	> 73	> 73	> 75	> 74	> 73	73	> 74	73	> 73
7	> 95	> 73	> 73	> 72	> 73	> 73	73	> 73	> 74	> 74	> 74	> 74
8	> 95	> 73	72	> 73	> 72	> 74	72	> 73	> 75	> 73	> 74	> 74
9	92	> 73	> 73	73	72	72	72	> 74	> 74	> 74	73	> 74
10	> 96	> 74	70	> 73	73	> 73	70	72	> 73	> 74	> 74	> 74

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -15.06 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -22.03 DBM

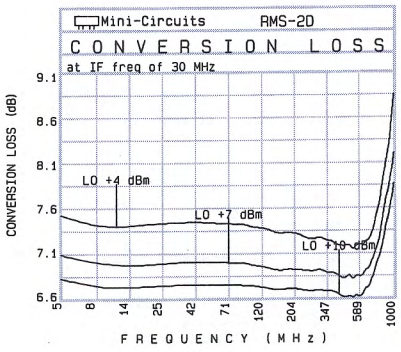
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	20	41	23	40	27	74	62	77	67	76
1	-	19	+0	27	13	33	22	55	72	75	75	> 84
2	81	55	46	53	46	56	45	54	51	> 83	76	> 84
3	93	60	56	57	61	60	50	60	55	67	81	82
4	93	73	71	73	76	70	70	72	70	70	70	79
5	94	> 83	75	78	69	78	62	71	61	76	60	75
6	93	> 83	> 83	> 83	83	> 84	81	> 84	80	> 85	80	> 84
7	> 96	> 84	> 83	81	> 83	> 84	83	83	83	> 84	> 84	83
8	> 96	> 84	> 84	> 83	> 82	> 83	> 84	81	> 84	> 85	81	> 85
9	94	> 83	> 85	> 84	> 83	> 84	> 84	83	> 84	> 85	> 85	83
10	> 96	> 84	> 84	82	> 84	> 83	> 83	> 83	82	> 83	> 84	> 85

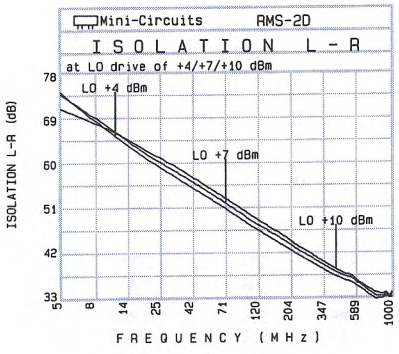
Harmonic LO Order

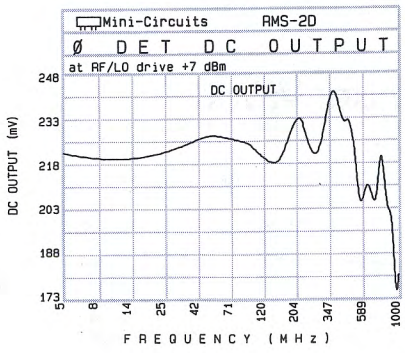
test condition: RF IN: 500.10 MHZ; -4.95 DBM
LO IN: 470.01 MHZ; +7.00 DBM
IF OUT: 30.09 MHZ; -11.70 DBM

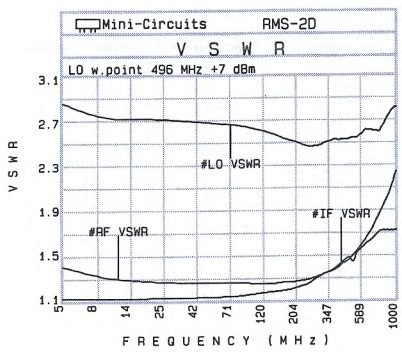
typical performance curves

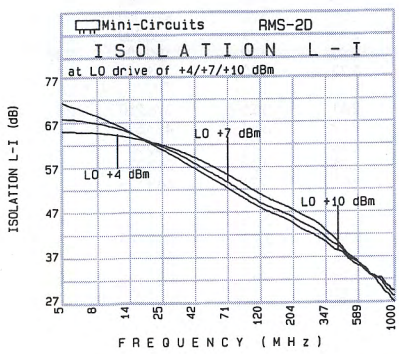
(production unit)

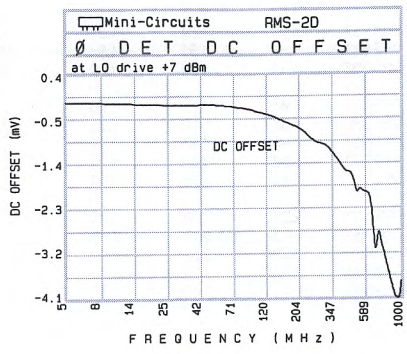












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
RMS-860
LRMS-860



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
800.000	830.000	6.06	5.73	5.48	800.000	32.50	34.10	35.20	24.10	26.50	28.20
820.833	850.833	6.08	5.76	5.54	820.833	32.90	34.40	35.60	23.50	25.70	27.70
831.250	861.250	6.03	5.74	5.53	831.250	33.50	35.00	36.10	23.50	25.60	27.30
841.667	871.667	6.10	5.79	5.57	841.667	33.70	35.20	36.40	23.30	25.30	27.10
862.500	892.500	6.17	5.84	5.62	862.500	34.50	36.10	37.30	22.80	24.80	26.40
872.917	902.917	6.25	5.89	5.66	872.917	34.70	36.50	37.60	22.50	24.60	26.10
883.333	913.333	6.24	5.87	5.64	883.333	35.40	37.00	38.20	22.50	24.20	25.80
904.167	934.167	6.31	5.92	5.68	904.167	36.10	38.00	39.30	22.00	23.80	25.40
914.583	944.583	6.33	5.92	5.70	914.583	36.90	38.70	40.00	21.90	23.60	25.10
925.000	955.000	6.32	5.92	5.70	925.000	37.20	39.10	40.30	21.80	23.40	24.90
945.833	975.833	6.39	5.96	5.73	945.833	38.30	40.20	41.20	21.30	22.90	24.40
956.250	986.250	6.34	5.95	5.73	956.250	38.90	40.90	41.50	21.30	22.90	24.20
966.667	996.667	6.44	6.03	5.77	966.667	39.30	41.40	41.90	21.00	22.60	23.90
987.500	1017.500	6.48	6.05	5.79	987.500	40.00	41.90	41.90	20.70	22.20	23.50
997.917	1027.917	6.57	6.10	5.86	997.917	40.50	41.90	41.70	20.40	22.00	23.20
1008.333	1038.333	6.67	6.20	5.92	1008.333	40.60	41.70	41.30	20.50	21.80	23.10
1018.750	1048.750	6.72	6.26	5.90	1018.750	40.60	41.50	41.00	20.50	21.60	23.00
1029.167	999.167	7.01	6.73	6.20	1029.167	40.50	40.80	40.30	20.40	21.60	22.80
1039.583	1009.583	7.27	6.65	6.25	1039.583	40.10	40.10	39.70	20.30	21.60	22.60
1050.000	1020.000	7.22	6.68	6.26	1050.000	39.50	39.20	38.90	20.20	21.20	22.40

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
800.000	1.29	1.21	1.16	2.03	2.49	3.11	2.000	1.96	1.67	1.50
820.833	1.34	1.26	1.22	2.16	2.68	3.38	5.000	1.99	1.70	1.52
831.250	1.37	1.29	1.25	2.23	2.84	3.79	10.000	1.99	1.70	1.51
841.667	1.40	1.32	1.28	2.25	2.88	3.79	20.000	1.99	1.70	1.52
862.500	1.46	1.39	1.35	2.18	2.65	3.32	60.000	2.01	1.73	1.54
872.917	1.50	1.42	1.39	2.12	2.58	3.26	80.000	2.04	1.75	1.56
883.333	1.54	1.46	1.43	2.14	2.58	3.32	100.000	2.04	1.75	1.57
904.167	1.63	1.54	1.51	2.32	2.88	3.79	126.750	2.06	1.77	1.60
914.583	1.67	1.59	1.54	2.35	2.92	3.79	189.125	2.10	1.82	1.66
925.000	1.73	1.64	1.59	2.27	2.72	3.50	251.500	2.16	1.89	1.75
945.833	1.84	1.75	1.70	2.18	2.61	3.26	376.250	2.32	2.06	1.94
956.250	1.88	1.80	1.75	2.25	2.72	3.44	438.625	2.40	2.18	2.06
966.667	1.96	1.87	1.81	2.35	2.84	3.71	500.000	2.43	2.23	2.16
987.500	2.08	1.99	1.94	2.30	2.76	3.38	563.375	2.52	2.32	2.25
997.917	2.14	2.06	1.99	2.20	2.58	3.21	688.125	2.52	2.43	2.46
1008.333	2.20	2.10	2.04	2.20	2.55	3.16	750.500	2.43	2.43	2.55
1018.750	2.27	2.16	2.12	2.27	2.65	3.44	812.875	2.37	2.46	2.65
1029.167	2.32	2.23	2.16	2.35	2.76	3.44	875.250	2.18	2.32	2.58
1039.583	2.37	2.27	2.23	2.37	2.76	3.50	937.625	1.89	2.04	2.32
1050.000	2.43	2.35	2.27	2.32	2.65	3.32	1000.000	1.59	1.71	1.96

ϕ detection

FREQ. (MHz)	max DC output mV	DC offset mV
800.000	216.14	-4.10
820.833	227.22	-4.64
831.250	226.54	-4.74
841.667	228.67	-5.09
862.500	205.20	-5.77
872.917	200.47	-6.31
883.333	194.57	-6.46
904.167	200.57	-6.95
914.583	194.65	-7.04
925.000	191.69	-7.15
945.833	200.39	-7.69
956.250	201.50	-7.76
966.667	201.64	-7.98
987.500	197.48	-8.25
997.917	196.21	-7.95
1008.333	193.32	-7.42
1018.750	189.70	-6.77
1029.167	185.75	-6.17
1039.583	186.77	-5.92
1050.000	186.62	-5.36

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	30	14	29	29	48	55	63	48	59
1	-	6	+0	21	14	39	50	33	52	63	61	67
2	87	42	54	45	37	45	42	51	58	59	67	74
3	93	43	38	45	43	52	42	53	53	47	58	68
4	> 97	53	63	57	52	53	49	57	68	64	69	75
5	93	58	62	62	61	62	52	60	56	65	68	71
6	89	79	74	68	75	66	64	76	62	84	78	72
7	> 91	79	> 80	79	71	79	68	72	73	76	71	84
8	> 91	> 80	80	> 80	84	77	81	79	77	74	69	74
9	87	> 80	> 81	> 80	> 80	84	84	84	84	83	77	> 85
10	> 90	79	> 80	> 80	> 80	> 80	85	84	> 86	81	82	81

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; -4.02 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -10.11 DBM

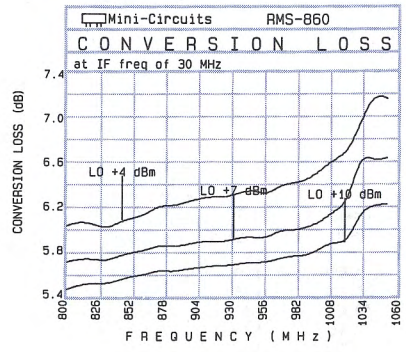
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	17	4	19	17	36	33	50	36	45
1	-	6	+0	19	13	35	47	27	47	54	51	54
2	> 96	51	50	51	47	51	51	61	64	72	> 70	> 69
3	96	63	59	70	57	65	61	71	68	71	71	> 70
4	> 97	> 75	> 76	> 76	> 77	> 76	> 77	> 75	> 76	> 76	> 76	73
5	> 96	> 76	75	> 76	> 75	> 77	> 76	> 76	> 76	> 75	> 76	> 76
6	> 91	> 70	74	> 75	> 76	> 75	> 76	> 76	> 76	> 77	> 74	76
7	> 90	> 70	> 70	72	> 76	76	75	> 76	> 76	> 76	> 75	> 76
8	90	> 71	> 70	66	> 75	> 77	> 76	> 76	75	75	> 76	> 75
9	89	> 70	70	67	> 69	> 75	> 76	> 76	> 76	75	> 76	> 77
10	90	> 70	> 70	> 71	> 69	69	> 76	> 77	> 76	74	> 76	76

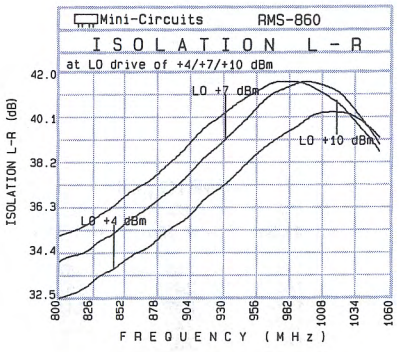
Harmonic LO Order

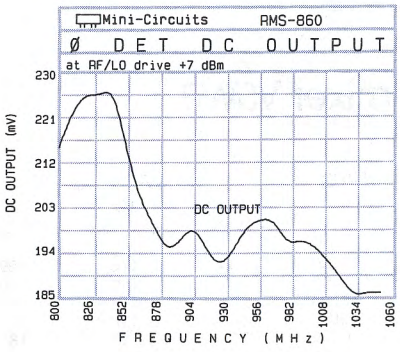
test condition: RF IN: 1000.10 MHZ; -14.01 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -20.14 DBM

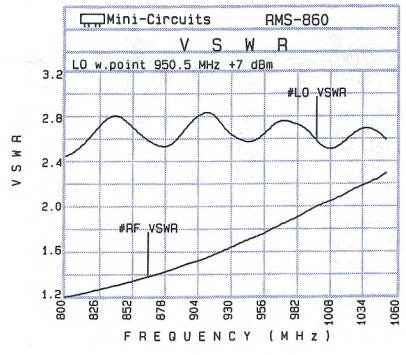
typical performance curves

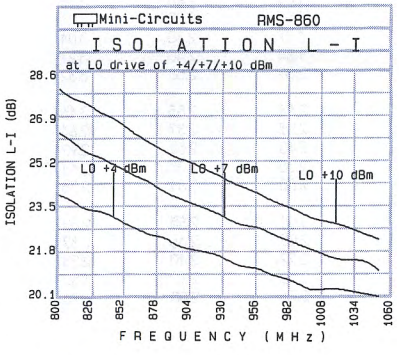
(production unit)

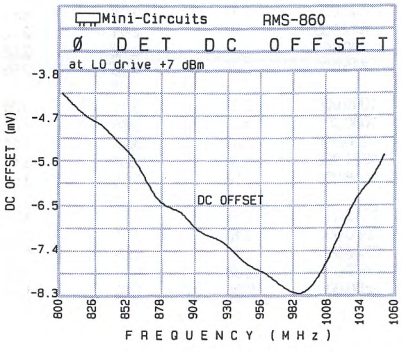












In Stock...Immediate Delivery

surface-mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Model
SYM-11



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
1.000	31.000	6.70	6.40	6.20	1.000	67.00	68.00	68.00	58.00	60.00	61.00
5.000	35.000	6.50	6.30	6.10	5.000	66.00	67.00	67.00	57.00	60.00	60.60
10.000	40.000	6.40	6.10	6.00	10.000	65.75	66.89	66.90	56.92	59.19	60.30
20.000	50.000	6.20	5.90	5.90	20.000	65.61	66.40	66.66	56.82	58.44	59.50
50.000	80.000	6.02	5.73	5.59	80.000	60.80	63.88	66.38	54.98	53.42	52.13
100.000	130.000	5.94	5.68	5.56	100.000	59.43	62.97	66.12	54.31	52.21	50.48
194.118	224.118	6.21	5.91	5.74	286.667	49.91	53.44	57.54	43.92	41.55	40.01
482.353	512.353	7.50	6.54	6.33	425.000	45.37	48.24	51.36	38.09	36.56	35.64
500.000	530.000	7.48	6.50	6.35	500.000	43.47	46.35	49.02	35.64	34.52	33.75
914.706	944.706	8.47	7.93	7.59	701.667	40.32	42.55	44.65	31.02	30.52	29.97
1000.000	1030.000	8.44	7.97	7.71	1000.000	37.06	38.96	40.67	28.07	27.74	27.12
1058.824	1088.824	8.41	7.96	7.72	1116.667	35.64	37.68	40.00	27.86	27.44	26.76
1250.000	1280.000	8.56	8.08	7.86	1250.000	36.06	37.80	39.60	26.75	26.59	26.12
1347.059	1377.059	8.65	8.20	7.99	1393.333	35.52	37.25	38.74	25.51	25.51	25.00
1635.294	1665.294	9.24	8.62	8.41	1531.667	34.65	36.02	37.50	24.18	23.96	23.53
2000.000	2030.000	9.76	8.57	8.19	1946.667	34.38	37.44	41.23	41.64	39.22	37.35
2067.647	2097.647	9.73	8.47	8.07	2000.000	35.23	38.87	43.39	44.50	50.34	42.14
2355.882	2385.882	9.81	8.58	8.12	2361.667	36.61	39.98	38.90	36.75	32.54	28.91
2470.000	2500.000	9.91	8.79	8.37	2470.000	34.60	36.58	35.10	33.72	29.89	26.88
2500.000	2470.000	10.16	8.92	8.49	2500.000	34.10	35.35	34.66	32.60	28.76	26.53

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
1.000	1.80	1.68	1.59	1.77	2.55	3.57	1.000	1.29	1.32	1.39
5.000	2.10	1.94	1.80	1.66	2.49	3.57	5.000	1.18	1.09	1.17
10.000	2.14	1.96	1.82	1.67	2.49	3.44	10.000	1.16	1.04	1.14
20.000	2.10	1.94	1.81	1.69	2.46	3.50	20.000	1.15	1.01	1.13
60.000	2.08	1.92	1.80	1.63	2.37	3.38	60.000	1.13	1.02	1.15
100.000	2.12	1.96	1.82	1.61	2.40	3.38	100.000	1.11	1.04	1.16
148.000	2.16	2.01	1.87	1.65	2.32	3.21	148.000	1.10	1.05	1.18
442.000	2.84	2.61	2.46	1.77	2.35	3.01	442.000	1.13	1.30	1.44
500.000	2.96	2.72	2.55	1.84	2.46	3.21	500.000	1.22	1.38	1.54
736.000	3.26	3.06	2.92	2.08	2.58	3.32	736.000	1.73	1.94	2.12
1000.000	3.32	3.11	3.01	2.14	2.55	3.16	1000.000	2.65	2.84	3.06
1030.000	3.38	3.16	3.06	2.08	2.37	2.84	1030.000	2.76	3.01	3.16
1250.000	3.38	3.26	3.21	2.43	2.52	2.92	1250.000	3.57	3.71	3.79
1324.000	3.38	3.26	3.16	2.35	2.35	2.61	1324.000	3.79	3.86	3.95
1618.000	3.26	3.16	3.11	2.80	2.61	2.76	1618.000	3.79	3.79	3.71
1912.000	3.16	3.11	3.01	3.01	2.55	2.52	1912.000	7.60	7.60	7.60
2000.000	3.16	3.06	2.96	2.92	2.46	2.37	2000.000	7.00	7.00	6.73
2206.000	2.68	2.65	2.55	2.92	2.40	2.23	2206.000	4.32	4.32	4.22
2470.000	2.08	2.04	1.99	2.76	2.12	1.82	2470.000	3.21	3.21	3.16
2500.000	2.04	1.99	1.96	2.76	2.08	1.76	2500.000	3.21	3.16	3.16

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

Mixer Harmonic Intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	0	34	14	32	20	43	46	47	52	47
1	-	20	0	33	43	37	32	39	57	46	47	60
2	93	69	46	57	44	> 75	53	70	50	57	65	65
3	96	69	> 76	71	61	71	75	69	67	71	72	> 69
4	> 98	> 76	75	> 75	74	> 76	71	> 76	75	> 76	75	> 76
5	> 97	> 76	> 76	75	74	> 76	> 76	> 76	> 76	> 76	> 75	> 75
6	> 91	> 70	> 76	> 75	> 77	> 75	> 76	75	> 76	> 76	75	75
7	> 91	> 71	> 70	74	72	> 76	73	> 77	> 76	75	> 76	> 75
8	> 92	> 71	67	> 70	> 75	> 76	75	74	> 76	> 76	> 77	> 76
9	> 91	> 70	> 71	> 71	> 70	> 75	> 76	73	> 76	73	> 76	> 76
10	> 92	67	> 71	> 70	> 70	69	75	75	> 76	75	74	> 76

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; -14.01 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -21.18 DBM

RF ORDER HARMONIC

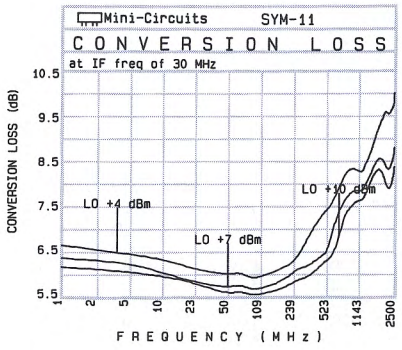
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	45	23	42	33	54	70	74	67	66
1	-	21	+0	34	43	41	33	44	67	54	60	74
2	86	66	39	52	37	75	50	64	46	57	73	67
3	92	53	62	61	41	58	62	56	55	58	69	64
4	96	> 86	62	80	55	64	51	82	63	77	57	63
5	> 98	80	75	76	81	77	58	67	72	70	68	70
6	> 92	> 80	80	> 86	76	> 85	68	76	63	84	72	82
7	> 91	> 80	79	> 85	85	85	> 85	84	73	77	81	81
8	> 91	78	> 79	79	> 85	> 87	85	84	81	84	74	84
9	> 91	> 80	> 80	> 80	> 80	> 85	> 86	> 86	> 86	84	> 85	> 85
10	90	> 80	> 79	> 80	76	> 80	> 85	> 86	> 86	> 85	> 86	> 84

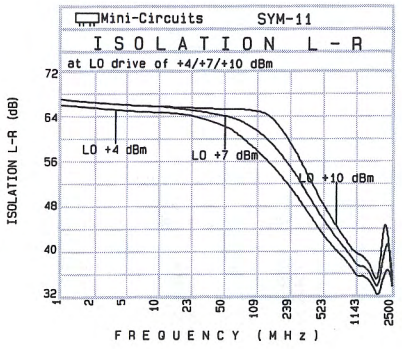
Harmonic LO Order

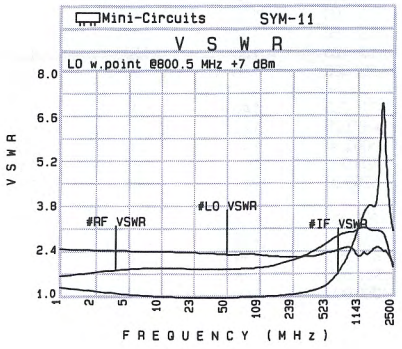
test condition: RF IN: 1000.10 MHZ; -3.91 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -11.46 DBM

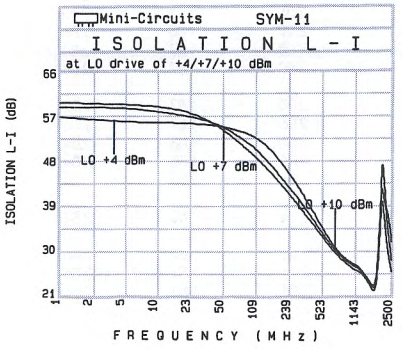
typical performance curves

(production unit)









In Stock...Immediate Delivery

surface-mount, plug-in

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models
TUF-11A
TUF-11ASM



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
1400.000	1500.000	7.65	6.77	6.75	1400.000	32.60	33.50	33.60	25.00	23.80	22.80
1441.667	1541.667	7.59	6.76	6.59	1441.667	31.70	32.60	33.00	25.30	24.20	23.10
1462.500	1562.500	7.65	6.77	6.73	1462.500	31.30	32.20	32.80	25.50	24.30	23.20
1483.333	1583.333	7.70	6.82	6.78	1483.333	30.80	31.90	32.60	25.70	24.50	23.30
1525.000	1625.000	7.82	7.48	6.66	1504.167	30.50	31.60	32.50	25.90	24.70	23.60
1545.833	1645.833	7.85	7.07	6.80	1525.000	30.30	31.40	32.50	26.20	24.90	23.80
1566.667	1666.667	7.83	6.94	6.75	1545.833	30.10	31.20	32.50	26.50	25.20	23.90
1608.333	1708.333	7.88	6.92	6.75	1587.500	29.70	30.80	32.50	27.30	25.80	24.40
1629.167	1729.167	7.91	7.02	6.73	1608.333	29.40	30.50	32.40	27.70	26.20	24.70
1650.000	1750.000	7.99	7.03	6.71	1629.167	29.10	30.40	32.30	28.20	26.70	25.10
1691.667	1791.667	7.84	6.84	6.71	1670.833	28.80	30.20	32.30	29.40	27.50	25.90
1712.500	1812.500	7.73	6.84	6.71	1691.667	28.80	30.20	32.40	29.90	27.80	26.20
1733.333	1833.333	7.76	6.96	6.68	1712.500	28.80	30.10	32.50	30.50	28.40	26.60
1775.000	1875.000	7.74	6.92	6.64	1754.167	29.10	30.50	33.00	31.90	29.40	27.20
1795.833	1895.833	7.75	6.95	6.65	1775.000	29.30	30.40	33.00	32.80	29.80	27.50
1800.000	1900.000	7.83	6.95	6.66	1795.833	29.00	30.20	32.90	33.70	30.50	28.00
1837.500	1737.500	7.76	6.79	6.70	1837.500	28.70	30.00	32.50	35.70	32.10	29.00
1858.333	1758.333	7.84	6.88	6.80	1858.333	28.80	29.80	32.30	36.60	32.80	29.50
1879.167	1779.167	8.05	7.66	6.86	1879.167	28.50	29.60	32.20	37.60	33.50	29.90
1900.000	1800.000	8.04	7.49	6.78	1900.000	28.50	29.40	31.90	38.10	34.70	30.60

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm
1400.000	1.45	1.50	1.56	2.18	1.96	2.14	2.000	8.31	9.18	10.20
1441.667	1.32	1.38	1.45	2.16	1.94	2.12	5.000	4.32	4.32	4.22
1462.500	1.26	1.32	1.40	2.18	1.92	2.10	10.000	2.10	2.01	1.94
1483.333	1.21	1.27	1.36	2.12	1.92	2.12	20.000	1.59	1.49	1.44
1525.000	1.09	1.19	1.29	2.12	1.92	2.10	60.000	1.36	1.21	1.13
1545.833	1.05	1.17	1.28	2.12	1.91	2.10	80.000	1.35	1.20	1.09
1566.667	1.01	1.16	1.27	2.08	1.91	2.10	100.000	1.34	1.19	1.08
1608.333	1.10	1.18	1.28	2.10	1.88	2.06	126.750	1.34	1.18	1.07
1629.167	1.16	1.22	1.31	2.08	1.87	2.04	189.125	1.35	1.20	1.11
1650.000	1.22	1.27	1.35	2.10	1.87	2.03	251.500	1.36	1.23	1.16
1691.667	1.48	1.54	1.61	2.08	1.87	2.03	376.250	1.40	1.31	1.28
1712.500	1.24	1.31	1.40	2.06	1.87	2.06	438.625	1.43	1.37	1.36
1733.333	1.33	1.35	1.41	2.06	1.88	2.04	500.000	1.47	1.43	1.44
1775.000	1.44	1.43	1.48	2.06	1.85	2.04	501.000	1.47	1.43	1.44
1795.833	1.48	1.46	1.51	2.06	1.85	2.03	625.750	1.57	1.61	1.66
1816.667	1.51	1.49	1.51	2.04	1.85	2.04	750.500	1.74	1.89	2.01
1837.500	1.56	1.53	1.54	2.03	1.84	2.06	812.875	1.87	2.08	2.23
1858.333	1.62	1.58	1.59	2.03	1.84	2.06	875.250	1.99	2.30	2.49
1879.167	1.71	1.66	1.66	2.01	1.82	2.06	937.625	2.16	2.52	2.76
1900.000	1.80	1.73	1.73	2.01	1.84	2.04	1000.000	2.30	2.72	3.06

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative desired to IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	12	28	25	56	33	56	49	57	46	75
1	-	17	+0	41	15	46	42	45	49	60	48	61
2	>97	47	46	46	56	49	53	59	49	58	60	62
3	>97	48	52	57	47	75	46	59	64	55	67	72
4	90	78	79	82	65	65	78	71	72	76	68	71
5	>92	>81	>81	78	70	70	57	>87	65	81	77	74
6	>91	>82	80	>80	82	>86	81	79	>87	80	84	>81
7	>91	>81	80	>81	>88	>87	86	85	80	>86	84	>87
8	>92	>82	>81	>82	>82	>87	>86	83	85	>87	85	>87
9	>87	>76	>82	>81	>80	>82	>87	86	>87	>87	>86	85
10	>88	>77	73	>82	80	>81	>81	>88	>87	>87	>86	>87

Harmonic LO Order

test condition: RF IN: 1500.10 MHZ; -3.98 DBM
LO IN: 1600.01 MHZ; +6.95 DBM
IF OUT: 99.91 MHZ; -10.21 DBM

RF ORDER HARMONIC

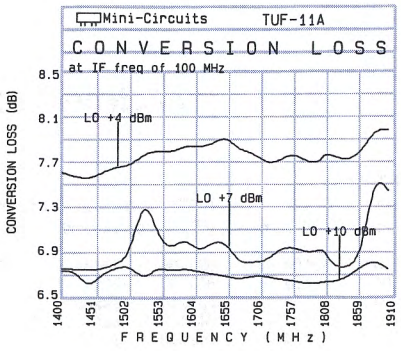
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	1	17	13	43	21	37	33	44	34	59
1	-	17	0	40	14	40	40	41	49	57	43	55
2	94	57	57	57	69	58	62	64	56	61	63	62
3	>98	68	70	>77	69	73	66	>76	69	67	>71	70
4	>92	>71	>77	>76	75	>76	>77	>78	76	>71	69	>71
5	>91	70	>71	76	>76	>76	>78	>76	>76	>77	>71	>71
6	>91	>71	71	69	>76	>76	>76	>77	>76	>77	>78	>72
7	>91	>71	>71	69	>77	76	>77	>76	75	>76	>77	>77
8	>92	>71	>71	>71	>71	>77	>77	74	>77	>77	75	>77
9	>86	>66	68	66	>71	>72	74	>77	>76	>77	74	>75
10	>87	>67	>65	68	>71	>71	>72	76	>77	76	>77	>77

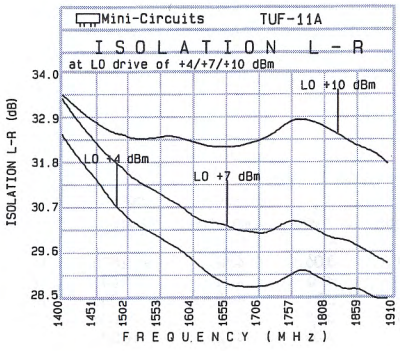
Harmonic LO Order

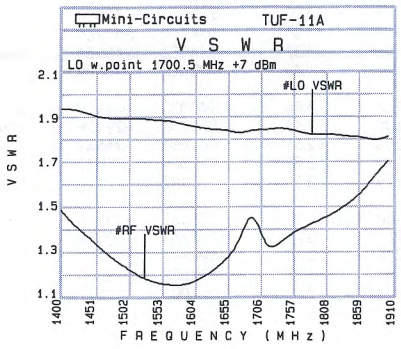
test condition: RF IN: 1500.10 MHZ; -14.01 DBM
LO IN: 1600.01 MHZ; +6.95 DBM
IF OUT: 99.91 MHZ; -20.33 DBM

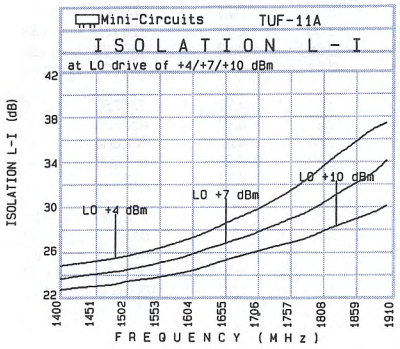
typical performance curves

(production unit)









plug-in, surface mount

Frequency Mixers

LEVEL 7 (+7dBm LO, up to +1dBm RF)

Models

SYM-860
TUF-860
TUF-860SM



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm	Isolation L-I (dB) LO +4 dBm	LO +7 dBm	LO +10 dBm
800.000	830.000	5.54	5.36	5.27	800.000	38.60	41.60	43.70	38.70	41.20	43.40
820.833	850.833	5.62	5.44	5.29	820.833	37.70	40.80	43.10	38.00	40.50	42.80
831.250	861.250	5.71	5.51	5.36	830.000	37.70	40.80	43.00	38.00	40.30	42.70
841.667	871.667	5.72	5.53	5.37	831.250	37.60	40.80	43.00	38.00	40.20	42.50
862.500	892.500	5.71	5.55	5.43	852.083	36.90	40.00	42.40	37.30	39.40	41.40
872.917	902.917	5.69	5.52	5.42	862.500	37.00	40.20	42.50	37.30	39.20	40.90
883.333	913.333	5.66	5.52	5.44	872.917	36.80	39.80	42.40	37.10	38.70	40.30
904.167	934.167	5.62	5.46	5.40	893.750	36.50	39.80	42.40	36.70	38.20	39.20
914.583	944.583	5.65	5.46	5.40	904.167	36.10	39.60	42.20	36.40	37.80	38.60
925.000	955.000	5.71	5.49	5.41	914.583	35.80	39.20	41.80	36.30	37.50	38.10
945.833	975.833	5.85	5.55	5.42	935.417	35.20	38.40	41.20	35.90	36.90	37.40
956.250	986.250	5.89	5.56	5.44	945.833	35.00	38.00	41.00	35.70	36.60	37.30
966.667	996.667	5.98	5.62	5.48	956.250	34.70	37.80	40.60	35.70	36.60	37.00
987.500	1017.500	6.01	5.68	5.52	977.083	34.70	37.50	40.10	35.60	36.50	36.70
997.917	1027.917	6.06	5.72	5.54	987.500	34.60	37.30	39.80	35.60	36.40	36.50
1008.333	1038.333	6.02	5.72	5.54	997.917	34.50	37.10	39.80	35.60	36.30	36.30
1020.000	1050.000	6.07	5.73	5.55	1018.750	34.50	37.20	39.50	35.60	36.40	36.00
1029.167	1999.167	6.07	5.80	5.65	1029.167	34.30	36.90	39.50	35.60	36.20	35.80
1039.583	1009.583	6.13	5.84	5.68	1039.583	34.30	36.80	39.20	35.60	36.10	35.50
1050.000	1020.000	6.21	5.89	5.70	1050.000	34.10	36.60	39.00	35.50	36.10	35.30

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +4 dBm	LO +7 dBm	LO +10 dBm	VSWR LO port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	VSWR IF port LO +4 dBm	LO +7 dBm	LO +10 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
800.000	1.33	1.46	1.58	2.20	3.06	4.12	2.000	1.01	1.06	1.06	800.000	-209.84	0.05
820.833	1.38	1.50	1.61	2.23	3.06	4.32	5.000	1.02	1.06	1.06	820.833	-215.48	0.50
831.250	1.40	1.53	1.63	2.30	3.21	4.42	10.000	1.04	1.06	1.06	831.250	-225.33	0.55
841.667	1.43	1.55	1.66	2.30	3.21	4.42	20.000	1.07	1.08	1.07	841.667	-223.33	0.63
862.500	1.48	1.59	1.70	2.32	3.26	4.32	60.000	1.21	1.17	1.14	862.500	-216.25	1.03
872.917	1.51	1.61	1.71	2.32	3.16	4.22	80.000	1.28	1.22	1.17	872.917	-197.53	1.30
883.333	1.52	1.63	1.74	2.30	3.11	4.22	100.000	1.34	1.26	1.20	883.333	-190.84	1.48
904.167	1.59	1.69	1.80	2.35	3.06	4.03	126.750	1.43	1.33	1.26	904.167	-183.60	1.97
914.583	1.62	1.71	1.81	2.32	3.06	4.03	189.125	1.63	1.48	1.37	914.583	-186.51	1.84
925.000	1.64	1.74	1.84	2.35	3.11	4.12	251.500	1.84	1.61	1.46	925.000	-192.89	1.57
945.833	1.69	1.78	1.87	2.40	3.11	4.22	376.250	2.49	2.06	1.84	945.833	-201.70	1.64
956.250	1.73	1.81	1.89	2.43	3.21	4.12	438.625	3.01	2.49	2.18	956.250	-209.28	2.09
966.667	1.77	1.85	1.92	2.46	3.26	4.22	500.000	3.50	2.96	2.61	966.667	-216.49	1.64
987.500	1.84	1.91	1.97	2.52	3.32	4.32	501.000	3.57	2.92	2.58	987.500	-228.13	1.85
997.917	1.87	1.94	2.01	2.52	3.26	4.32	625.750	3.95	3.79	3.64	997.917	-224.27	2.02
1008.333	1.91	1.96	2.03	2.58	3.32	4.12	750.500	3.01	3.50	3.79	1008.333	-206.56	2.16
1018.750	1.94	1.99	2.06	2.58	3.26	4.12	812.875	2.40	2.84	3.21	1018.750	-195.34	2.21
1029.167	1.97	2.03	2.08	2.61	3.26	4.12	875.250	1.81	2.12	2.43	1029.167	-180.09	2.65
1039.583	2.03	2.06	2.12	2.61	3.26	4.12	937.625	1.39	1.55	1.73	1039.583	-173.30	3.08
1050.000	2.06	2.10	2.16	2.65	3.26	4.22	1000.000	1.46	1.49	1.59	1050.000	-173.77	3.26

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF Output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	20	27	25	36	30	61	57	74	72	69
1	-	12	+0	27	12	52	48	31	52	55	76	70
2	86	44	44	52	47	54	50	68	54	66	74	81
3	92	51	49	52	46	52	39	56	57	41	67	64
4	96	> 88	78	72	66	59	66	60	63	74	75	74
5	> 98	66	76	80	64	60	56	63	58	73	71	59
6	> 92	> 82	86	> 88	> 88	80	84	86	83	76	80	> 88
7	> 91	> 80	> 81	> 87	> 87	> 88	79	83	86	83	70	77
8	> 91	> 81	> 82	> 82	86	> 88	> 89	> 86	85	82	> 87	82
9	> 91	> 81	> 82	> 83	> 81	86	> 87	> 87	> 86	84	82	84
10	90	> 82	> 82	> 81	80	80	86	> 87	> 88	86	87	83

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; -3.91 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -9.48 DBM

RF ORDER HARMONIC

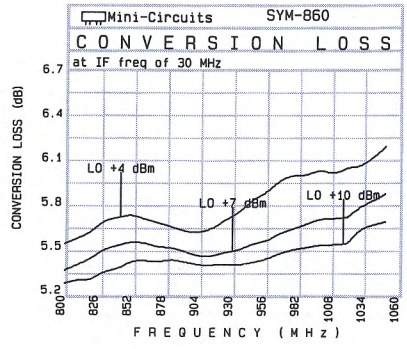
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	15	15	26	20	50	44	59	51	52
1	-	12	+0	26	11	43	51	25	48	49	64	59
2	93	55	52	57	53	68	55	71	61	67	68	> 72
3	96	69	67	68	64	65	60	71	71	58	> 78	> 71
4	> 98	> 78	> 78	> 78	75	77	> 79	> 77	> 77	> 78	> 77	> 78
5	> 97	> 78	> 78	> 79	> 78	> 78	> 78	> 79	77	> 77	> 79	77
6	> 91	71	> 78	> 78	> 78	> 78	> 78	> 78	> 78	> 78	> 78	> 78
7	> 91	> 72	> 72	> 77	> 78	77	> 78	> 78	> 78	> 78	> 77	> 78
8	> 92	> 73	71	> 72	> 78	> 79	77	> 77	> 78	> 78	> 78	> 79
9	> 91	> 71	> 72	> 72	> 71	> 77	74	> 78	> 78	> 77	> 78	> 78
10	> 92	> 73	> 72	71	> 72	> 72	> 78	> 78	76	77	> 78	> 78

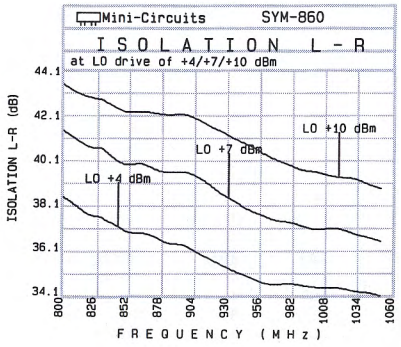
Harmonic LO Order

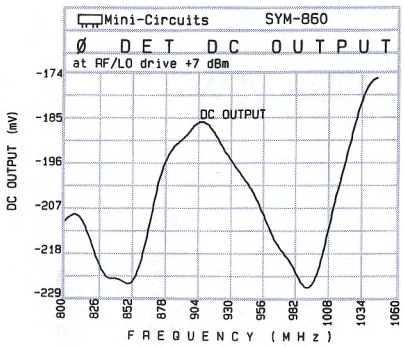
test condition: RF IN: 1000.10 MHZ; -14.01 DBM
LO IN: 970.01 MHZ; +6.99 DBM
IF OUT: 30.09 MHZ; -19.01 DBM

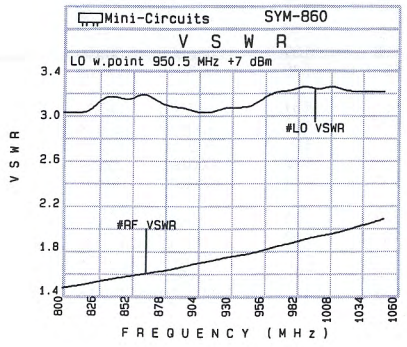
typical performance curves

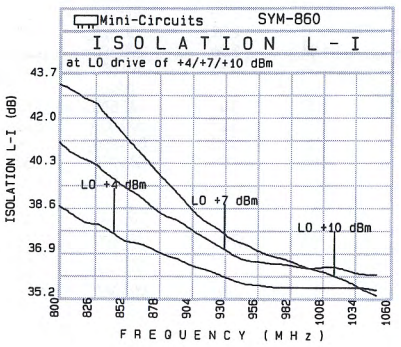
(production unit)

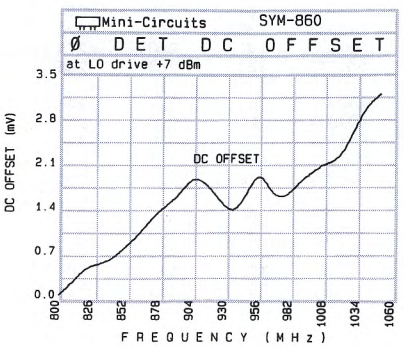












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 10: (+10dBm LO, up to +5dBm RF)

Models
RMS-5LH
LRMS-5LH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
10.000	40.000	6.19	5.72	5.52	10.000	67.91	67.66	67.05	67.81	66.96	61.29
20.000	50.000	5.96	5.51	5.37	20.000	66.98	65.38	63.71	64.68	62.08	55.74
50.000	80.000	5.72	5.28	5.12	50.000	67.77	62.52	59.92	58.17	56.44	48.86
100.000	70.000	5.66	5.24	5.10	100.000	81.27	60.56	56.90	52.26	50.66	43.46
154.190	124.194	5.68	5.27	5.13	154.190	63.60	57.69	53.49	48.91	46.95	39.45
200.000	170.000	5.64	5.26	5.14	200.000	55.37	53.98	50.86	44.65	43.78	36.46
298.390	268.387	5.83	5.39	5.21	298.390	45.53	46.15	45.38	38.88	37.49	31.95
442.580	412.581	6.36	5.83	5.59	442.580	37.69	38.38	38.14	33.20	30.46	26.40
500.000	470.000	6.53	6.00	5.59	500.000	35.47	36.28	36.34	31.00	28.19	24.71
586.770	556.774	6.76	6.07	5.62	586.770	32.75	33.52	33.72	27.63	24.91	22.18
730.970	700.968	7.69	6.90	6.39	730.970	29.16	30.15	30.59	22.27	20.68	18.69
750.000	720.000	7.35	6.57	6.11	750.000	28.86	29.88	30.41	21.68	20.05	18.29
875.160	845.161	7.75	7.15	6.81	875.160	27.02	28.44	29.28	19.06	16.93	15.36
1000.000	970.000	8.13	7.62	7.23	1000.000	25.85	27.37	28.55	16.88	15.37	13.87
1019.350	989.355	7.41	6.91	6.57	1019.350	25.49	27.03	28.32	16.54	15.01	13.57
1163.550	1133.548	8.22	7.82	7.69	1163.550	24.22	25.69	26.85	13.64	12.77	11.93
1259.680	1229.677	8.28	7.99	7.82	1259.680	23.64	25.02	26.19	12.44	11.85	11.17
1403.870	1373.871	8.44	7.89	7.76	1403.870	22.12	23.59	24.60	10.81	10.74	10.31
1451.940	1421.936	8.80	8.03	7.83	1451.940	21.66	23.18	24.29	10.61	10.63	10.35
1500.000	1470.000	9.07	8.11	7.81	1500.000	21.18	22.62	23.79	10.38	10.48	10.23

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
10.000	1.67	1.65	1.71	1.89	2.80	4.01	10.000	1.10	1.12	1.35	10.000	328.40	0.06
20.000	1.30	1.30	1.33	1.85	2.77	4.01	20.000	1.10	1.13	1.35	20.000	331.20	0.04
50.000	1.06	1.04	1.04	1.96	2.82	4.19	50.000	1.15	1.16	1.37	50.000	339.10	0.09
100.000	1.26	1.21	1.22	1.87	2.67	3.92	100.000	1.27	1.21	1.37	100.000	333.40	0.04
154.190	1.54	1.47	1.50	1.84	2.56	3.67	106.130	1.29	1.22	1.37	106.130	328.80	0.08
200.000	1.80	1.70	1.74	1.78	2.44	3.33	200.000	1.56	1.39	1.40	200.000	325.60	0.18
298.390	2.34	2.15	2.24	1.71	2.24	2.90	202.260	1.56	1.39	1.40	250.320	325.60	0.65
442.580	2.89	2.60	2.74	1.59	1.92	2.32	250.320	1.67	1.45	1.39	394.520	315.40	1.74
500.000	2.91	2.60	2.75	1.54	1.88	2.36	298.390	1.75	1.50	1.39	500.000	306.90	2.80
586.770	2.63	2.43	2.55	1.52	1.88	2.34	394.520	1.83	1.53	1.35	538.710	287.62	2.51
730.970	2.53	2.37	2.48	1.79	2.39	3.07	442.580	1.82	1.51	1.31	682.900	285.75	4.90
750.000	2.51	2.36	2.47	1.97	2.56	3.27	500.000	1.76	1.46	1.25	730.970	293.56	6.73
875.160	3.36	3.20	3.44	2.58	3.36	4.25	538.710	1.68	1.40	1.21	875.160	297.88	9.35
1000.000	4.95	4.75	5.31	3.38	4.08	4.91	586.770	1.56	1.31	1.17	1000.000	295.99	8.51
1019.350	4.62	4.51	5.00	3.45	4.11	4.96	634.840	1.42	1.23	1.18	1019.350	301.91	8.65
1163.550	6.86	6.63	7.80	4.18	4.54	5.23	730.970	1.38	1.45	1.63	1163.550	302.53	7.10
1259.680	6.32	6.05	6.97	5.00	4.67	5.04	779.030	1.28	1.40	1.62	1259.680	289.83	6.81
1403.870	4.48	4.25	4.68	4.62	4.06	4.04	827.100	1.31	1.51	1.78	1403.870	288.72	10.07
1451.940	3.98	3.76	4.09	4.44	3.86	3.70	875.160	1.40	1.64	1.93	1451.940	287.52	13.78
1500.000	3.51	3.33	3.59	4.40	3.66	3.50	900.000	1.48	1.73	2.03	1500.000	277.56	19.02

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF \ CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	1	9	+2	20	8	58	40	54	47	60
1	-	22	+0	37	14	46	40	43	63	65	60	69
2	95	56	44	54	42	57	47	69	57	> 74	> 74	74
3	95	> 74	> 75	73	67	73	69	> 74	> 74	> 74	> 73	> 74
4	> 96	> 74	> 74	73	> 75	> 75	> 76	73	73	71	> 74	72
5	> 94	> 74	72	> 74	> 75	> 75	> 74	74	74	74	72	> 74
6	> 94	> 73	> 73	> 74	> 75	> 74	> 76	> 74	> 75	> 75	> 75	> 74
7	> 95	73	> 74	71	> 74	> 75	> 74	> 75	> 74	74	> 75	> 75
8	> 95	> 74	> 74	> 74	72	> 74	> 75	73	74	74	> 74	> 75
9	92	73	> 74	> 74	> 74	> 74	> 73	73	> 74	> 75	74	> 75
10	> 96	> 75	> 74	73	> 74	> 73	> 74	73	> 75	74	74	74

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -15.06 DBM
LO IN: 470.01 MHZ; + 10.05 DBM
IF OUT: 30.09 MHZ; -21.37 DBM

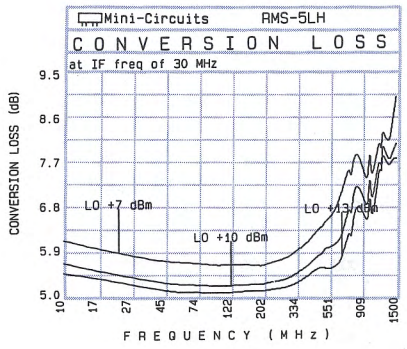
RF \ CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	19	8	31	19	73	52	67	57	76
1	-	22	0	39	14	50	40	43	65	67	63	74
2	81	47	35	44	33	51	37	63	47	82	76	76
3	93	61	60	56	52	56	54	62	68	68	80	83
4	93	> 84	77	70	69	67	67	66	69	76	68	81
5	94	> 83	82	> 84	76	84	71	> 85	70	83	80	> 85
6	93	80	> 83	> 84	82	> 85	80	> 85	76	> 84	80	> 84
7	> 96	> 85	> 84	> 83	> 84	80	> 85	84	> 85	> 85	83	> 86
8	> 96	84	> 85	> 84	> 83	> 84	> 85	> 85	> 86	> 85	> 85	> 84
9	94	> 84	> 85	> 84	84	> 84	82	> 85	83	> 86	> 84	> 85
10	> 96	> 85	> 84	> 85	84	> 84	80	> 84	> 85	> 85	84	> 86

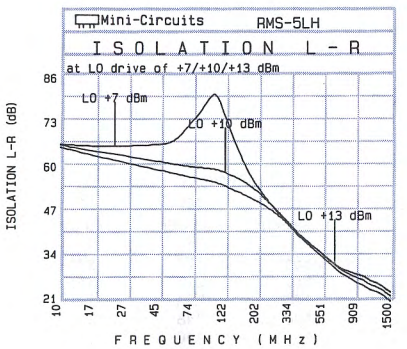
Harmonic LO Order

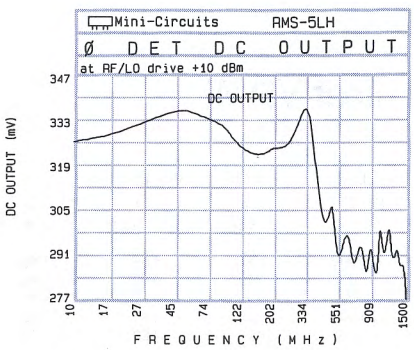
test condition: RF IN: 500.10 MHZ; -4.95 DBM
LO IN: 470.01 MHZ; + 10.07 DBM
IF OUT: 30.09 MHZ; -11.05 DBM

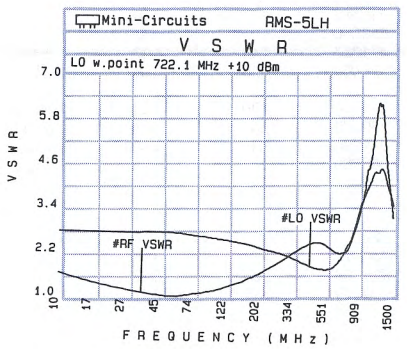
typical performance curves

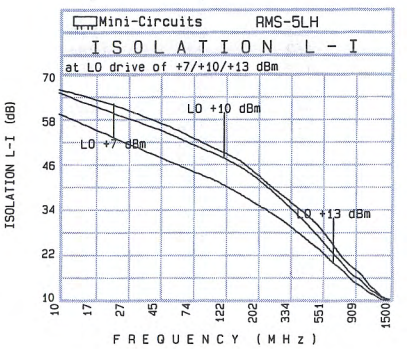
(production unit)

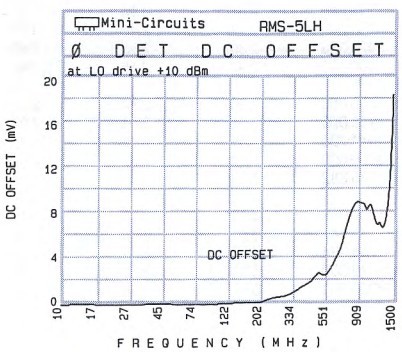












In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 10 (+10dBm LO, up to +5dBm RF)

Model
SYM-11LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
1.000	31.000	6.90	6.50	6.30	1.000	58.40	61.00	64.00	58.50	60.60	61.40
5.000	35.000	6.80	6.40	6.30	5.000	58.20	60.80	63.60	58.50	60.00	61.00
10.000	40.000	6.70	6.30	6.20	10.000	58.18	60.77	63.32	58.45	59.99	60.87
20.000	50.000	6.50	6.10	6.00	20.000	58.44	61.07	63.59	58.53	59.34	59.43
50.000	80.000	6.24	5.93	5.73	60.000	57.45	60.38	62.67	56.35	54.58	52.68
80.000	110.000	6.20	5.94	5.77	100.000	56.24	59.60	62.21	53.49	51.54	49.60
100.000	130.000	6.12	5.84	5.69	134.375	54.67	58.27	60.27	51.54	48.96	46.75
250.000	280.000	7.08	6.38	6.08	383.125	45.79	48.22	49.08	37.30	36.40	34.89
440.000	470.000	7.37	6.40	6.25	500.000	42.37	45.06	46.96	33.66	34.17	33.48
500.000	530.000	7.91	7.29	6.42	631.875	39.53	42.23	43.76	31.03	31.50	31.12
700.000	730.000	8.47	7.50	7.14	880.625	36.87	38.46	39.70	28.49	29.07	29.00
830.000	860.000	8.67	7.95	7.53	1000.000	36.13	38.08	39.55	27.90	28.07	27.58
1000.000	1030.000	8.36	7.91	7.76	1005.000	36.02	37.94	39.72	27.70	28.08	27.79
1090.000	1120.000	8.66	8.16	8.01	1129.375	33.89	36.12	37.96	27.30	27.65	27.28
1250.000	1280.000	8.72	8.27	8.33	1253.750	34.00	36.11	37.68	26.01	27.37	27.60
1480.000	1510.000	9.00	8.38	8.56	1500.000	34.45	36.02	38.01	24.03	25.08	25.44
1610.000	1640.000	9.39	8.70	8.73	1626.875	34.58	36.26	38.33	24.17	25.19	25.54
1870.000	1900.000	9.75	8.97	8.80	1875.625	33.82	35.66	37.48	26.15	25.82	25.24
1970.000	2000.000	9.71	8.88	8.66	1970.000	31.57	33.51	34.92	29.07	28.03	27.09
2000.000	1970.000	9.58	8.78	8.59	2000.000	31.23	32.77	34.14	32.88	31.12	29.66

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm
1.000	1.80	1.69	1.59	1.51	2.23	3.16	1.000	1.26	1.31	1.42
5.000	2.04	1.91	1.78	1.50	2.25	3.16	5.000	1.16	1.10	1.24
10.000	2.06	1.92	1.78	1.45	2.23	3.21	10.000	1.15	1.06	1.22
20.000	2.04	1.91	1.78	1.48	2.18	3.16	20.000	1.14	1.06	1.23
60.000	2.03	1.89	1.77	1.44	2.10	3.06	60.000	1.12	1.08	1.24
100.000	2.08	1.92	1.80	1.43	2.14	3.11	100.000	1.11	1.09	1.25
118.588	2.08	1.94	1.81	1.43	2.14	3.06	118.588	1.10	1.09	1.25
250.000	2.27	2.12	1.99	1.46	2.08	2.88	250.000	1.05	1.14	1.30
471.353	2.80	2.58	2.40	1.62	2.10	2.84	471.353	1.13	1.33	1.49
500.000	2.84	2.65	2.46	1.62	2.12	2.80	500.000	1.16	1.36	1.52
600.000	3.06	2.84	2.61	1.71	2.06	2.65	600.000	1.30	1.50	1.67
750.000	3.38	3.11	2.92	1.78	1.92	2.37	750.000	1.61	1.84	2.03
941.706	3.64	3.38	3.21	1.91	2.08	2.58	941.706	2.14	2.40	2.58
1000.000	3.57	3.38	3.26	2.01	1.92	2.18	1000.000	2.32	2.58	2.80
1176.882	3.44	3.26	3.16	2.25	1.97	2.10	1176.882	2.96	3.16	3.32
1412.059	3.71	3.57	3.44	2.32	1.97	2.08	1412.059	3.57	3.71	3.79
1529.647	3.57	3.44	3.38	2.32	1.94	1.94	1529.647	3.71	3.79	3.86
1764.824	3.57	3.44	3.38	2.32	1.89	1.88	1764.824	3.95	3.95	3.95
1970.000	3.64	3.50	3.38	2.25	1.85	1.84	1970.000	5.33	5.33	5.17
2000.000	3.57	3.44	3.32	2.20	1.84	1.82	2000.000	5.49	5.49	5.49

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative to desired RF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	31	19	32	25	45	47	61	51	65
1	-	22	+0	32	24	37	30	43	54	55	65	63
2	86	67	44	56	41	66	49	60	46	62	62	80
3	>97	62	62	63	49	62	56	62	68	66	74	>77
4	>97	>86	75	83	65	82	63	81	71	81	65	78
5	>97	85	>87	>86	>86	80	73	78	78	82	83	81
6	87	>81	85	85	85	>86	82	84	81	>86	>86	>86
7	>90	>80	>80	82	>86	>87	82	>86	83	>87	>86	>86
8	>92	>80	80	79	85	>87	85	85	>87	>85	>86	>86
9	90	>80	79	>80	79	>85	>86	>87	>86	83	>85	>86
10	91	79	>80	>80	>80	>79	>86	>85	86	>86	>87	>87

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; +3.98 DBM
LO IN: 970.01 MHZ; +9.94 DBM
IF OUT: 30.09 MHZ; -10.97 DBM

RF ORDER HARMONIC

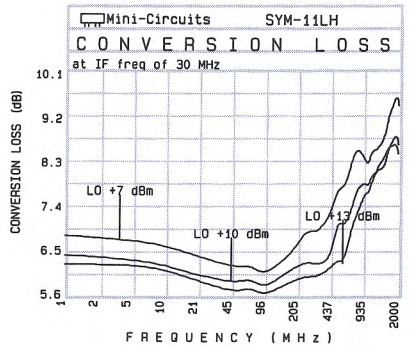
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	21	9	22	14	34	33	50	36	48
1	-	22	0	31	24	37	30	43	54	53	55	62
2	93	74	53	65	50	74	59	67	56	68	>69	69
3	96	>76	75	>76	68	73	72	73	75	>75	>76	68
4	>98	>76	>76	>76	76	>76	>77	>76	74	75	>76	73
5	>97	>76	>76	>76	>75	>76	>76	75	75	>76	>76	72
6	>91	>70	71	>76	>77	>76	>76	>76	>76	74	75	>76
7	>91	>70	69	>75	>76	>76	>76	>77	>77	74	>75	>76
8	>92	>71	69	>69	>75	>76	>77	>76	73	75	75	>76
9	>91	>70	>70	>70	66	>75	>76	>76	>76	>76	75	>75
10	>92	69	69	>69	>70	>70	>75	>76	>76	>76	>76	>76

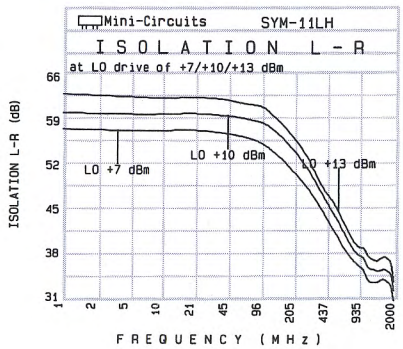
Harmonic LO Order

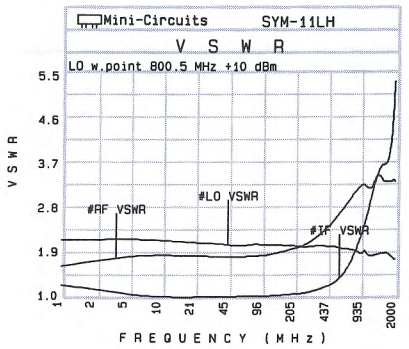
test condition: RF IN: 1000.10 MHZ; -14.01 DBM
LO IN: 970.01 MHZ; +9.94 DBM
IF OUT: 30.09 MHZ; -21.06 DBM

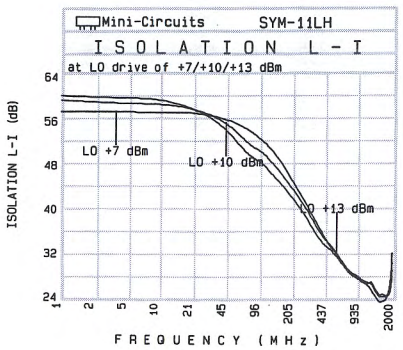
typical performance curves

(production unit)









In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
LMX-123MH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
10.000	40.000	6.66	5.96	5.69	10.000	43.33	47.24	50.75	32.59	36.58	40.18
20.000	50.000	6.61	5.94	5.65	20.000	45.45	49.26	52.34	33.22	37.43	41.45
50.000	80.000	6.71	6.02	5.73	50.000	47.15	51.02	53.61	33.30	37.48	41.16
100.000	70.000	6.75	6.07	5.84	100.000	47.44	51.06	52.59	32.42	36.26	39.32
200.000	170.000	6.86	6.17	5.90	200.000	49.05	49.57	48.15	32.39	35.73	37.14
250.970	220.968	6.91	6.21	5.95	250.970	49.18	47.46	46.68	32.42	35.21	35.83
491.940	461.936	7.07	6.37	5.96	491.940	43.78	43.41	42.70	33.40	33.02	31.68
500.000	470.000	7.10	6.40	5.97	500.000	43.46	43.15	42.50	33.27	32.80	31.47
732.900	702.903	7.36	6.57	6.10	732.900	40.23	39.19	39.03	32.76	30.53	28.79
973.870	943.871	7.47	6.58	6.13	973.870	42.67	40.45	39.30	32.84	29.30	27.40
1000.000	970.000	7.45	6.53	6.10	1000.000	43.41	40.71	39.31	32.77	29.02	27.11
1214.840	1184.839	8.18	7.15	6.66	1214.840	57.02	45.72	42.84	31.98	28.05	25.97
1250.000	1220.000	8.32	7.24	6.73	1250.000	54.87	48.70	44.82	32.31	28.19	25.79
1455.810	1425.807	9.02	7.63	6.92	1455.810	44.81	46.72	47.10	30.36	27.96	26.43
1696.770	1666.774	9.25	7.81	7.18	1696.770	41.11	41.63	41.65	29.00	27.83	26.86
1937.740	1907.742	9.44	7.88	7.26	1937.740	36.14	36.07	36.28	29.07	28.31	27.92
2000.000	1970.000	9.25	7.76	7.15	2000.000	35.17	35.31	35.73	28.95	28.30	28.14
2178.710	2148.710	8.62	7.48	6.98	2178.710	32.52	32.54	33.54	28.59	28.58	29.21
2419.680	2389.677	8.10	7.17	6.79	2419.680	30.43	30.75	32.06	27.41	27.78	28.99
2500.000	2470.000	8.12	7.18	6.81	2500.000	31.96	32.18	33.66	29.35	29.47	30.45

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
10.000	1.74	1.46	1.29	1.16	1.41	2.12	10.000	1.58	1.16	1.05
20.000	1.75	1.46	1.29	1.11	1.44	2.15	20.000	1.57	1.15	1.04
50.000	1.75	1.46	1.28	1.14	1.40	2.06	50.000	1.53	1.14	1.05
100.000	1.72	1.45	1.28	1.21	1.33	1.99	100.000	1.53	1.14	1.05
200.000	1.74	1.47	1.31	1.28	1.29	1.90	200.000	1.51	1.13	1.05
408.400	1.88	1.62	1.47	1.45	1.25	1.77	408.400	1.48	1.12	1.05
500.000	2.02	1.73	1.57	1.55	1.24	1.70	500.000	1.47	1.15	1.05
682.300	2.38	2.08	1.90	1.78	1.27	1.56	682.300	1.47	1.13	1.03
881.500	2.69	2.37	2.17	2.15	1.35	1.39	881.500	1.50	1.18	1.06
1000.000	2.78	2.45	2.24	2.50	1.49	1.30	1000.000	1.54	1.24	1.12
1155.400	2.76	2.41	2.22	2.74	1.58	1.23	1155.400	1.63	1.35	1.22
1250.000	2.69	2.36	2.17	2.84	1.62	1.15	1250.000	1.71	1.43	1.30
1429.300	2.55	2.24	2.05	2.69	1.61	1.09	1429.300	1.86	1.58	1.43
1628.500	2.54	2.24	2.05	2.72	1.62	1.04	1628.500	1.99	1.68	1.52
1827.700	2.49	2.23	2.06	2.44	1.55	1.05	1827.700	2.06	1.73	1.56
2000.000	2.28	2.06	1.92	2.45	1.56	1.10	2000.000	1.97	1.66	1.49
2101.600	2.15	1.94	1.82	2.57	1.61	1.12	2101.600	1.86	1.57	1.42
2300.800	1.92	1.75	1.65	2.47	1.61	1.25	2300.800	1.64	1.41	1.29
2425.300	1.86	1.70	1.59	2.26	1.57	1.42	2425.300	1.55	1.37	1.29
2500.000	1.83	1.68	1.57	2.16	1.56	1.48	2500.000	1.52	1.37	1.31

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	12	12	24	21	29	26	34	34	30
1	-	24	+0	34	15	40	27	37	21	39	24	43
2	94	67	64	62	59	57	52	52	52	55	57	59
3	95	74	65	74	62	79	61	77	58	75	59	76
4	> 96	76	> 80	78	78	> 79	> 80	> 80	> 80	76	> 79	77
5	94	> 79	> 80	78	79	> 79	> 80	> 80	> 79	> 79	78	> 80
6	> 96	> 78	77	> 79	> 79	> 79	> 81	79	> 79	> 80	> 80	> 80
7	> 95	> 79	> 78	78	> 79	> 80	79	> 80	79	78	> 81	> 80
8	> 97	> 79	> 79	> 78	77	> 79	> 80	79	> 79	> 80	79	> 80
9	> 96	> 79	> 79	78	> 78	> 78	> 79	> 79	> 81	> 80	> 80	> 80
10	95	> 79	> 79	> 80	> 79	> 79	> 78	> 79	> 80	> 80	> 81	> 79

Harmonic LO Order

test condition: RF IN: 490.10 MHZ; -9.97 DBM
LO IN: 460.01 MHZ; + 12.96 DBM
IF OUT: 30.09 MHZ; -16.36 DBM

RF ORDER HARMONIC

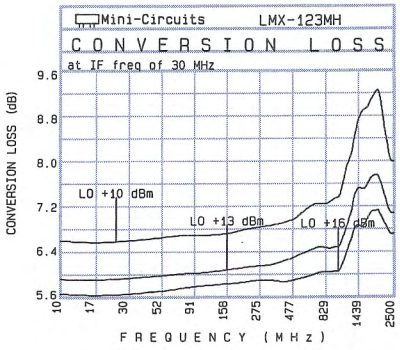
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	22	23	37	34	46	39	60	48	48
1	-	24	+0	35	15	42	33	40	23	43	28	50
2	91	60	55	55	54	54	45	47	45	50	49	54
3	88	64	45	69	44	60	43	57	41	57	42	80
4	> 96	71	71	68	72	64	67	61	63	60	65	68
5	94	77	73	80	67	82	64	75	61	71	61	68
6	> 96	80	81	80	87	76	81	76	78	74	76	78
7	> 95	88	88	86	> 89	> 89	82	89	76	86	73	83
8	> 96	88	> 89	85	88	86	> 89	> 90	> 90	86	89	84
9	> 96	> 89	88	88	84	> 86	87	> 89	88	> 90	84	88
10	> 97	> 89	> 89	88	89	> 89	> 89	> 89	> 89	> 90	> 90	87

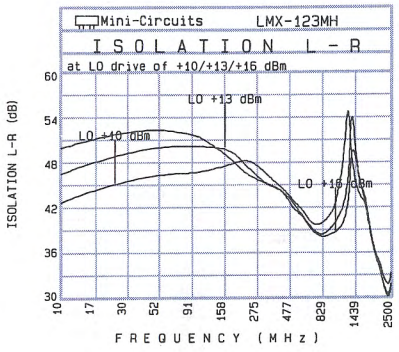
Harmonic LO Order

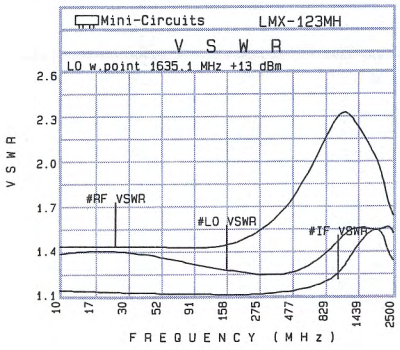
test condition: RF IN: 490.10 MHZ; + .08 DBM
LO IN: 460.01 MHZ; + 12.96 DBM
IF OUT: 30.09 MHZ; -6.13 DBM

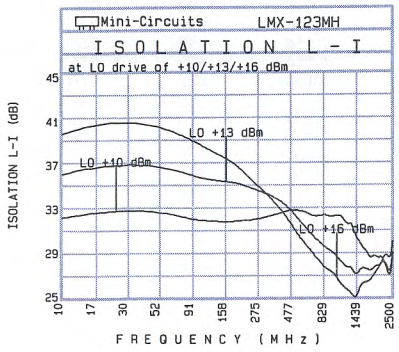
typical performance curves

(production unit)









broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
SYM-11MH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
50.000	120.000	6.50	6.10	6.00	50.000	43.36	48.54	52.92	33.44	36.59	39.33
90.000	160.000	6.50	6.10	6.00	80.000	47.82	52.28	55.37	35.43	38.66	41.86
100.000	170.000	6.51	6.21	6.05	100.000	48.94	53.00	55.79	36.19	39.60	42.92
218.750	288.750	6.65	6.33	6.14	250.000	57.88	56.74	54.36	38.94	42.55	42.85
250.000	320.000	6.55	6.25	6.06	293.750	61.57	56.65	53.21	40.22	42.72	41.13
337.500	407.500	6.76	6.41	6.20	415.625	60.94	54.53	51.12	42.81	42.69	39.68
500.000	570.000	6.82	6.41	6.18	500.000	58.79	53.04	49.66	45.32	42.69	38.63
575.000	645.000	7.05	6.59	6.35	659.375	52.21	46.93	44.50	64.23	41.91	36.80
750.000	820.000	6.94	6.56	6.33	903.125	51.03	44.61	41.15	38.74	36.84	34.33
812.500	882.500	7.00	6.58	6.36	1000.000	43.98	40.78	38.95	35.90	35.69	34.01
931.250	1001.250	6.89	6.61	6.46	1025.000	43.78	40.83	39.12	35.41	35.95	34.73
1000.000	1070.000	7.00	6.67	6.51	1146.875	36.83	35.04	33.63	32.54	33.54	32.88
1168.750	1238.750	7.15	6.74	6.60	1268.750	37.61	34.57	32.40	30.53	32.06	31.94
1287.500	1357.500	7.29	6.82	6.63	1500.000	33.93	31.92	30.71	27.14	29.63	30.59
1406.250	1476.250	8.01	7.43	7.16	1512.500	33.06	31.39	30.29	26.62	29.04	30.30
1500.000	1570.000	8.45	7.93	7.73	1634.375	32.63	31.63	30.90	25.24	28.06	30.43
1643.750	1713.750	8.56	8.15	8.01	1756.250	30.31	30.24	30.02	24.68	27.57	29.76
1881.250	1951.250	8.97	8.50	8.30	1878.125	29.28	29.31	29.42	24.31	26.39	28.47
1930.000	2000.000	9.01	8.49	8.28	1930.000	28.57	28.89	29.63	24.25	25.96	28.10
2000.000	1930.000	8.82	8.12	7.83	2000.000	27.33	27.68	29.26	24.01	25.70	27.78

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
50.000	1.33	1.21	1.14	1.42	2.10	2.84	50.000	1.50	1.33	1.21
80.000	1.33	1.20	1.11	1.42	2.06	2.88	80.000	1.51	1.34	1.20
100.000	1.33	1.20	1.10	1.41	2.06	2.84	100.000	1.53	1.34	1.21
250.000	1.32	1.17	1.07	1.40	1.97	2.76	250.000	1.54	1.35	1.21
279.412	1.31	1.17	1.06	1.40	1.94	2.65	279.412	1.54	1.34	1.21
394.118	1.28	1.14	1.03	1.46	1.92	2.52	394.118	1.51	1.33	1.20
500.000	1.26	1.12	1.02	1.48	1.96	2.55	500.000	1.48	1.32	1.21
623.529	1.24	1.12	1.08	1.54	1.97	2.55	623.529	1.44	1.31	1.23
852.941	1.26	1.20	1.20	1.54	1.92	2.55	852.941	1.33	1.25	1.24
967.647	1.35	1.32	1.32	1.54	1.85	2.40	967.647	1.34	1.28	1.30
1000.000	1.39	1.35	1.35	1.56	1.75	2.20	1000.000	1.34	1.30	1.32
1082.353	1.46	1.43	1.44	1.62	1.80	2.32	1082.353	1.34	1.31	1.35
1250.000	1.69	1.64	1.64	1.64	1.68	2.04	1250.000	1.38	1.38	1.44
1426.471	1.92	1.85	1.82	1.80	1.59	1.81	1426.471	1.48	1.48	1.55
1500.000	2.01	1.92	1.88	1.97	1.66	1.74	1500.000	1.53	1.53	1.59
1541.176	2.06	1.96	1.91	2.04	1.67	1.74	1541.176	1.57	1.56	1.61
1750.000	2.25	2.12	2.01	2.04	1.64	1.66	1750.000	1.84	1.80	1.81
1885.294	2.37	2.20	2.06	2.08	1.54	1.46	1885.294	2.08	2.03	2.01
1930.000	2.40	2.23	2.06	2.14	1.54	1.42	1930.000	2.14	2.08	2.08
2000.000	2.40	2.23	2.04	2.01	1.47	1.34	2000.000	2.23	2.18	2.16

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Mini-Circuits
ULTRA-REL™ MIXERS
5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	21	20	29	44	22	24	37	37	53
1	-	30	0	27	12	38	31	43	30	38	47	47
2	87	65	45	53	50	53	52	53	55	54	46	62
3	> 97	55	60	64	56	64	58	66	53	58	59	68
4	> 97	86	84	75	81	77	82	72	78	74	70	73
5	> 96	85	81	82	86	83	78	78	75	76	74	83
6	90	> 82	> 87	> 87	> 87	> 88	> 87	86	> 87	86	> 86	84
7	> 91	78	> 80	83	> 87	> 87	> 86	> 87	> 87	> 87	> 87	86
8	> 91	> 81	> 82	> 81	> 87	86	86	> 87	> 86	> 87	81	> 88
9	> 91	> 81	> 81	> 82	> 82	> 88	> 87	> 87	> 86	83	> 88	> 88
10	> 93	> 81	> 81	> 81	> 82	> 81	> 88	> 87	> 88	> 88	80	> 87

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; -4.01 DBM
LO IN: 900.01 MHZ; + 12.96 DBM
IF OUT: 100.09 MHZ; -9.86 DBM

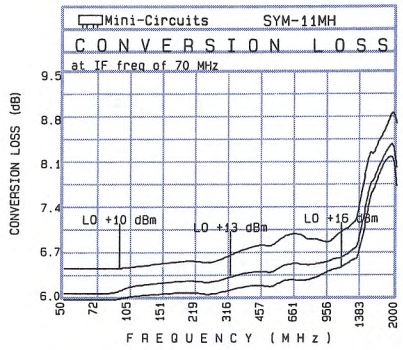
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	3	11	10	17	29	11	13	25	25	41
1	-	29	0	26	12	38	33	39	31	36	42	45
2	> 98	71	55	66	60	66	64	61	61	64	54	> 71
3	> 97	71	75	75	72	> 78	73	76	69	> 77	71	> 72
4	> 97	> 78	74	73	> 77	> 77	76	76	> 77	> 77	> 77	73
5	96	73	> 77	> 77	75	> 76	> 77	> 77	76	> 77	> 77	> 78
6	> 91	70	> 76	> 77	> 77	76	> 76	> 77	> 77	> 78	75	> 77
7	> 91	> 71	> 71	> 77	> 77	> 78	> 77	> 77	> 78	> 77	> 77	> 77
8	> 92	> 71	> 72	> 71	> 76	> 78	76	> 77	> 77	> 78	> 76	> 78
9	90	> 71	70	> 72	> 71	> 77	76	> 78	> 76	> 77	> 78	> 77
10	> 92	> 72	> 71	> 72	> 71	> 71	76	> 77	> 77	> 78	> 77	> 77

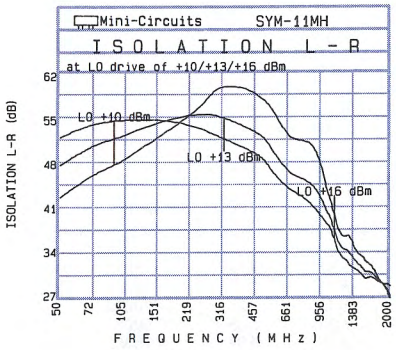
Harmonic LO Order

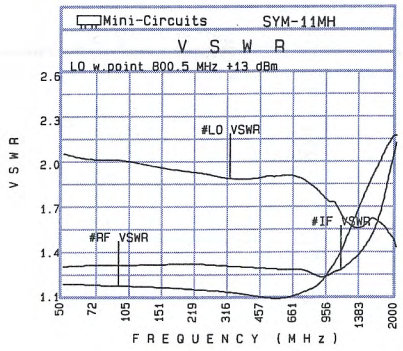
test condition: RF IN: 1000.10 MHZ; -14.05 DBM
LO IN: 900.01 MHZ; + 12.96 DBM
IF OUT: 100.09 MHZ; -19.94 DBM

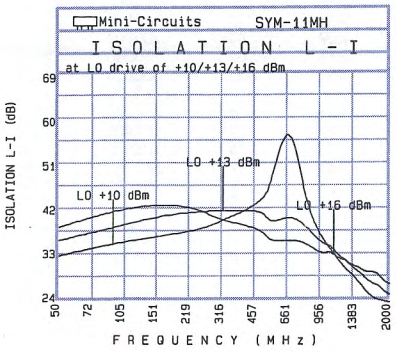
typical performance curves

(production unit)









In Stock...Immediate Delivery

broadband high dynamic range

Frequency Mixers

LEVEL 13 (+13dBm LO, up to +9dBm RF)

Model
ZEM-4300MH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
300.000	500.000	7.57	7.02	6.67	300.000	43.35	42.09	40.49	11.43	9.54	8.77
500.000	700.000	8.37	6.66	6.00	500.000	37.14	33.47	33.25	8.74	9.04	10.15
575.860	775.862	7.38	6.30	5.60	575.860	37.70	35.56	35.06	8.18	9.47	11.38
600.000	800.000	7.34	6.62	5.88	600.000	37.59	35.00	34.05	8.22	9.79	11.86
989.660	789.655	7.80	6.61	5.89	989.660	38.03	36.09	34.58	14.54	17.49	19.75
1000.000	800.000	7.61	6.53	5.99	1000.000	38.18	36.06	34.71	14.52	17.37	19.48
1403.450	1203.448	6.77	6.30	6.02	1403.450	31.74	32.65	33.06	15.13	14.72	14.13
1679.310	1479.310	6.07	5.89	5.60	1679.310	36.70	39.70	41.55	17.17	19.11	20.80
2000.000	1800.000	6.80	6.16	5.89	2000.000	33.37	34.09	34.46	21.40	23.50	24.76
2093.100	1893.103	7.06	6.43	5.91	2093.100	33.03	33.26	33.41	22.06	23.82	24.49
2231.030	2031.035	7.11	6.54	6.15	2231.030	32.10	32.41	32.35	23.59	25.64	25.83
2368.970	2168.966	6.71	6.30	6.03	2368.970	31.01	31.34	31.40	24.92	28.66	29.56
2506.900	2306.897	6.64	6.24	5.91	2506.900	29.33	29.89	30.01	22.30	27.33	32.64
2920.690	2720.690	6.63	6.23	5.91	2920.690	27.36	27.73	28.35	15.11	17.77	20.51
3000.000	2800.000	6.54	6.20	5.89	3000.000	25.60	26.08	26.50	13.82	16.39	18.66
3334.480	3134.483	6.54	6.22	6.15	3334.480	26.40	27.73	29.51	15.10	15.67	14.59
3610.340	3410.345	7.35	6.38	6.20	3610.340	29.54	30.12	32.02	16.80	13.56	10.92
4000.000	3800.000	6.98	6.47	6.37	4000.000	30.72	33.12	34.86	11.63	10.27	9.25
4162.070	3962.069	6.89	6.54	6.24	4162.070	31.76	35.73	39.24	10.73	10.47	10.18
4300.000	4100.000	7.00	6.83	6.66	4300.000	34.27	39.65	43.08	11.43	11.87	11.95

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
300.000	2.29	2.21	2.06	7.63	5.54	4.24	5.000	1.13	1.33	1.49	300.000	-310.80	6.58
500.000	3.42	3.20	2.94	12.26	5.20	3.78	12.500	1.12	1.32	1.48	500.000	-387.70	2.49
600.000	3.47	3.19	2.90	11.93	5.14	4.27	20.000	1.12	1.32	1.48	575.860	-434.10	2.32
733.330	2.74	2.55	2.34	7.80	6.32	6.63	50.000	1.11	1.30	1.45	600.000	-457.50	2.75
1000.000	1.78	1.64	1.56	3.81	4.48	5.99	95.450	1.06	1.23	1.37	989.660	-287.88	-0.77
1166.670	2.81	2.66	2.48	2.35	3.06	4.03	100.000	1.05	1.22	1.36	1000.000	-313.30	-5.56
1455.560	5.89	5.34	4.91	1.78	2.48	3.34	185.910	1.07	1.09	1.21	1403.450	-165.40	-10.71
1744.440	4.73	4.31	3.90	3.30	4.59	7.44	200.000	1.10	1.06	1.18	1679.310	-48.66	-12.26
2000.000	2.81	2.63	2.55	2.44	2.77	3.62	276.360	1.22	1.09	1.13	2000.000	2.35	-10.07
2100.000	2.62	2.48	2.40	1.84	1.88	2.33	366.820	1.42	1.31	1.32	2093.100	74.80	-5.66
2177.780	2.57	2.42	2.35	1.83	1.88	2.30	457.270	1.63	1.60	1.65	2231.030	136.41	-9.20
2200.000	2.50	2.35	2.29	1.85	1.89	2.33	487.420	1.72	1.72	1.79	2368.970	218.78	-5.88
2466.670	2.44	2.26	2.15	1.77	1.90	2.34	500.000	1.74	1.76	1.83	2506.900	288.56	-4.73
2755.560	2.51	2.30	2.17	2.25	2.41	3.01	547.730	1.84	1.94	2.05	2920.690	401.60	-3.67
3000.000	2.45	2.29	2.17	2.21	2.23	2.63	638.180	2.01	2.28	2.47	3000.000	364.70	-1.95
3188.890	2.42	2.29	2.20	3.37	3.01	3.32	728.640	2.09	2.51	2.81	3334.480	535.80	11.35
3500.000	1.89	1.82	1.78	3.82	2.73	2.36	819.090	2.02	2.45	2.78	3610.340	512.70	11.36
3911.110	2.57	2.35	2.18	2.49	1.84	1.71	909.550	1.91	2.21	2.51	4000.000	498.80	4.45
4055.560	2.51	2.27	2.09	2.17	2.41	2.84	969.850	1.87	2.04	2.21	4162.070	454.50	-12.32
4200.000	2.58	2.30	2.08	2.39	3.08	3.75	1000.000	1.94	2.03	2.13	4300.000	349.10	-18.78

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	26	+4	38	17	38	35	46	33	52
1	-	23	0	45	31	37	50	45	35	40	48	48
2	94	51	56	52	50	67	49	67	54	> 67	60	66
3	87	70	72	77	62	77	77	70	> 72	70	63	> 67
4	88	> 73	> 80	> 76	> 73	> 72	> 77	> 80	> 73	> 72	> 73	> 67
5	> 89	> 73	72	79	76	> 73	> 73	> 78	> 79	> 73	> 73	> 72
6	> 89	> 73	71	> 73	> 80	> 78	> 72	> 73	74	78	> 74	> 74
7	> 84	> 67	> 73	> 73	> 73	> 80	77	> 72	> 74	74	> 80	71
8	> 84	> 68	64	> 73	> 73	> 73	> 79	> 78	71	> 78	> 76	> 73
9	> 84	67	> 67	> 68	> 73	> 72	> 72	> 80	> 78	> 79	> 79	> 79
10	> 78	59	65	> 66	> 67	> 74	> 74	> 72	> 80	> 79	> 80	> 78

Harmonic LO Order

test condition: RF IN: 1980.10 MHZ; -9.93 DBM
LO IN: 2180.01 MHZ; +12.96 DBM
IF OUT: 199.91 MHZ; -16.31 DBM

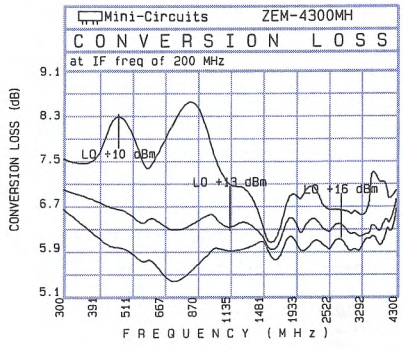
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	5	37	6	48	29	48	67	58	44	70
1	-	23	0	46	31	40	51	48	38	43	53	59
2	> 96	43	47	46	42	63	42	62	48	61	55	73
3	> 90	66	63	66	44	68	64	61	69	68	51	57
4	> 90	79	78	64	81	60	63	81	65	74	64	67
5	> 89	> 82	77	84	75	72	63	85	83	75	> 83	> 83
6	> 89	> 82	82	> 83	> 89	82	76	73	79	> 91	80	81
7	> 83	77	> 83	80	> 82	> 90	87	80	83	81	87	> 83
8	> 84	> 77	77	> 83	80	> 83	> 89	88	82	87	> 87	> 83
9	> 84	75	> 77	> 77	> 84	> 84	81	> 89	> 88	> 88	87	> 90
10	> 79	> 72	> 78	> 76	77	> 82	> 83	> 82	88	> 88	87	> 89

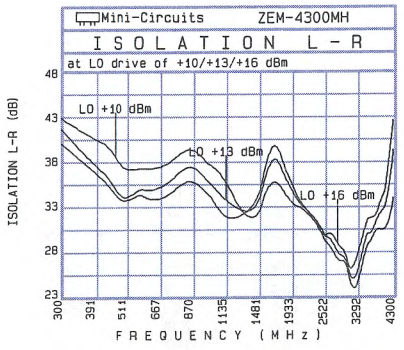
Harmonic LO Order

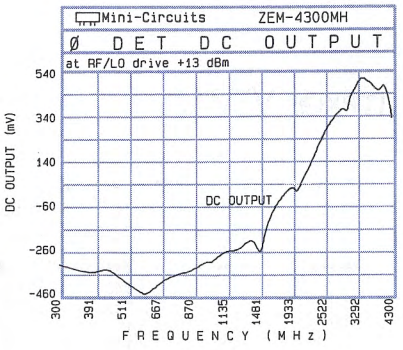
test condition: RF IN: 1980.10 MHZ; -.02 DBM
LO IN: 2180.01 MHZ; +12.96 DBM
IF OUT: 199.91 MHZ; -6.46 DBM

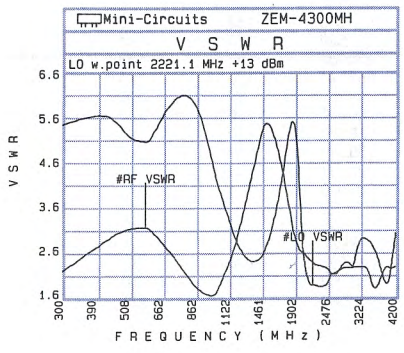
typical performance curves

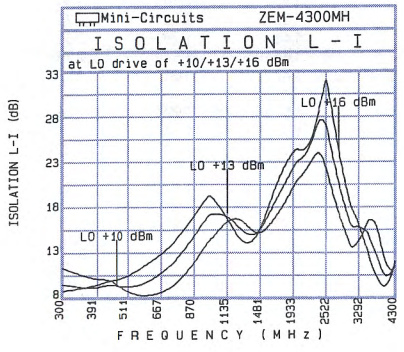
(production unit)

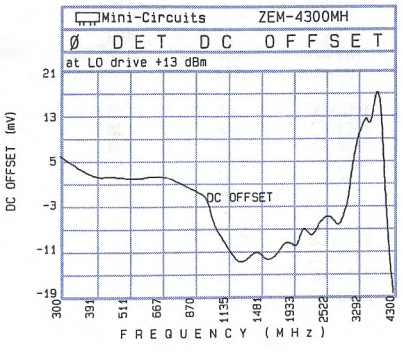












In Stock...Immediate Delivery

very high dynamic range

Frequency Mixers

LEVEL 17 (+17dBm LO, up to +10dBm RF)

Model
SYM-11H



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
50.000	120.000	6.60	6.20	6.10	50.000	42.44	47.66	51.38	35.38	38.14	40.17
90.000	160.000	6.50	6.10	6.20	80.000	46.39	50.07	50.74	37.39	39.91	42.42
100.000	170.000	6.51	6.24	6.15	100.000	47.33	50.35	50.28	38.07	41.04	43.72
218.750	288.750	6.60	6.35	6.20	250.000	45.74	43.82	42.54	40.23	40.83	40.03
250.000	320.000	6.52	6.27	6.13	293.750	44.27	41.93	40.58	40.18	39.07	37.70
337.500	407.500	6.69	6.37	6.24	415.625	41.81	39.87	39.01	38.85	37.13	35.75
500.000	570.000	6.72	6.37	6.24	500.000	40.39	38.49	37.76	37.92	35.80	34.52
575.000	645.000	6.88	6.48	6.33	659.375	38.47	36.98	36.50	36.01	33.49	32.28
750.000	820.000	6.82	6.46	6.33	903.125	37.24	36.16	35.35	33.44	31.66	30.83
812.500	882.500	6.90	6.51	6.36	1000.000	36.68	36.06	35.29	31.72	30.99	30.63
931.250	1001.250	6.94	6.63	6.48	1025.000	37.25	36.75	36.19	32.17	31.46	31.13
1000.000	1070.000	7.00	6.69	6.53	1146.875	38.03	36.24	35.47	29.84	29.45	29.10
1168.750	1238.750	6.87	6.60	6.51	1268.750	34.07	32.26	31.71	30.35	29.68	28.87
1287.500	1357.500	6.84	6.54	6.48	1500.000	33.43	31.19	30.07	29.83	29.69	29.53
1406.250	1476.250	7.06	6.68	6.59	1512.500	32.90	30.99	30.09	29.30	29.28	29.21
1500.000	1570.000	7.73	7.13	6.86	1634.375	36.41	34.38	33.03	29.06	29.85	30.41
1643.750	1713.750	8.05	7.50	7.22	1756.250	35.26	33.53	32.54	29.49	31.92	33.36
1881.250	1951.250	8.16	7.62	7.48	1878.125	35.89	33.28	31.64	29.38	31.14	31.53
1930.000	2000.000	8.28	7.63	7.43	1930.000	35.80	33.28	31.51	29.61	31.51	31.64
2000.000	1930.000	8.15	7.48	7.29	2000.000	34.92	32.60	31.02	29.62	30.67	30.81

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm
50.000	1.28	1.18	1.13	1.51	2.12	2.80	50.000	1.14	1.12	1.14
80.000	1.28	1.16	1.10	1.48	2.12	2.92	80.000	1.15	1.12	1.12
100.000	1.28	1.16	1.09	1.48	2.12	2.92	100.000	1.17	1.13	1.12
250.000	1.29	1.15	1.08	1.44	2.08	2.84	250.000	1.34	1.23	1.16
279.412	1.29	1.15	1.08	1.42	1.97	2.58	279.412	1.38	1.25	1.17
394.118	1.30	1.17	1.10	1.45	2.10	2.80	394.118	1.51	1.31	1.19
500.000	1.32	1.19	1.12	1.51	2.06	2.76	500.000	1.63	1.37	1.21
623.529	1.33	1.22	1.16	1.48	1.96	2.55	623.529	1.73	1.41	1.23
852.941	1.37	1.26	1.20	1.44	1.82	2.25	852.941	1.67	1.38	1.21
967.647	1.43	1.31	1.26	1.47	1.84	2.27	967.647	1.75	1.44	1.27
1000.000	1.44	1.33	1.27	1.51	1.92	2.46	1000.000	1.75	1.44	1.28
1082.353	1.48	1.36	1.30	1.43	1.74	2.14	1082.353	1.70	1.44	1.30
1250.000	1.57	1.44	1.38	1.62	2.04	2.58	1250.000	1.57	1.40	1.31
1426.471	1.68	1.54	1.47	1.61	1.84	2.23	1426.471	1.44	1.38	1.35
1500.000	1.71	1.57	1.49	1.85	1.89	2.23	1500.000	1.41	1.40	1.39
1541.176	1.74	1.59	1.51	1.80	1.80	2.08	1541.176	1.42	1.43	1.43
1750.000	1.84	1.67	1.58	1.92	1.85	2.08	1750.000	1.63	1.68	1.74
1885.294	1.85	1.69	1.59	2.01	1.77	1.87	1885.294	1.94	1.96	1.97
1930.000	1.84	1.68	1.59	2.10	1.80	1.91	1930.000	2.03	2.03	2.03
2000.000	1.84	1.67	1.58	1.92	1.68	1.74	2000.000	2.14	2.12	2.12

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Mini-Circuits

ULTRA•REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	14	25	30	34	39	34	41	64	42	50
1	-	21	+0	38	12	35	25	38	33	41	40	44
2	79	47	41	45	45	45	41	45	52	42	46	58
3	> 88	44	41	48	64	49	50	55	46	57	60	61
4	86	64	65	66	59	57	56	55	55	58	54	58
5	> 86	66	68	59	64	61	59	60	57	62	57	66
6	80	88	77	91	69	77	69	69	68	65	70	69
7	> 82	> 90	89	81	80	79	87	74	78	74	81	68
8	> 82	82	87	86	> 95	> 96	83	94	87	90	78	90
9	> 81	> 90	> 90	> 91	> 90	89	86	84	82	> 92	80	80
0	81	86	> 90	89	90	> 89	> 94	95	92	91	82	> 95

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; +4.94 DBM
LO IN: 900.01 MHZ; +17.02 DBM
IF OUT: 100.09 MHZ; -1.17 DBM

RF ORDER HARMONIC

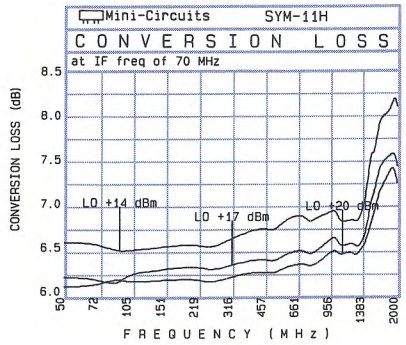
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	15	20	24	28	19	21	33	23	36
1	-	20	+0	35	12	36	26	41	34	39	33	35
2	89	63	45	58	47	52	47	51	57	49	52	56
3	> 97	57	63	64	67	64	61	64	58	73	63	64
4	> 97	85	76	81	78	78	80	76	78	76	73	80
5	> 96	> 86	> 86	82	82	84	85	> 85	> 86	> 85	83	83
6	> 91	79	84	85	85	> 85	> 86	> 86	> 85	> 85	> 86	> 86
7	> 91	> 80	76	> 85	84	> 87	> 86	84	> 85	> 85	> 86	> 86
8	91	> 80	> 81	80	> 86	> 86	> 86	> 86	82	84	80	85
9	91	79	> 80	> 80	> 80	> 86	> 86	> 86	> 85	> 85	85	> 86
10	> 91	> 81	79	78	80	> 80	> 85	> 86	> 86	85	81	> 86

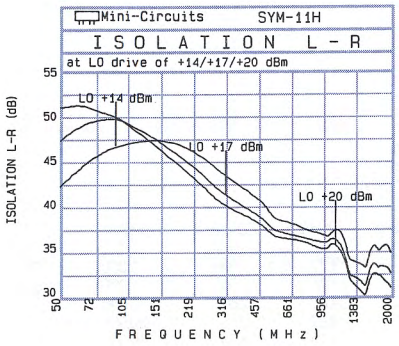
Harmonic LO Order

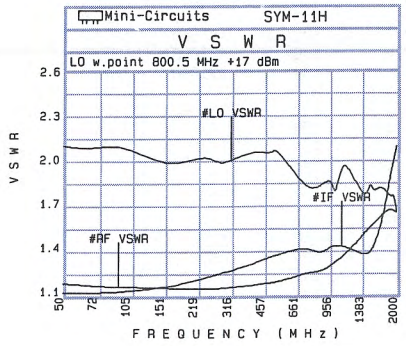
test condition: RF IN: 1000.10 MHZ; -5.07 DBM
LO IN: 900.01 MHZ; +17.02 DBM
IF OUT: 100.09 MHZ; -10.99 DBM

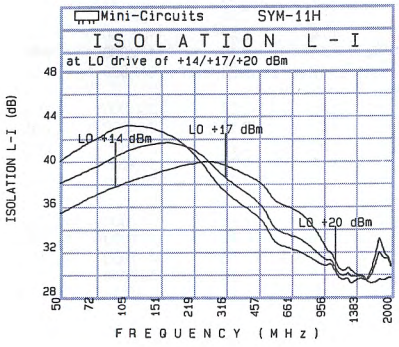
typical performance curves

(production unit)









In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14 dBm RF)

Models
RMS-1H
LRMS-1H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
2.000	32.000	7.57	6.78	6.41	2.000	81.98	79.29	82.48	71.18	69.19	68.76
4.000	34.000	7.39	6.60	6.22	4.000	72.53	72.35	71.57	69.53	63.39	60.08
5.000	35.000	7.37	6.57	6.17	5.000	71.15	71.51	71.45	68.75	62.98	59.64
10.000	40.000	7.34	6.55	6.16	10.000	65.40	65.84	66.21	67.50	61.30	57.95
20.000	50.000	7.21	6.48	6.14	20.000	58.89	59.50	59.74	65.57	58.68	55.05
35.200	65.200	6.96	6.36	6.09	50.000	50.89	51.64	52.16	59.79	53.67	50.73
50.000	80.000	7.24	6.53	6.15	50.190	50.86	51.61	52.13	59.74	53.63	50.71
85.000	55.000	7.14	6.47	6.15	98.390	44.74	45.13	45.32	57.32	48.67	45.35
100.000	70.000	7.16	6.48	6.15	100.000	44.61	44.98	45.16	57.39	48.52	45.07
134.800	104.800	7.10	6.32	6.01	146.580	40.93	41.19	41.80	54.39	46.50	42.42
184.600	154.600	7.14	6.35	6.03	194.770	37.95	38.78	39.25	48.00	44.90	41.99
200.000	170.000	7.22	6.40	6.03	200.000	37.74	38.62	39.06	47.27	44.42	41.61
234.400	204.400	6.97	6.30	6.00	242.970	36.20	36.44	36.72	43.46	41.20	38.39
250.000	220.000	6.93	6.22	5.96	250.000	35.88	36.14	36.35	43.00	41.01	37.98
284.200	254.200	7.07	6.22	5.96	291.160	34.03	35.11	35.73	39.80	38.57	37.07
334.000	304.000	6.77	6.18	6.04	339.350	33.02	33.38	33.79	37.62	37.07	35.58
383.800	353.800	6.68	6.11	5.93	387.550	32.06	32.33	31.78	34.32	33.77	33.58
433.600	403.600	6.58	6.16	6.06	435.740	31.30	32.22	32.26	31.30	31.10	31.71
483.400	453.400	6.75	6.45	6.35	483.940	30.58	31.29	31.48	29.60	29.09	29.35
500.000	470.000	6.80	6.45	6.33	500.000	29.94	30.80	30.79	29.14	28.30	28.39

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
2.000	1.31	1.33	1.37	1.22	1.77	2.58	2.000	1.02	1.07	1.13	2.000	930.60	0.13
5.000	1.17	1.20	1.25	1.15	1.75	2.56	5.000	1.01	1.06	1.12	5.000	940.10	0.07
10.000	1.11	1.15	1.20	1.22	1.82	2.67	10.000	1.02	1.04	1.10	10.000	949.80	0.11
20.000	1.10	1.14	1.19	1.22	1.82	2.66	20.000	1.01	1.04	1.10	20.000	938.60	0.12
50.000	1.09	1.13	1.19	1.19	1.75	2.54	50.000	1.03	1.04	1.10	47.270	923.80	0.09
81.000	1.09	1.14	1.20	1.19	1.75	2.54	81.000	1.04	1.04	1.09	92.550	928.70	0.08
100.000	1.10	1.14	1.19	1.20	1.76	2.54	100.000	1.05	1.05	1.10	100.000	922.30	0.09
133.000	1.12	1.15	1.20	1.24	1.74	2.52	133.000	1.07	1.06	1.10	137.820	922.70	-0.01
172.000	1.14	1.17	1.22	1.31	1.71	2.40	172.000	1.09	1.08	1.10	183.090	931.60	-0.32
212.000	1.17	1.19	1.24	1.40	1.69	2.33	212.000	1.11	1.09	1.11	200.000	907.80	-0.39
250.000	1.20	1.22	1.26	1.45	1.65	2.23	250.000	1.15	1.12	1.13	228.360	942.00	-0.62
264.000	1.21	1.23	1.27	1.46	1.62	2.18	264.000	1.10	1.06	1.08	243.450	949.20	-1.12
277.000	1.22	1.24	1.28	1.47	1.63	2.17	277.000	1.14	1.11	1.11	250.000	956.30	-1.28
303.000	1.24	1.26	1.30	1.52	1.62	2.12	303.000	1.16	1.13	1.13	273.640	937.60	-1.45
343.000	1.28	1.30	1.34	1.60	1.58	1.99	343.000	1.19	1.16	1.15	318.910	987.10	-0.87
382.000	1.32	1.34	1.38	1.65	1.54	1.88	382.000	1.22	1.18	1.17	364.180	1026.20	-1.12
421.000	1.37	1.39	1.42	1.68	1.51	1.79	421.000	1.24	1.20	1.19	409.450	992.40	-1.66
461.000	1.42	1.44	1.47	1.64	1.45	1.73	461.000	1.27	1.23	1.21	454.730	988.00	-1.93
487.000	1.46	1.47	1.50	1.63	1.41	1.70	487.000	1.28	1.25	1.23	484.910	924.50	-1.88
500.000	1.48	1.49	1.53	1.62	1.39	1.71	500.000	1.29	1.25	1.23	500.000	909.60	-2.66

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE*

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	23	11	28	21	31	40	41	26	37
1	-	16	+0	33	19	59	19	36	20	35	24	34
2	51	53	41	74	65	67	59	66	60	71	64	72
3	61	60	52	>80	60	77	56	71	59	70	65	73
4	90	77	78	>80	79	>80	>79	78	>79	>80	79	>80
5	96	>79	>79	>80	>80	78	>80	>80	79	79	79	>80
6	>97	>80	>80	>79	>80	79	79	>80	>79	>80	79	>80
7	>97	>79	>79	>79	>80	>80	>80	>78	>80	>80	78	>80
8	>96	>79	>79	78	>80	>79	79	>80	79	79	>80	79
9	>96	>80	>79	>79	>79	>79	>79	>80	>79	>79	>79	79
10	95	>79	77	79	>79	78	79	>79	>79	>80	79	>80

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -10.03 DBM
LO IN: 155.01 MHZ; +17.00 DBM
IF OUT: 30.09 MHZ; -16.80 DBM

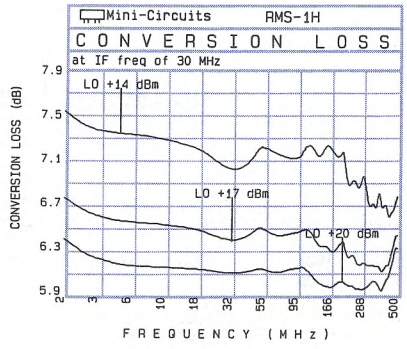
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	28	33	21	38	31	40	56	50	39	51
1	-	16	+0	34	17	50	22	38	22	35	25	35
2	41	55	41	68	65	63	58	63	59	67	56	62
3	50	55	55	63	45	69	43	58	45	56	48	58
4	82	82	67	83	68	80	76	78	76	83	74	86
5	96	79	75	85	64	82	62	75	68	75	78	86
6	>97	89	86	>90	87	>90	83	>89	84	>90	84	>90
7	96	86	88	>89	82	>89	81	87	86	87	84	>89
8	>97	88	>90	>89	>90	>90	87	89	>90	>90	88	>90
9	>97	>89	>89	>90	>89	88	89	>90	89	89	>90	>90
10	>96	87	88	>89	89	>89	>90	>89	89	>90	>90	>89

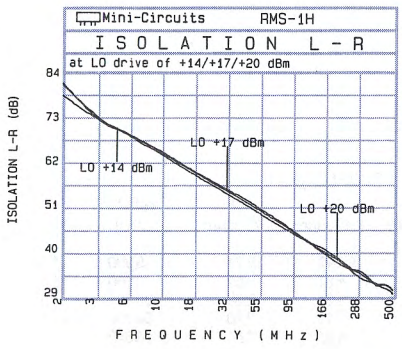
Harmonic LO Order

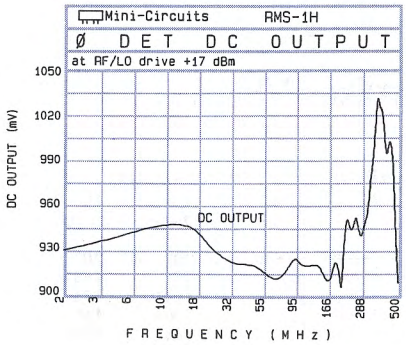
test condition: RF IN: 185.10 MHZ; -.04 DBM
LO IN: 155.01 MHZ; +17.00 DBM
IF OUT: 30.09 MHZ; -6.72 DBM

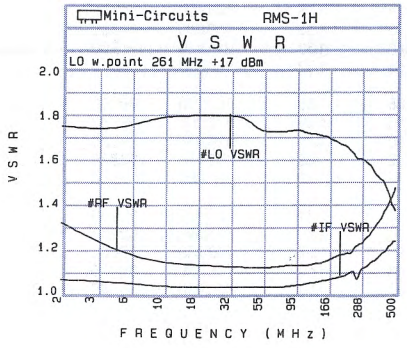
typical performance curves

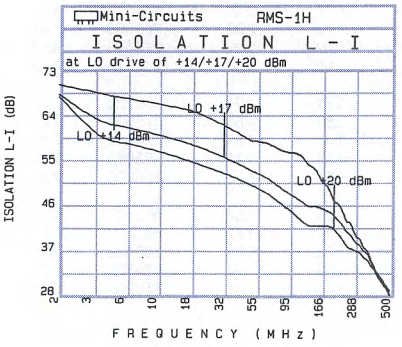
(production unit)

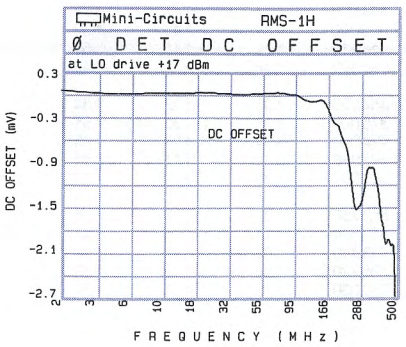












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models
RMS-1WH
LRMS-1WH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
5.000	35.000	8.68	7.75	7.20	5.000	64.86	66.55	68.27	73.06	73.50	71.89
10.000	40.000	8.40	7.52	7.00	10.000	62.27	63.83	65.42	72.36	69.50	66.38
20.000	50.000	8.41	7.55	7.01	20.000	57.44	59.08	60.58	71.26	64.80	60.89
50.000	80.000	8.43	7.42	6.90	50.000	50.45	52.11	53.60	67.76	57.91	53.86
74.840	44.844	8.30	7.41	6.91	74.840	46.95	48.49	49.98	64.89	53.78	49.60
100.000	70.000	8.32	7.39	6.91	100.000	44.50	46.11	47.57	63.75	51.70	47.52
144.690	114.688	8.42	7.45	6.92	144.690	41.50	42.99	44.25	62.95	49.47	45.02
200.000	170.000	8.27	7.30	6.79	200.000	38.70	40.13	41.60	60.40	47.34	43.07
214.530	184.531	8.37	7.40	6.84	214.530	38.06	39.53	40.73	59.55	46.89	42.48
284.370	254.375	8.22	7.23	6.78	284.370	35.96	37.33	38.39	53.28	45.02	41.00
354.220	324.219	8.24	7.16	6.80	354.220	34.04	35.54	36.42	48.78	43.14	39.28
375.000	345.000	8.06	7.05	6.70	375.000	33.67	35.14	36.16	48.58	42.85	38.45
424.060	394.063	8.08	7.16	6.82	424.060	32.81	34.14	35.33	44.82	41.59	38.28
493.910	463.906	7.83	7.03	6.75	493.910	32.03	33.18	33.86	39.28	37.59	35.97
500.000	470.000	7.82	7.01	6.74	500.000	31.90	33.08	33.79	39.07	37.44	35.96
563.750	533.750	7.84	7.11	6.82	563.750	31.59	32.88	33.69	35.77	35.30	34.45
633.590	603.594	7.87	7.37	7.07	633.590	31.33	32.86	33.79	32.18	31.86	32.61
703.440	673.438	7.83	7.34	7.10	703.440	30.56	32.15	33.18	30.77	31.10	30.99
726.720	696.719	7.97	7.41	7.12	726.720	30.39	32.02	32.84	29.94	30.76	30.43
750.000	720.000	8.11	7.47	7.15	750.000	30.20	31.80	32.59	28.89	30.34	30.31

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.94	2.02	2.07	1.52	1.97	2.71	5.000	1.30	1.07	1.07	5.000	887.60	0.25
10.000	1.58	1.71	1.83	1.32	1.87	2.69	10.000	1.31	1.07	1.06	10.000	888.60	0.23
20.000	1.45	1.61	1.74	1.24	1.84	2.58	20.000	1.31	1.08	1.07	20.000	876.20	0.19
50.000	1.39	1.56	1.68	1.31	1.92	2.70	50.000	1.33	1.12	1.10	50.000	891.10	-0.04
74.840	1.35	1.53	1.65	1.25	1.86	2.61	74.840	1.37	1.16	1.13	74.840	889.60	-0.22
100.000	1.33	1.50	1.62	1.25	1.81	2.54	100.000	1.41	1.21	1.17	100.000	885.20	-0.61
144.690	1.32	1.47	1.58	1.27	1.77	2.47	144.690	1.52	1.31	1.25	144.690	863.50	-1.53
200.000	1.32	1.43	1.52	1.31	1.70	2.32	200.000	1.67	1.45	1.36	200.000	892.30	-2.85
214.530	1.32	1.41	1.50	1.33	1.70	2.29	214.530	1.71	1.48	1.38	214.530	913.00	-3.22
284.370	1.34	1.37	1.42	1.38	1.58	2.07	284.370	1.94	1.66	1.52	284.370	886.10	-5.61
354.220	1.35	1.32	1.34	1.45	1.51	1.94	354.220	2.20	1.86	1.66	354.220	990.80	-5.62
375.000	1.35	1.30	1.31	1.48	1.50	1.86	375.000	2.25	1.90	1.69	375.000	988.60	-6.15
424.060	1.34	1.25	1.25	1.50	1.44	1.85	424.060	2.41	2.00	1.75	424.060	892.00	-8.95
493.910	1.30	1.17	1.15	1.49	1.36	1.71	493.910	2.60	2.12	1.82	493.910	933.30	-11.44
500.000	1.29	1.17	1.14	1.48	1.36	1.74	500.000	2.58	2.14	1.82	500.000	936.50	-11.69
563.750	1.22	1.08	1.07	1.42	1.29	1.64	563.750	2.62	2.15	1.81	563.750	822.90	-10.06
633.590	1.11	1.03	1.13	1.33	1.29	1.72	633.590	2.59	2.10	1.77	633.590	829.40	-14.53
703.440	1.02	1.17	1.27	1.25	1.36	1.92	703.440	2.45	1.99	1.67	703.440	779.80	-16.35
726.720	1.06	1.22	1.33	1.22	1.40	1.94	726.720	2.39	1.93	1.63	726.720	818.70	-19.81
750.000	1.12	1.28	1.39	1.21	1.46	2.11	750.000	2.31	1.87	1.58	750.000	860.40	-20.55

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	8	28	+1	9	10	54	59	58	46	53
1	-	15	+0	29	19	40	25	40	51	71	55	71
2	88	61	47	51	50	57	55	66	53	> 78	78	> 79
3	> 95	75	69	77	61	72	61	73	60	71	74	77
4	> 95	> 78	> 78	> 77	> 79	> 79	> 79	78	77	77	77	> 77
5	94	> 77	> 77	> 79	74	77	> 79	> 79	> 80	78	> 78	> 78
6	93	> 77	> 77	> 77	> 78	> 79	> 80	78	> 78	> 78	> 78	> 78
7	> 96	> 79	76	> 76	> 78	> 78	76	78	77	75	> 78	78
8	> 96	75	> 79	> 78	76	77	> 78	> 78	> 78	> 79	> 78	> 78
9	> 95	> 77	> 78	77	> 78	> 78	> 78	77	> 78	> 79	> 79	> 79
10	> 97	77	> 78	> 79	> 77	> 78	> 78	74	> 78	> 79	> 78	> 79

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -9.94 DBM
LO IN: 470.01 MHZ; + 16.92 DBM
IF OUT: 30.09 MHZ; -17.40 DBM

RF CAL

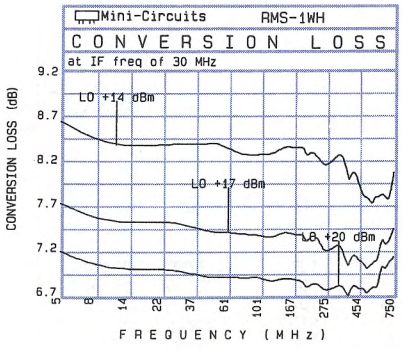
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	40	10	20	21	64	64	71	57	66
1	-	15	+0	28	18	55	27	40	55	73	59	76
2	71	55	40	46	41	51	45	61	50	81	85	> 88
3	87	64	59	62	47	56	44	70	43	55	77	> 88
4	95	66	67	69	70	69	67	72	64	65	59	> 87
5	> 94	> 87	69	74	70	75	67	74	70	84	70	84
6	94	86	86	81	83	86	82	81	79	81	82	79
7	> 96	> 88	> 87	85	86	85	83	> 88	84	87	88	> 88
8	93	87	> 88	> 88	85	> 88	84	> 89	> 88	> 89	87	> 89
9	93	87	> 88	87	> 89	> 87	> 88	87	> 89	> 88	> 88	> 89
10	> 95	> 89	> 87	87	87	> 88	87	> 87	87	> 88	> 88	> 89

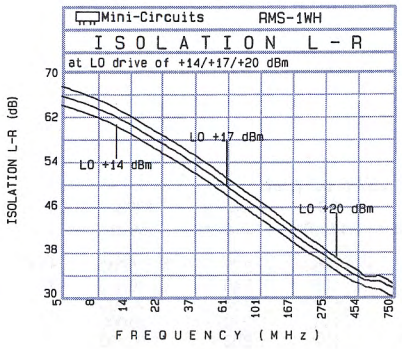
Harmonic LO Order

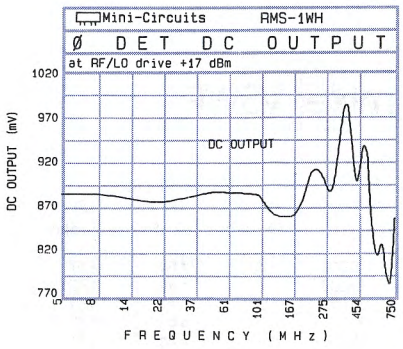
test condition: RF IN: 500.10 MHZ; -.03 DBM
LO IN: 470.01 MHZ; + 16.92 DBM
IF OUT: 30.09 MHZ; -7.45 DBM

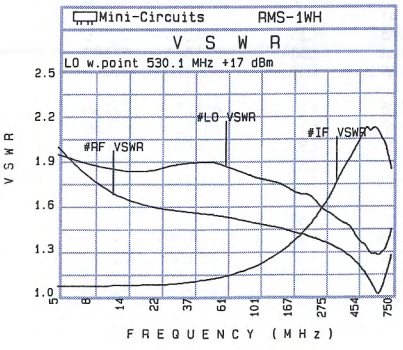
typical performance curves

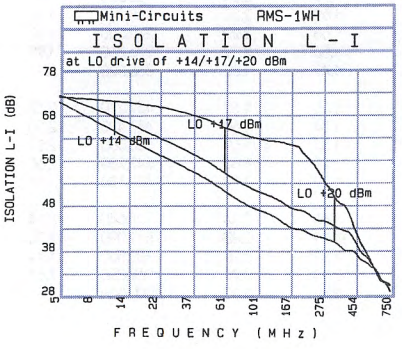
(production unit)

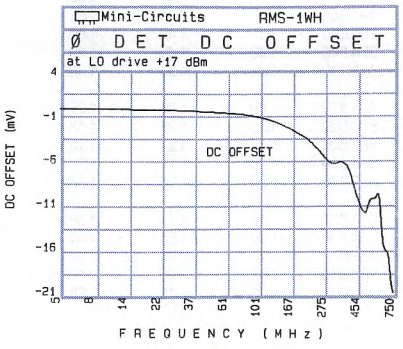












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models
RMS-2H
LRMS-2H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
5.000	35.000	9.06	7.85	7.26	5.000	64.63	66.33	68.05	72.73	72.89	71.08
10.000	40.000	8.86	7.64	7.07	10.000	62.11	63.63	65.24	71.84	68.70	65.74
20.000	50.000	8.86	7.69	7.10	20.000	57.30	58.93	60.41	69.99	63.79	60.12
50.000	80.000	8.75	7.55	6.99	50.000	50.35	52.00	53.52	65.16	56.89	53.18
95.450	65.454	8.71	7.54	7.02	95.450	44.81	46.41	47.87	61.07	50.84	47.07
100.000	70.000	8.71	7.53	7.00	100.000	44.43	46.04	47.54	61.18	50.67	46.89
185.910	155.909	8.67	7.51	6.95	185.910	39.30	40.70	42.05	59.00	46.79	42.59
200.000	170.000	8.52	7.37	6.86	200.000	38.67	40.02	41.52	59.36	46.99	42.87
276.360	246.364	8.47	7.35	6.86	276.360	36.16	37.35	38.55	52.92	44.46	40.70
366.820	336.818	8.38	7.22	6.85	366.820	33.78	35.28	36.25	47.94	42.69	38.37
457.270	427.273	7.95	7.11	6.80	457.270	32.51	33.66	34.50	42.04	39.45	37.22
487.420	457.424	8.05	7.17	6.86	487.420	32.07	33.17	33.88	39.68	37.61	35.77
500.000	470.000	7.90	7.07	6.78	500.000	31.88	33.04	33.73	38.94	37.36	35.77
547.730	517.727	7.89	7.11	6.83	547.730	31.74	32.95	33.80	36.39	35.68	34.48
638.180	608.182	8.02	7.46	7.13	638.180	31.12	32.78	33.65	32.03	31.60	32.17
728.640	698.636	8.08	7.45	7.16	728.640	30.41	31.90	32.72	29.84	30.61	30.26
819.090	789.091	8.61	7.76	7.43	819.090	29.53	30.74	31.45	26.63	28.78	30.22
909.550	879.546	8.97	8.24	7.88	909.550	28.77	29.67	30.61	24.81	27.10	29.16
969.850	939.849	9.36	8.54	8.05	969.850	28.63	29.46	30.42	24.08	25.48	27.85
1000.000	970.000	9.53	8.75	8.20	1000.000	28.51	29.31	30.21	23.73	24.84	27.16

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
5.000	1.40	1.54	1.67	1.52	1.95	2.77	5.000	1.31	1.07	1.07	5.000	891.20	0.22
10.000	1.32	1.49	1.62	1.31	1.85	2.65	10.000	1.32	1.08	1.06	10.000	889.50	0.21
20.000	1.30	1.47	1.61	1.22	1.79	2.54	20.000	1.32	1.08	1.07	20.000	885.70	0.19
50.000	1.29	1.45	1.59	1.29	1.91	2.70	50.000	1.34	1.12	1.10	50.000	892.20	0.01
98.280	1.29	1.44	1.56	1.23	1.79	2.53	95.450	1.41	1.20	1.17	95.450	890.80	0.00
100.000	1.30	1.43	1.55	1.23	1.79	2.54	100.000	1.41	1.21	1.17	100.000	886.60	-0.64
191.560	1.36	1.43	1.52	1.31	1.69	2.30	185.910	1.62	1.41	1.32	185.910	876.90	-2.53
200.000	1.37	1.42	1.50	1.32	1.68	2.29	200.000	1.67	1.45	1.35	200.000	896.10	-2.87
284.840	1.43	1.40	1.42	1.38	1.56	2.09	276.360	1.92	1.64	1.50	276.360	893.90	-5.26
378.130	1.44	1.34	1.32	1.48	1.47	1.82	366.820	2.24	1.88	1.67	366.820	994.90	-5.70
471.410	1.40	1.25	1.20	1.49	1.36	1.62	457.270	2.47	2.05	1.78	457.270	927.00	-10.54
500.000	1.38	1.24	1.18	1.49	1.34	1.69	487.420	2.56	2.10	1.81	487.420	931.30	-10.77
502.500	1.35	1.21	1.15	1.49	1.34	1.69	500.000	2.57	2.11	1.82	500.000	939.80	-11.79
564.690	1.25	1.11	1.07	1.45	1.28	1.60	547.730	2.60	2.11	1.80	547.730	833.30	-9.46
657.970	1.09	1.06	1.16	1.35	1.29	1.78	638.180	2.54	2.07	1.75	638.180	821.00	-13.64
751.250	1.13	1.27	1.39	1.24	1.46	2.24	728.640	2.34	1.89	1.60	728.640	826.00	-19.87
844.530	1.39	1.54	1.66	1.33	1.81	2.80	819.090	2.03	1.65	1.42	819.090	795.10	-23.51
937.810	1.74	1.90	2.04	1.60	2.21	3.20	909.550	1.74	1.44	1.24	909.550	764.20	-28.50
984.450	1.91	2.06	2.19	1.73	2.34	3.29	969.850	1.61	1.34	1.18	969.850	656.10	-29.12
1000.000	1.97	2.10	2.23	1.79	2.40	3.39	1000.000	1.57	1.32	1.19	1000.000	669.00	-27.57

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	8	28	+1	9	10	54	59	58	46	53
1	-	15	+0	29	19	40	25	40	51	71	55	71
2	88	61	47	51	50	57	55	66	53	> 78	78	> 79
3	> 95	75	69	77	61	72	61	73	60	71	74	77
4	> 95	> 78	> 78	> 77	> 79	> 79	> 79	78	77	77	77	> 77
5	94	> 77	> 77	> 79	74	77	> 79	> 79	> 80	78	> 78	> 78
6	93	> 77	> 77	> 77	> 78	> 79	> 80	78	> 78	> 78	> 78	> 78
7	> 96	> 79	76	> 76	> 78	> 78	76	78	77	75	> 78	78
8	> 96	75	> 79	> 78	76	77	> 78	> 78	> 78	> 79	> 78	> 78
9	> 95	> 77	> 78	77	> 78	> 78	> 78	77	> 78	> 79	> 79	> 79
10	> 97	77	> 78	> 79	> 77	> 78	> 78	74	> 78	> 79	> 78	> 79

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -9.94 DBM
LO IN: 470.01 MHZ; +16.92 DBM
IF OUT: 30.09 MHZ; -17.40 DBM

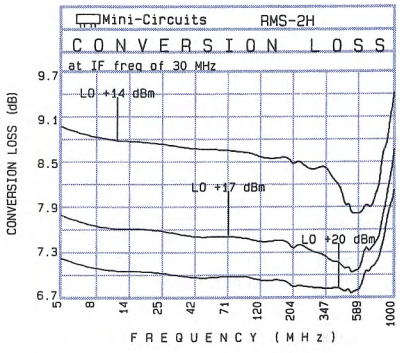
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	40	10	20	21	64	64	71	57	66
1	-	15	+0	28	18	55	27	40	55	73	59	76
2	71	55	40	46	41	51	45	61	50	81	85	> 88
3	87	64	59	62	47	56	44	70	43	55	77	> 88
4	95	66	67	69	70	69	67	72	64	65	59	> 87
5	> 94	> 87	69	74	70	75	67	74	70	84	70	84
6	94	86	86	81	83	86	82	81	79	81	82	79
7	> 96	> 88	> 87	85	86	85	83	> 88	84	87	88	> 88
8	93	87	> 88	> 88	85	> 88	84	> 89	> 88	> 89	87	> 89
9	93	87	> 88	87	> 89	> 87	> 88	87	> 89	> 88	> 88	> 89
10	> 95	> 89	> 87	87	87	> 88	87	> 87	87	> 88	> 88	> 89

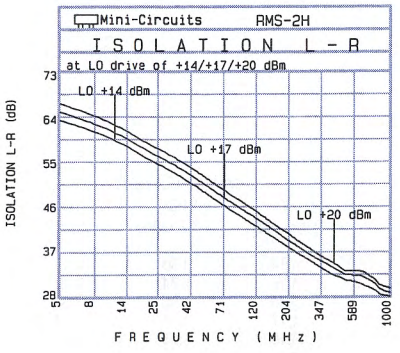
Harmonic LO Order

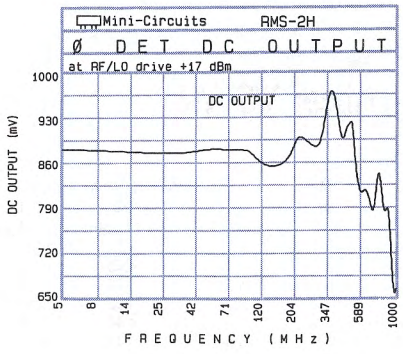
test condition: RF IN: 500.10 MHZ; -.03 DBM
LO IN: 470.01 MHZ; +16.92 DBM
IF OUT: 30.09 MHZ; -7.45 DBM

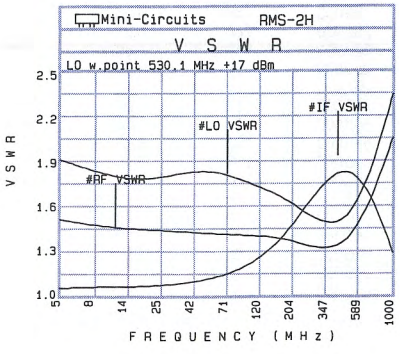
typical performance curves

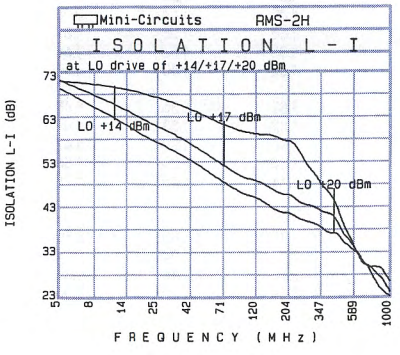
(production unit)

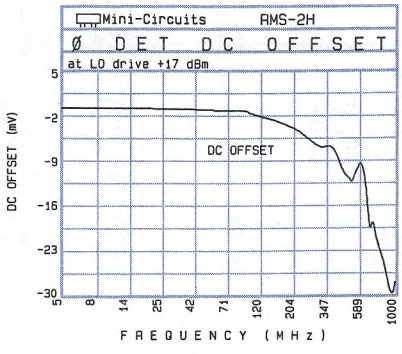












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17dBm LO, up to +14dBm RF)

Models
RMS-2UH
LRMS-2UH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
10.000	40.000	7.08	6.57	6.19	10.000	65.08	63.77	61.28	57.77	56.97	56.13
20.000	50.000	7.08	6.50	6.13	20.000	60.51	60.57	59.58	56.03	55.13	54.27
50.000	80.000	7.01	6.37	5.98	50.000	54.05	55.16	55.63	54.73	52.62	50.70
97.350	67.353	6.91	6.33	5.95	97.350	48.32	49.98	51.11	54.30	49.21	46.37
100.000	70.000	6.91	6.34	5.96	100.000	48.10	49.79	50.93	54.36	49.22	46.29
184.710	154.706	7.06	6.58	6.34	184.710	43.52	44.84	45.99	60.38	46.89	41.99
200.000	170.000	7.03	6.61	6.36	200.000	42.86	44.17	45.31	55.81	46.34	41.53
272.060	242.059	7.67	7.05	6.61	272.060	40.38	41.60	43.02	45.75	42.28	38.59
359.410	329.412	8.57	7.68	6.91	359.410	38.04	39.85	41.63	40.20	39.62	36.25
446.760	416.765	9.29	8.11	7.36	446.760	36.84	39.07	41.12	37.27	36.19	34.46
475.880	445.882	9.40	8.07	7.24	475.880	37.13	39.72	41.74	36.93	35.21	33.32
500.000	470.000	9.46	8.04	7.20	500.000	37.07	39.78	42.20	36.28	35.17	33.32
534.120	504.118	9.34	8.08	7.27	534.120	36.84	39.35	41.66	35.62	35.18	33.45
621.470	591.471	9.70	8.27	7.45	621.470	36.35	37.94	39.71	34.47	34.61	33.76
708.820	678.824	10.44	8.76	7.79	708.820	35.92	37.24	38.09	36.46	34.54	33.07
796.180	766.177	10.20	8.91	8.00	796.180	35.31	36.08	36.37	43.54	36.92	34.17
883.530	853.529	10.34	9.44	8.77	883.530	36.06	36.18	36.17	40.31	42.57	37.49
941.760	911.765	10.27	9.54	8.98	941.760	36.50	36.44	36.20	34.52	38.78	37.29
970.880	940.882	9.94	9.32	8.90	970.880	36.90	36.79	36.44	32.01	35.40	35.45
1000.000	970.000	10.18	9.47	9.22	1000.000	36.43	36.36	36.07	29.80	32.59	32.96

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm
10.000	1.49	1.46	1.45	1.54	1.86	2.56	10.000	1.85	1.80	1.80
20.000	1.29	1.25	1.23	1.26	1.74	2.49	20.000	1.43	1.40	1.44
50.000	1.26	1.20	1.16	1.16	1.80	2.56	50.000	1.21	1.12	1.19
100.000	1.41	1.34	1.30	1.17	1.68	2.34	100.000	1.24	1.05	1.10
115.000	1.46	1.39	1.35	1.18	1.68	2.35	115.000	1.27	1.09	1.11
190.000	1.83	1.73	1.69	1.44	1.64	2.11	190.000	1.43	1.24	1.18
200.000	1.90	1.80	1.75	1.49	1.64	2.08	200.000	1.46	1.26	1.19
280.000	2.34	2.19	2.11	1.68	1.58	1.87	280.000	1.60	1.35	1.23
370.000	3.00	2.71	2.54	1.85	1.52	1.68	370.000	1.69	1.38	1.21
460.000	3.18	2.81	2.58	1.82	1.40	1.50	460.000	1.60	1.30	1.13
490.000	3.21	2.82	2.56	1.82	1.36	1.45	490.000	1.57	1.28	1.14
500.000	3.17	2.77	2.52	1.82	1.33	1.49	500.000	1.54	1.26	1.14
550.000	2.97	2.53	2.26	1.70	1.29	1.47	550.000	1.46	1.33	1.35
640.000	2.49	2.14	1.96	1.54	1.25	1.56	640.000	1.37	1.46	1.60
730.000	2.29	2.01	1.85	1.41	1.35	1.78	730.000	1.50	1.78	2.02
820.000	2.57	2.28	2.13	1.49	1.58	1.98	820.000	1.87	2.24	2.56
910.000	3.14	2.83	2.64	1.78	1.83	2.19	910.000	2.26	2.59	2.92
970.000	3.81	3.45	3.21	2.12	2.04	2.34	970.000	2.52	2.82	3.11
985.000	4.26	3.82	3.54	2.28	2.11	2.34	985.000	2.64	2.93	3.21
1000.000	4.39	3.91	3.67	2.49	2.20	2.35	1000.000	2.65	2.91	3.16

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF \ CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	2	23	+3	40	+0	40	33	56	54	72
1	-	29	+0	29	18	30	53	37	51	66	56	70
2	88	63	63	56	66	64	57	73	58	> 77	73	> 78
3	94	75	66	74	63	72	67	73	> 77	> 77	74	> 76
4	94	> 77	> 78	> 77	> 78	77	77	> 78	77	> 77	> 77	> 77
5	> 94	76	> 76	77	> 78	> 78	> 78	> 77	> 79	> 77	> 77	76
6	> 94	> 77	> 77	> 78	> 77	76	> 78	> 79	77	> 78	> 78	> 77
7	91	77	73	74	> 77	> 78	77	> 78	> 78	> 79	> 78	> 78
8	> 96	> 78	> 78	> 78	> 75	> 77	> 78	> 77	> 78	> 78	> 79	> 78
9	> 95	> 77	> 78	> 77	> 77	76	> 77	> 78	> 77	> 77	> 77	> 79
10	> 95	75	> 77	> 77	77	> 76	> 77	> 78	> 78	> 77	> 78	> 78

Harmonic LO Order

test condition: RF IN: 500.10 MHZ; -9.90 DBM
LO IN: 470.01 MHZ; + 16.99 DBM
IF OUT: 30.09 MHZ; -18.05 DBM

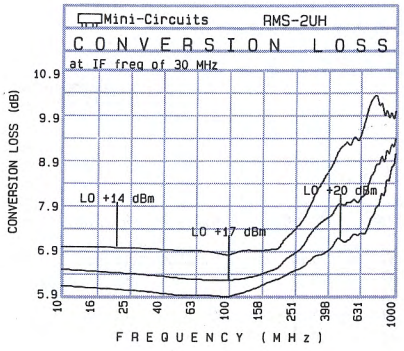
RF \ CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	32	8	50	10	51	44	68	66	83
1	-	29	+0	30	17	30	56	37	52	65	57	73
2	71	55	52	49	53	56	48	69	54	77	69	77
3	87	66	49	62	45	60	48	63	73	64	86	82
4	94	82	86	72	78	67	73	68	82	> 87	71	> 86
5	> 95	> 87	86	84	76	78	72	74	71	79	86	85
6	91	> 86	85	> 88	87	84	85	83	81	81	86	86
7	> 96	> 88	> 86	85	86	> 88	87	87	87	> 88	87	> 88
8	94	> 87	86	> 87	> 86	86	> 88	> 88	87	84	86	> 88
9	> 95	> 87	> 88	> 87	> 88	> 87	86	86	> 87	> 87	> 87	> 88
10	> 95	> 87	> 87	> 87	> 87	86	> 87	> 87	> 88	> 87	> 87	84

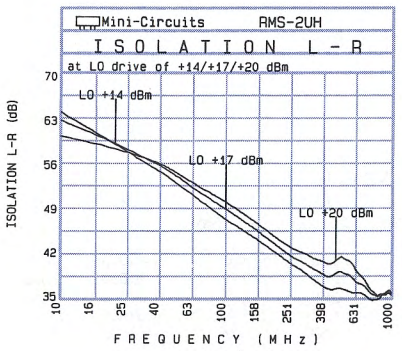
Harmonic LO Order

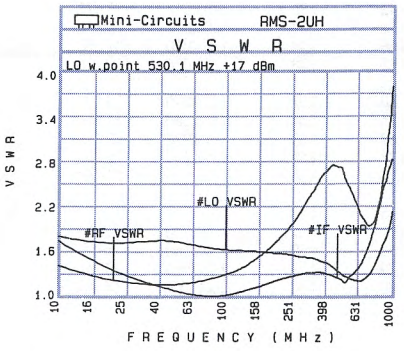
test condition: RF IN: 500.10 MHZ; 0.00 DBM
LO IN: 470.01 MHZ; + 16.99 DBM
IF OUT: 30.09 MHZ; -8.10 DBM

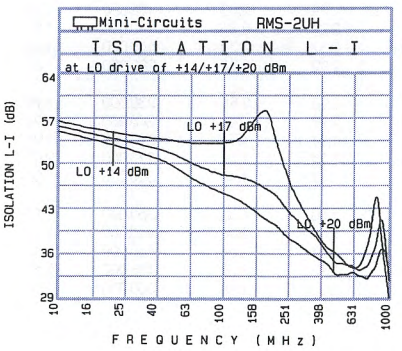
typical performance curves

(production unit)









In Stock...Immediate Delivery

ultra-low distortion

Frequency Mixers

LEVEL 23 (+23dBm LO, up to +15dBm RF)

Model
RAY-11



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +20 dBm	LO +23 dBm	LO +26 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +20 dBm	LO +23 dBm	LO +26 dBm	Isolation L-I (dB) LO +20 dBm	LO +23 dBm	LO +26 dBm
100.000	130.000	8.26	6.80	5.95	100.000	56.64	57.63	56.43	42.08	42.09	42.22
200.000	230.000	7.78	6.92	6.09	200.000	50.45	51.54	46.32	39.00	42.54	47.95
332.260	362.258	8.07	6.89	5.99	332.260	45.92	47.39	42.95	34.27	38.02	48.90
500.000	530.000	7.03	6.39	5.94	500.000	44.78	47.64	46.77	27.06	31.79	37.13
564.520	534.516	7.13	6.40	5.92	564.520	44.87	47.27	42.20	25.63	29.16	34.90
796.770	766.774	9.12	7.84	6.92	796.770	45.01	48.68	52.69	23.56	25.70	27.49
1000.000	970.000	7.62	7.12	6.84	1000.000	40.46	43.65	48.41	19.46	20.91	22.20
1029.030	999.032	7.75	7.09	6.79	1029.030	39.73	42.35	48.15	19.00	20.20	21.38
1200.000	1170.000	7.40	6.60	6.35	1200.000	38.22	40.57	42.78	17.72	18.33	18.93
1250.000	1220.000	7.18	6.54	6.30	1250.000	38.63	40.50	42.82	18.30	18.94	19.49
1261.290	1231.290	7.33	6.61	6.36	1261.290	38.52	40.48	43.47	18.50	19.06	19.65
1416.130	1386.129	8.90	8.12	7.61	1416.130	37.63	40.54	45.65	19.18	19.84	20.37
1570.970	1540.968	9.71	8.52	7.93	1570.970	36.63	38.53	41.52	19.91	21.16	22.38
1803.230	1773.226	8.79	7.98	7.58	1803.230	36.21	37.48	39.26	21.42	23.58	25.52
2000.000	1970.000	8.68	7.79	7.29	2000.000	35.13	36.62	38.14	24.78	26.62	26.69
2035.480	2005.484	8.73	7.71	7.17	2035.480	35.13	36.57	38.35	25.82	27.20	26.83
2200.000	2170.000	8.50	7.86	7.37	2200.000	34.45	36.32	37.72	30.93	28.35	25.92
2345.160	2315.161	8.01	7.50	7.04	2345.160	34.03	36.12	37.73	30.54	26.61	24.35
2422.580	2392.581	7.75	7.31	6.98	2422.580	33.88	36.72	39.23	28.22	25.92	24.69
2500.000	2470.000	7.53	7.10	6.78	2500.000	34.65	38.10	41.97	27.20	26.17	25.27

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +20 dBm	LO +23 dBm	LO +26 dBm	VSWR LO port LO +20 dBm	LO +23 dBm	LO +26 dBm	FREQ. (MHz)	VSWR IF port LO +20 dBm	LO +23 dBm	LO +26 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
100.000	2.35	2.26	2.14	2.03	2.35	2.53	5.000	1.59	1.31	1.14	100.000	-1147.50	8.65
200.000	2.81	2.58	2.36	1.65	2.14	2.42	10.000	1.62	1.32	1.15	200.000	-1288.80	6.90
325.000	3.00	2.84	2.58	1.41	2.00	2.28	20.000	1.63	1.33	1.16	254.840	-1206.70	9.88
500.000	3.11	3.10	2.95	1.35	1.64	1.74	50.000	1.66	1.37	1.20	487.100	-1347.60	10.62
550.000	2.98	2.98	2.83	1.35	1.59	1.74	57.500	1.64	1.36	1.21	500.000	-1315.60	10.26
775.000	2.69	2.58	2.49	1.39	1.47	1.52	95.000	1.66	1.41	1.27	719.350	-1066.90	-7.51
1000.000	2.15	2.08	2.09	2.42	2.39	2.42	100.000	1.68	1.42	1.28	951.610	-978.70	-6.22
1037.500	2.22	2.15	2.17	2.31	2.24	2.26	140.000	1.81	1.52	1.37	1000.000	-892.30	-8.33
1200.000	2.57	2.39	2.23	2.80	2.37	2.33	185.000	1.85	1.58	1.44	1183.870	-1071.50	13.53
1225.000	2.53	2.33	2.16	3.91	2.92	2.78	200.000	1.89	1.63	1.48	1200.000	-1100.30	12.83
1300.000	2.94	2.59	2.25	3.99	2.98	2.81	230.000	1.95	1.68	1.52	1261.290	-724.70	10.94
1450.000	3.39	3.18	2.84	3.89	2.70	2.43	245.000	1.98	1.71	1.54	1416.130	-577.30	-5.47
1600.000	3.72	3.66	3.38	2.53	1.85	1.71	250.000	1.96	1.69	1.53	1570.970	-522.60	-13.41
1825.000	2.32	2.29	2.16	1.76	1.34	1.29	275.000	2.07	1.77	1.59	1803.230	-321.80	-4.06
2000.000	2.09	2.04	1.94	1.93	1.47	1.40	320.000	2.06	1.76	1.58	2000.000	-236.61	0.95
2050.000	2.22	2.18	2.07	2.12	1.60	1.52	365.000	2.18	1.85	1.63	2035.480	-205.96	0.60
2237.500	2.90	2.83	2.66	2.59	2.41	2.44	410.000	2.10	1.79	1.57	2200.000	-23.73	5.68
2350.000	2.92	2.85	2.67	2.51	2.63	2.64	455.000	2.13	1.80	1.59	2345.160	59.99	9.59
2425.000	2.75	2.74	2.60	2.62	2.75	2.76	485.000	2.10	1.79	1.59	2422.580	205.10	12.75
2500.000	2.25	2.29	2.27	2.86	2.90	2.88	500.000	2.11	1.80	1.60	2500.000	146.84	13.51

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+14	26	+0	18	24	38	21	34	27	34
1	-	27	+0	37	29	35	36	50	45	50	38	50
2	70	>83	46	69	45	76	51	83	66	77	68	65
3	94	>83	79	77	70	73	>83	81	78	>83	80	>76
4	95	>84	>83	>83	>84	83	80	>83	>83	83	>83	>84
5	>96	>83	82	83	>81	83	83	>82	82	>82	83	>83
6	89	77	>84	>83	83	>82	>85	>84	>83	82	>82	>83
7	>90	>78	77	>83	83	>84	79	83	83	>84	>83	>84
8	90	>79	>77	77	>83	>84	80	>82	>83	>84	83	>83
9	>91	>78	>79	>78	76	>83	>83	>83	>82	>84	>85	>84
10	90	>79	>78	78	77	>77	>83	82	83	>83	>84	>84

Harmonic LO Order

test condition: RF IN: 1000.10 MHZ; -5.03 DBM
LO IN: 970.01 MHZ; +23.05 DBM
IF OUT: 30.09 MHZ; -12.22 DBM

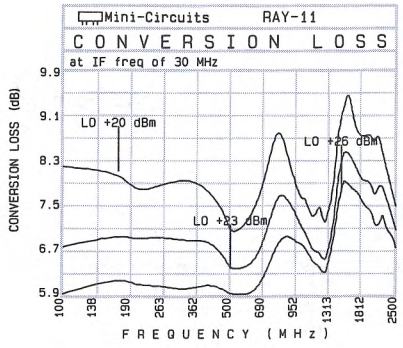
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	39	10	28	35	46	32	49	35	49
1	-	28	+0	37	29	36	34	52	47	49	41	49
2	50	71	38	64	36	68	42	73	58	67	62	57
3	86	66	61	60	49	57	68	66	63	75	68	77
4	>96	>94	70	93	61	79	58	85	65	76	77	82
5	89	>94	85	85	>93	78	82	75	90	83	81	92
6	90	>89	93	>93	87	>94	78	88	77	>92	87	88
7	88	>88	>87	>95	>94	93	93	93	90	90	93	93
8	85	89	>88	>88	93	>95	>94	>94	>94	>95	93	>94
9	>91	88	>90	>88	>88	>94	92	>93	>93	>94	93	>94
10	>90	>89	87	88	>88	87	>94	92	93	93	93	>94

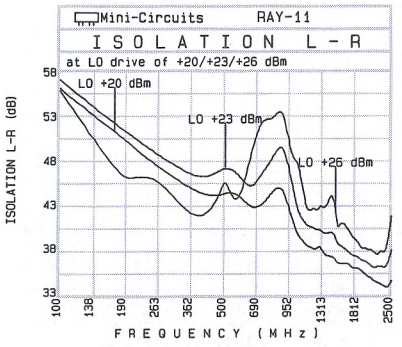
Harmonic LO Order

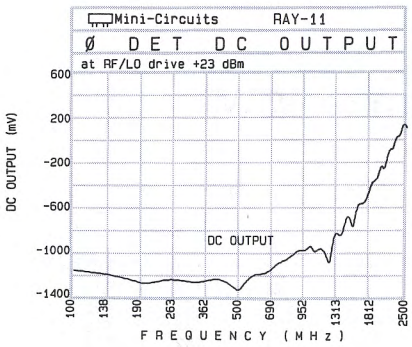
test condition: RF IN: 1000.10 MHZ; +4.97 DBM
LO IN: 970.01 MHZ; +23.05 DBM
IF OUT: 30.09 MHZ; -1.79 DBM

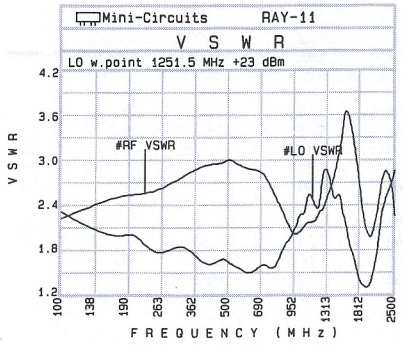
typical performance curves

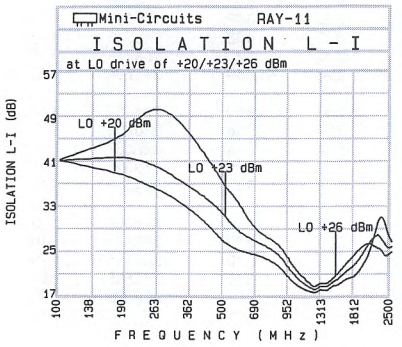
(production unit)

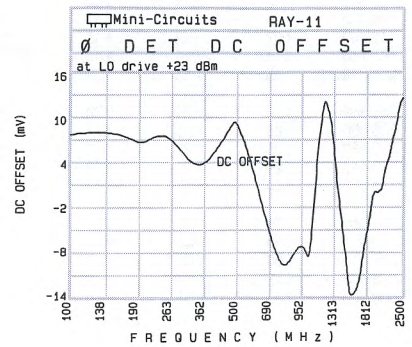












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
TUF-1LH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. MHz	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
2.000	32.000	6.66	6.28	6.06	2.000	66.96	67.01	67.63	80.76	84.01	77.93
4.000	34.000	6.32	5.95	5.72	4.000	66.09	65.93	66.27	79.49	80.03	76.17
5.000	35.000	6.26	5.89	5.67	5.000	65.82	65.47	66.09	78.22	78.57	75.39
10.000	40.000	6.19	5.80	5.58	10.000	64.67	63.93	64.36	74.47	73.13	71.36
20.000	50.000	6.18	5.82	5.60	20.000	62.97	61.72	62.40	69.87	68.22	66.96
50.000	80.000	6.21	5.82	5.60	50.000	56.94	56.12	56.72	62.84	60.69	59.63
59.871	89.871	6.17	5.78	5.57	59.871	55.67	54.83	55.54	61.60	59.50	58.36
100.000	70.000	6.12	5.77	5.56	100.000	50.25	51.13	52.07	58.11	55.91	54.81
117.742	87.742	6.18	5.79	5.57	117.742	49.18	50.12	51.11	56.96	55.10	54.06
175.613	145.613	6.03	5.69	5.52	175.613	46.10	47.32	48.54	53.92	52.30	51.45
200.000	170.000	6.11	5.73	5.55	200.000	45.29	46.57	47.64	52.66	51.26	50.23
233.484	203.484	6.03	5.70	5.53	233.484	44.07	45.24	46.43	50.91	49.36	48.64
291.355	261.355	5.99	5.69	5.53	291.355	42.58	43.94	45.05	47.28	46.68	46.58
300.000	270.000	5.98	5.68	5.53	300.000	42.36	43.65	44.82	46.40	46.00	45.91
349.226	319.226	5.98	5.71	5.55	349.226	41.48	42.63	43.57	43.35	43.46	44.17
407.097	377.097	5.95	5.70	5.54	407.097	40.33	41.85	42.83	41.12	41.86	42.45
464.968	434.968	5.98	5.72	5.56	464.968	38.99	40.61	41.76	38.50	39.52	40.80
522.839	492.839	6.05	5.77	5.58	522.839	37.97	39.23	40.34	37.05	37.60	38.20
580.710	550.710	6.10	5.84	5.68	580.710	37.75	38.82	39.86	35.98	36.92	37.78
600.000	570.000	6.14	5.87	5.69	600.000	37.80	38.87	39.80	35.37	36.44	37.42

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
2.000	1.44	1.47	1.49	2.03	2.80	3.90	2.000	1.19	1.10	1.04	2.000	-351.00	0.40
4.000	1.23	1.27	1.30	1.86	2.68	3.79	4.000	1.19	1.10	1.05	4.000	-357.00	0.39
5.000	1.19	1.23	1.26	1.83	2.65	3.78	5.000	1.20	1.10	1.05	5.000	-358.20	0.35
10.000	1.09	1.14	1.18	1.66	2.48	3.58	10.000	1.24	1.13	1.06	10.000	-355.60	0.36
20.000	1.05	1.12	1.16	1.70	2.53	3.64	20.000	1.23	1.12	1.06	20.000	-351.60	0.34
50.000	1.03	1.11	1.15	1.65	2.47	3.53	50.000	1.24	1.14	1.08	50.000	-354.50	0.41
100.000	1.06	1.11	1.16	1.58	2.35	3.37	100.000	1.27	1.17	1.11	81.733	-336.90	0.39
115.742	1.07	1.12	1.16	1.58	2.37	3.38	115.742	1.28	1.17	1.12	100.000	-333.10	0.36
163.718	1.11	1.15	1.18	1.57	2.32	3.30	163.718	1.31	1.21	1.16	161.467	-349.30	0.33
211.694	1.15	1.18	1.21	1.55	2.26	3.19	211.694	1.35	1.25	1.20	200.000	-357.00	0.24
261.169	1.19	1.21	1.24	1.59	2.33	3.29	261.169	1.40	1.29	1.24	241.200	-366.00	0.19
300.000	1.23	1.25	1.27	1.59	2.27	3.18	300.000	1.43	1.33	1.28	281.067	-350.10	0.14
325.637	1.25	1.27	1.30	1.58	2.24	3.14	325.637	1.46	1.36	1.31	300.000	-358.40	0.02
373.613	1.29	1.31	1.33	1.61	2.29	3.19	373.613	1.51	1.40	1.35	320.933	-368.10	0.08
421.589	1.34	1.35	1.37	1.64	2.28	3.13	421.589	1.56	1.46	1.40	400.667	-382.70	0.42
471.064	1.39	1.40	1.42	1.67	2.28	3.12	471.064	1.63	1.52	1.46	480.400	-345.90	0.26
519.041	1.45	1.45	1.46	1.71	2.29	3.10	519.041	1.70	1.59	1.53	500.000	-340.40	0.35
567.016	1.50	1.49	1.51	1.75	2.33	3.12	567.016	1.78	1.66	1.60	560.133	-303.70	0.51
583.508	1.52	1.51	1.52	1.78	2.33	3.10	583.508	1.80	1.68	1.62	580.067	-301.93	0.66
600.000	1.53	1.53	1.54	1.78	2.31	3.06	600.000	1.82	1.70	1.64	600.000	-302.48	0.77

ϕ detection

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	27	32	30	46	31	44	35	43	38	44
1	-	21	0	34	13	38	21	43	31	45	42	52
2	88	67	63	67	62	68	61	70	60	73	61	71
3	> 92	70	63	72	58	71	54	72	53	69	52	71
4	> 92	> 80	80	> 75	75	> 76	> 76	> 75	> 76	72	> 76	75
5	> 92	> 80	80	> 76	72	75	74	75	72	73	73	75
6	91	> 81	> 81	> 76	> 76	75	76	75	75	> 77	76	> 76
7	> 92	80	> 80	> 76	75	76	75	> 76	75	> 77	75	> 76
8	91	> 81	> 80	> 76	73	> 76	> 76	> 76	72	> 77	72	72
9	90	79	> 80	75	74	76	> 76	> 76	73	> 77	> 76	> 76
10	> 91	> 81	75	72	75	> 76	> 76	> 76	> 76	75	> 76	> 76

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -9.95 DBM
LO IN: 155.01 MHZ; + 10.05 DBM
IF OUT: 30.09 MHZ; -15.64 DBM

RF ORDER HARMONIC

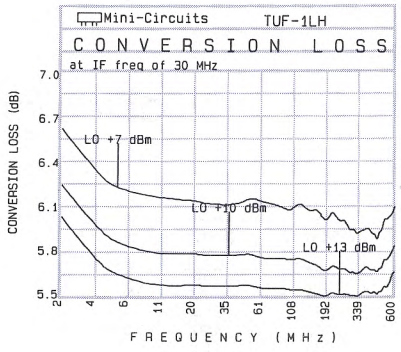
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	35	41	42	56	44	55	53	55	72	57
1	-	21	0	37	12	41	20	45	29	47	43	54
2	73	76	59	72	59	71	59	82	57	72	58	67
3	82	52	50	52	60	53	53	57	56	57	46	55
4	> 91	75	73	75	73	79	73	81	73	83	72	80
5	90	70	66	72	59	72	56	71	53	67	51	65
6	91	80	81	81	81	81	83	85	82	86	85	> 86
7	90	78	82	78	> 86	77	71	75	69	74	66	72
8	90	83	> 85	> 86	> 85	> 86	> 86	> 87	> 86	> 86	> 87	85
9	90	84	79	> 85	77	84	78	82	78	80	78	86
10	90	> 85	85	82	84	> 86	82	> 87	> 86	85	85	83

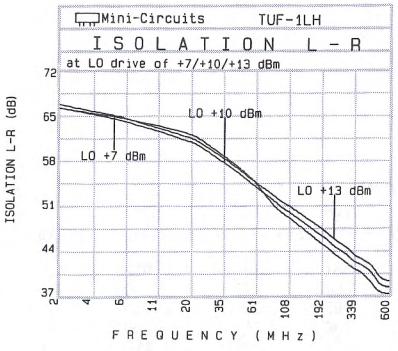
Harmonic LO Order

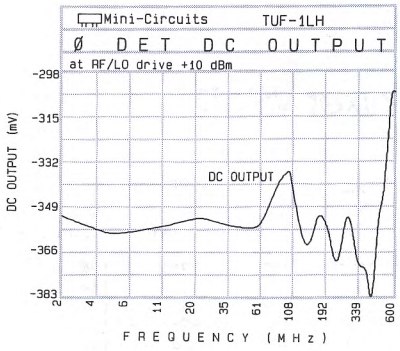
test condition: RF IN: 185.10 MHZ; -.02 DBM
LO IN: 155.01 MHZ; + 10.05 DBM
IF OUT: 30.09 MHZ; -5.83 DBM

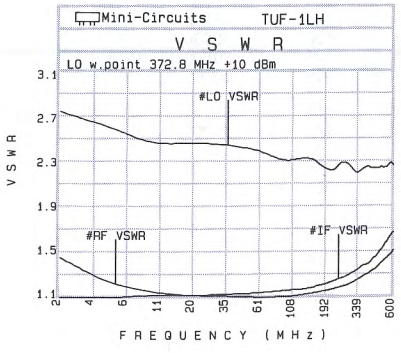
typical performance curves

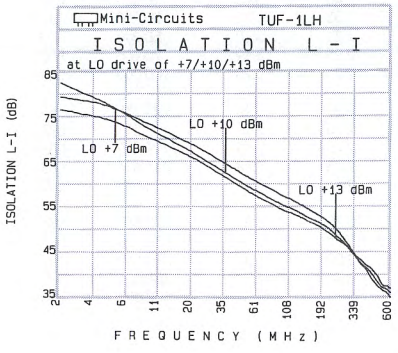
(production unit)

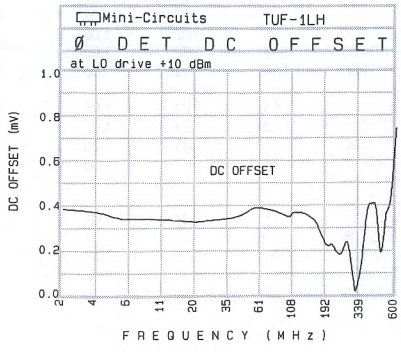












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
TUF-3LH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
0.150	30.150	5.18	4.98	4.81	0.150	68.61	69.38	70.23	95.61	85.98	81.23
0.300	30.300	5.09	4.90	4.75	0.300	68.54	69.38	70.31	95.14	85.28	81.11
0.500	30.500	5.02	4.83	4.68	0.500	68.43	69.26	70.29	91.53	86.26	81.09
1.000	31.000	4.92	4.74	4.59	1.000	68.40	69.26	70.08	86.70	83.06	79.78
1.500	31.500	4.86	4.69	4.55	1.500	68.24	69.08	70.11	84.04	80.98	78.01
2.000	32.000	4.84	4.66	4.52	2.000	68.12	68.95	69.89	81.22	78.75	76.49
5.000	35.000	4.78	4.62	4.47	5.000	67.27	68.20	69.26	73.17	71.20	69.86
10.000	40.000	4.78	4.59	4.48	10.000	65.60	66.47	67.46	67.00	65.07	63.96
20.000	50.000	4.85	4.68	4.52	20.000	62.39	63.23	64.03	61.39	59.53	58.49
50.000	80.000	4.82	4.66	4.53	50.000	55.08	56.07	57.00	52.77	50.61	49.95
57.271	87.271	4.79	4.67	4.55	57.271	53.94	54.97	55.81	51.39	49.44	48.90
100.000	70.000	4.79	4.67	4.56	100.000	49.62	50.23	50.46	46.30	45.42	44.83
114.393	84.393	4.80	4.68	4.57	114.393	48.13	48.98	49.51	45.94	45.06	44.19
171.514	141.514	4.89	4.80	4.70	171.514	44.32	45.17	45.57	45.37	42.49	40.72
200.000	170.000	4.91	4.81	4.71	200.000	42.08	42.29	43.40	42.82	40.27	38.37
228.636	198.636	4.99	4.90	4.80	228.636	41.98	41.00	41.55	38.69	37.35	35.80
285.757	255.757	5.16	5.11	4.97	285.757	48.96	48.00	49.13	36.58	34.00	32.56
342.879	312.879	5.33	5.17	5.10	342.879	37.90	39.79	40.14	35.55	33.43	29.25
385.720	355.720	5.85	5.29	5.08	385.720	33.47	34.24	35.13	31.36	31.62	29.70
400.000	370.000	6.33	5.48	5.12	400.000	33.80	34.34	34.65	29.69	30.09	29.15

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
0.300	1.20	1.21	1.24	1.82	2.67	3.81	0.300	1.33	1.22	1.10	0.150	367.10	0.25
0.500	1.14	1.15	1.19	1.78	2.64	3.77	0.500	1.34	1.23	1.11	0.300	368.90	0.04
1.000	1.09	1.10	1.14	1.73	2.57	3.67	1.000	1.35	1.23	1.11	0.500	368.30	0.24
2.000	1.08	1.06	1.11	1.69	2.52	3.61	2.000	1.36	1.24	1.12	1.000	370.80	0.22
5.000	1.09	1.03	1.09	1.55	2.36	3.42	5.000	1.39	1.26	1.13	1.500	371.40	0.21
10.000	1.12	1.02	1.07	1.59	2.40	3.46	10.000	1.47	1.31	1.16	2.000	371.70	0.22
20.000	1.11	1.01	1.07	1.54	2.33	3.33	20.000	1.45	1.30	1.16	5.000	374.20	0.20
50.000	1.12	1.02	1.05	1.53	2.31	3.30	50.000	1.49	1.34	1.20	10.000	370.80	0.21
70.765	1.13	1.02	1.05	1.51	2.25	3.19	70.765	1.52	1.37	1.23	20.000	366.80	0.23
100.000	1.14	1.02	1.06	1.51	2.25	3.20	100.000	1.58	1.43	1.29	50.000	376.70	0.25
129.235	1.13	1.01	1.06	1.56	2.29	3.22	129.235	1.64	1.48	1.35	57.271	377.60	0.32
177.211	1.13	1.01	1.06	1.58	2.25	3.10	177.211	1.75	1.60	1.48	100.000	363.10	0.51
199.700	1.13	1.01	1.06	1.60	2.28	3.13	199.700	1.81	1.65	1.53	114.393	380.20	0.77
211.694	1.12	1.01	1.06	1.66	2.33	3.18	211.694	1.83	1.68	1.56	171.514	359.20	0.95
235.682	1.13	1.01	1.06	1.75	2.44	3.30	235.682	1.89	1.73	1.61	200.000	364.40	0.85
282.159	1.14	1.04	1.03	1.77	2.39	3.21	282.159	1.96	1.80	1.70	228.636	384.70	1.05
330.135	1.19	1.09	1.04	1.85	2.41	3.21	330.135	2.03	1.86	1.78	285.757	368.30	0.88
376.612	1.30	1.20	1.17	2.02	2.58	3.35	376.612	2.04	1.87	1.79	342.879	335.10	1.35
388.606	1.33	1.23	1.20	2.11	2.76	3.50	388.606	2.05	1.88	1.81	385.720	308.20	2.59
400.600	1.37	1.27	1.24	2.10	2.78	3.54	400.600	2.05	1.89	1.81	400.000	296.56	2.36

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	19	29	19	31	19	43	22	45	24	49
1	-	15	0	29	12	32	19	45	33	44	36	45
2	88	64	53	> 77	53	67	52	76	51	64	56	69
3	> 92	62	61	61	63	62	54	70	54	61	53	68
4	> 92	> 77	> 78	76	> 77	> 77	76	76	75	> 77	73	> 77
5	> 92	> 77	74	75	76	> 77	73	76	73	> 77	70	> 77
6	91	> 77	> 77	> 78	76	76	> 76	76	> 77	> 77	> 78	76
7	> 92	> 75	75	> 76	> 78	> 77	> 77	76	74	77	> 77	76
8	91	74	> 77	> 77	> 77	76	> 77	76	> 78	> 77	> 77	75
9	90	> 76	76	76	> 77	> 77	> 76	76	76	76	> 78	73
10	> 91	75	> 76	> 77	74	> 77	76	> 77	76	> 76	76	75

Harmonic LO Order

test condition: RF IN: 185.10 MHZ; -9.95 DBM
LO IN: 155.01 MHZ; + 10.05 DBM
IF OUT: 30.09 MHZ; -14.76 DBM

RF CAL

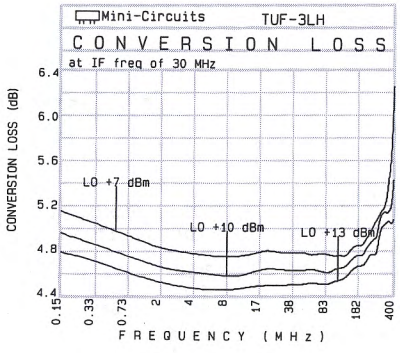
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	27	40	31	42	31	57	35	60	39	65
1	-	15	0	28	12	33	19	41	32	49	42	52
2	73	56	50	59	50	60	50	65	46	59	51	66
3	82	48	43	46	45	51	48	50	45	53	48	55
4	> 91	80	66	78	64	76	63	72	61	73	58	73
5	90	74	56	59	61	63	55	61	51	64	50	62
6	91	82	76	> 87	70	80	70	81	72	83	71	82
7	90	85	79	79	73	73	68	69	78	72	67	72
8	90	> 86	83	> 87	81	> 87	79	> 87	79	85	80	84
9	90	> 86	83	83	85	84	81	80	73	77	80	76
10	90	> 86	> 86	> 86	86	> 87	83	> 87	> 86	> 86	84	> 87

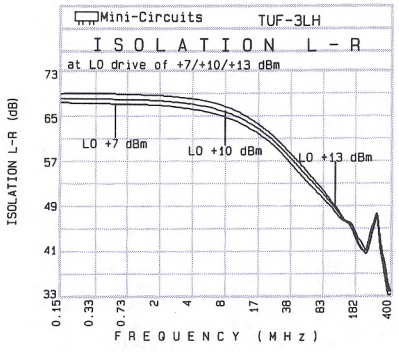
Harmonic LO Order

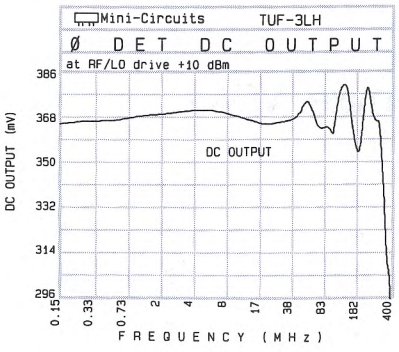
test condition: RF IN: 185.10 MHZ; -.02 DBM
LO IN: 155.01 MHZ; + 10.05 DBM
IF OUT: 30.09 MHZ; -4.94 DBM

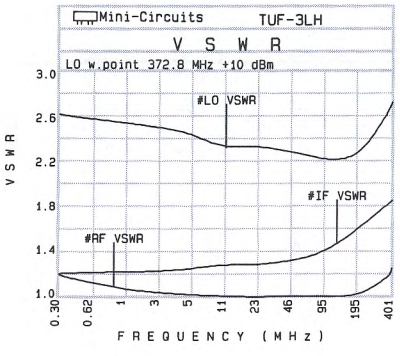
typical performance curves

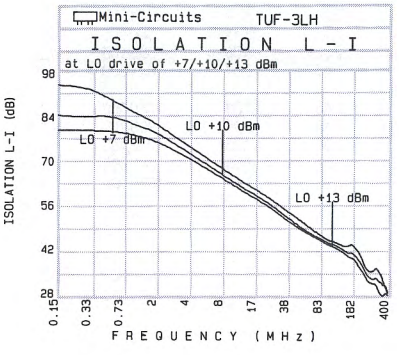
(production unit)

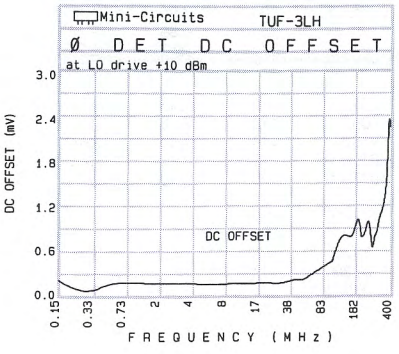












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
TUF-5LH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
20.000	50.000	6.16	5.60	5.32	20.000	60.03	62.84	65.31	52.95	53.81	53.97
50.000	80.000	5.94	5.38	5.11	50.000	56.16	57.81	58.63	45.17	46.30	46.99
100.000	70.000	5.77	5.25	5.02	100.000	51.45	52.60	53.19	39.63	40.86	42.17
158.750	128.750	5.75	5.20	4.99	158.750	48.07	49.11	49.80	36.46	38.29	39.36
200.000	170.000	5.73	5.25	5.04	200.000	46.20	47.45	48.56	35.21	36.98	37.90
297.500	267.500	5.84	5.37	5.14	297.500	43.08	44.43	45.38	32.91	34.13	34.88
436.250	406.250	6.00	5.54	5.29	436.250	40.45	42.14	43.65	30.51	31.89	32.83
500.000	470.000	6.31	5.74	5.40	500.000	39.72	41.47	42.99	29.22	30.68	32.12
575.000	545.000	6.44	5.89	5.58	575.000	38.96	40.90	42.85	28.19	30.02	31.84
713.750	683.750	7.34	6.61	5.94	713.750	37.91	40.16	42.29	26.80	28.61	30.68
750.000	720.000	7.54	6.80	6.29	750.000	37.69	39.71	41.82	26.74	28.48	30.42
760.000	730.000	7.61	6.83	6.33	760.000	37.61	39.62	41.68	26.70	28.42	30.30
852.500	822.500	7.81	7.07	6.57	852.500	37.34	39.30	41.26	26.36	28.00	29.52
991.250	961.250	8.07	6.99	6.35	991.250	37.60	38.97	40.14	25.48	26.26	26.11
1000.000	970.000	8.11	7.07	6.39	1000.000	37.58	38.98	40.00	25.42	26.16	25.85
1130.000	1100.000	7.74	7.19	6.80	1130.000	34.64	35.93	36.66	23.92	24.11	23.00
1222.500	1192.500	7.52	7.02	6.74	1222.500	36.37	38.43	39.92	22.38	22.14	20.59
1361.250	1331.250	7.39	6.88	6.66	1361.250	37.05	39.21	41.17	19.42	19.23	18.11
1453.750	1423.750	7.46	6.78	6.53	1453.750	36.58	38.09	39.40	16.89	16.51	15.40
1500.000	1470.000	7.35	6.66	6.38	1500.000	36.61	37.95	39.53	16.37	16.08	15.11

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm
20.000	1.50	1.43	1.37	1.75	2.57	3.66	20.000	1.15	1.01	1.12
40.000	1.41	1.32	1.25	1.71	2.51	3.56	40.000	1.16	1.02	1.11
50.000	1.40	1.31	1.23	1.70	2.50	3.55	50.000	1.16	1.02	1.11
100.000	1.44	1.34	1.24	1.62	2.38	3.37	100.000	1.18	1.04	1.10
200.000	1.58	1.48	1.38	1.57	2.28	3.19	200.000	1.19	1.05	1.10
253.100	1.72	1.59	1.48	1.62	2.36	3.30	253.100	1.20	1.05	1.10
371.500	2.06	1.91	1.77	1.67	2.34	3.17	371.500	1.20	1.05	1.09
500.000	2.57	2.36	2.17	1.77	2.36	3.11	500.000	1.21	1.05	1.09
526.900	2.72	2.49	2.29	1.80	2.36	3.08	526.900	1.20	1.05	1.09
641.600	3.27	2.97	2.71	1.93	2.45	3.07	641.600	1.19	1.04	1.12
750.000	3.75	3.40	3.09	2.03	2.46	3.04	750.000	1.16	1.05	1.16
800.700	3.88	3.53	3.22	2.11	2.48	3.01	800.700	1.14	1.07	1.18
915.400	4.15	3.80	3.54	2.27	2.56	2.95	915.400	1.09	1.14	1.28
1000.000	4.20	3.86	3.64	2.35	2.67	3.08	1000.000	1.19	1.31	1.47
1070.800	4.28	3.95	3.73	2.42	2.70	3.11	1070.800	1.22	1.37	1.55
1189.200	4.21	3.91	3.73	2.59	2.73	3.06	1189.200	1.43	1.64	1.84
1303.900	4.01	3.77	3.62	2.70	2.73	3.00	1303.900	1.81	2.06	2.30
1422.300	3.90	3.65	3.53	2.94	2.77	2.92	1422.300	2.41	2.71	3.00
1459.300	3.78	3.54	3.42	3.09	2.78	2.88	1459.300	2.67	2.97	3.25
1500.000	3.72	3.47	3.36	3.12	2.77	2.86	1500.000	2.98	3.32	3.60

ϕ detection

FREQ. (MHz)	max DC output mV	DC offset mV
20.000	-342.60	-0.57
40.000	-351.00	-0.57
50.000	-353.80	-0.56
100.000	-343.30	-0.58
158.750	-341.10	-0.61
200.000	-350.50	-0.66
297.500	-351.60	-0.64
436.250	-332.10	-0.81
500.000	-310.40	-0.97
575.000	-306.90	-1.09
713.750	-318.90	-1.34
750.000	-316.20	-1.31
852.500	-306.70	-2.09
991.250	-283.48	-2.21
1000.000	-285.87	-2.14
1130.000	-294.84	-0.72
1268.750	-304.60	2.11
1407.500	-302.59	2.20
1453.750	-293.30	2.56
1500.000	-291.46	2.84

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+1	30	6	31	9	44	36	43	48	49
1	-	21	0	38	30	36	31	52	47	50	61	43
2	> 90	70	52	56	52	73	45	65	42	71	61	64
3	90	68	69	70	52	72	65	70	62	> 73	70	65
4	> 91	> 75	> 74	> 74	74	74	74	> 74	73	> 75	69	74
5	> 91	> 75	> 74	> 74	> 74	> 75	74	> 75	74	> 74	> 75	74
6	83	> 67	74	73	72	> 74	> 75	> 74	74	> 74	> 73	71
7	> 85	64	> 67	73	> 73	71	> 74	74	73	72	> 75	> 74
8	> 86	65	> 68	> 67	> 74	74	> 74	73	73	72	74	> 74
9	84	> 66	> 68	> 68	> 68	> 74	73	73	> 74	> 76	> 75	> 75
10	> 85	67	> 68	> 69	> 67	> 68	> 75	73	73	> 74	> 75	> 74

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -10.02 DBM
LO IN: 970.01 MHZ; + 10.07 DBM
IF OUT: 30.09 MHZ; -16.71 DBM

RF ORDER HARMONIC

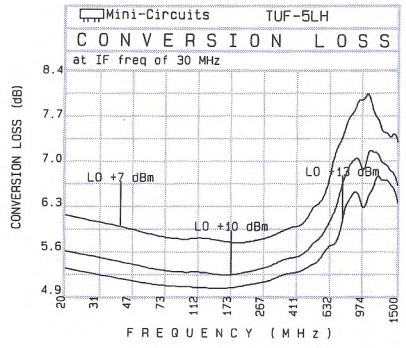
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	41	17	40	22	56	53	64	72	66
1	-	21	0	38	31	38	32	58	55	58	75	63
2	84	63	52	49	50	69	39	63	38	68	61	68
3	89	48	53	55	33	56	49	55	45	66	62	68
4	> 91	70	61	81	63	71	62	75	54	66	49	78
5	> 90	81	64	70	71	65	52	68	63	67	60	74
6	> 85	78	76	84	76	83	73	74	68	83	64	74
7	> 85	> 77	> 78	> 84	80	79	80	76	63	76	72	77
8	84	77	74	> 77	82	> 84	80	> 83	81	81	77	> 85
9	> 85	> 78	77	77	> 78	> 85	> 86	81	> 84	81	76	80
10	84	> 78	> 78	> 78	> 78	> 78	> 85	83	83	83	> 85	84

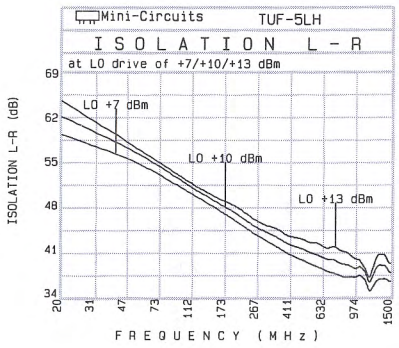
Harmonic LO Order

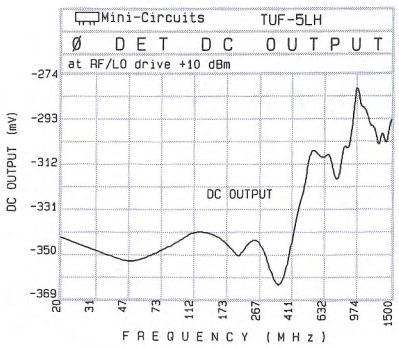
test condition: RF IN:1000.10 MHZ; + 0.07 DBM
LO IN: 970.01 MHZ; + 10.07 DBM
IF OUT: 30.09 MHZ; -6.80 DBM

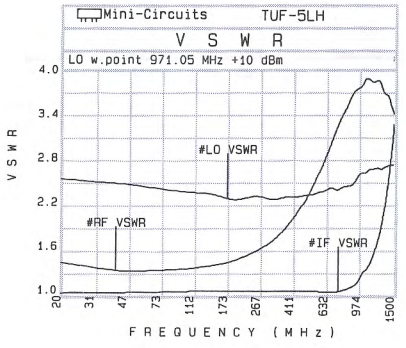
typical performance curves

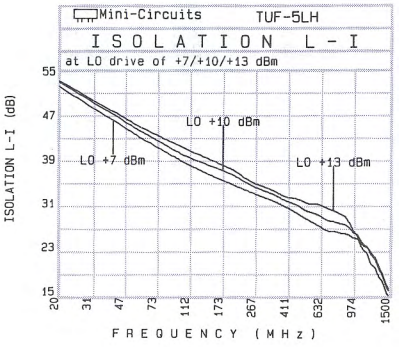
(production unit)

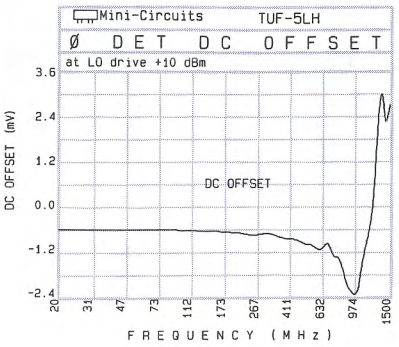












broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
TUF-11ALH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
1400.000	1350.000	8.08	7.64	7.36	1400.000	30.85	32.04	33.03	33.97	35.28	30.00
1439.470	1389.474	8.00	7.59	7.26	1439.470	30.14	31.29	32.31	33.93	34.81	29.09
1478.950	1428.947	8.05	7.56	7.18	1478.950	29.56	31.02	32.25	32.69	36.41	30.19
1492.110	1442.105	8.09	7.57	7.17	1492.110	29.53	31.07	32.34	32.11	37.32	30.74
1505.260	1455.263	8.13	7.55	7.13	1505.260	29.54	31.07	32.35	31.60	37.67	31.09
1544.740	1494.737	8.05	7.38	6.98	1544.740	29.25	30.74	31.93	30.31	37.43	30.86
1571.050	1521.053	7.95	7.27	6.85	1571.050	29.06	30.53	31.75	30.18	37.11	30.77
1584.210	1534.211	7.95	7.24	6.83	1584.210	28.95	30.45	31.66	30.07	37.02	30.97
1623.680	1573.684	8.01	7.15	6.73	1623.680	28.80	30.47	31.45	28.93	36.30	32.12
1663.160	1613.158	7.88	6.99	6.62	1663.160	28.56	30.12	30.97	28.13	35.15	31.41
1676.320	1626.316	7.86	7.00	6.61	1676.320	28.37	29.89	30.70	28.03	34.75	30.89
1702.630	1652.632	7.91	7.01	6.61	1702.630	27.99	29.56	30.25	27.51	33.82	30.64
1742.110	1692.105	7.91	6.97	6.57	1742.110	27.97	29.37	29.91	26.96	32.60	30.63
1768.420	1718.421	7.92	6.96	6.57	1768.420	27.91	29.26	29.47	26.36	31.76	29.76
1781.580	1731.579	7.93	7.02	6.57	1781.580	27.88	29.13	29.21	26.18	31.35	29.21
1821.050	1771.053	7.92	7.06	6.58	1821.050	27.57	28.58	28.61	25.82	30.17	27.89
1860.530	1810.526	7.98	7.10	6.59	1860.530	27.61	28.45	28.38	25.46	29.36	27.44
1873.680	1823.684	7.97	7.10	6.62	1873.680	27.66	28.39	28.22	25.37	29.09	27.08
1886.840	1836.842	7.93	7.08	6.61	1886.840	27.70	28.35	28.01	25.21	28.81	26.75
1900.000	1850.000	7.94	7.10	6.60	1900.000	27.72	28.25	27.70	25.13	28.47	26.31

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm
1400.000	1.90	1.80	1.78	2.60	2.08	2.16	40.000	1.40	1.26	1.25
1438.750	1.74	1.65	1.63	2.76	2.12	2.13	50.000	1.33	1.20	1.18
1477.500	1.60	1.52	1.50	2.79	2.12	2.16	80.000	1.28	1.12	1.09
1490.000	1.56	1.47	1.46	2.72	2.12	2.17	90.000	1.28	1.11	1.07
1515.000	1.49	1.40	1.39	2.65	2.12	2.16	100.000	1.28	1.10	1.06
1550.000	1.39	1.28	1.28	2.80	2.17	2.13	148.000	1.27	1.08	1.03
1580.000	1.31	1.19	1.20	2.85	2.18	2.14	173.000	1.27	1.08	1.04
1592.500	1.29	1.15	1.17	2.86	2.18	2.15	200.000	1.27	1.09	1.05
1631.250	1.21	1.12	1.16	2.77	2.18	2.16	222.000	1.27	1.09	1.07
1668.750	1.17	1.07	1.16	2.89	2.22	2.15	250.000	1.26	1.10	1.09
1682.500	1.17	1.05	1.17	2.89	2.22	2.16	270.000	1.26	1.11	1.11
1707.500	1.16	1.05	1.16	2.78	2.21	2.17	282.000	1.26	1.11	1.12
1750.000	1.21	1.06	1.14	2.95	2.25	2.17	306.000	1.26	1.12	1.13
1771.250	1.23	1.11	1.16	2.99	2.24	2.17	343.000	1.26	1.14	1.16
1785.000	1.25	1.14	1.17	2.89	2.23	2.19	379.000	1.26	1.16	1.19
1822.500	1.31	1.21	1.22	2.85	2.24	2.18	400.000	1.26	1.17	1.21
1861.250	1.37	1.28	1.28	3.02	2.28	2.17	427.000	1.26	1.19	1.23
1873.750	1.39	1.30	1.30	3.08	2.30	2.18	464.000	1.26	1.21	1.27
1887.500	1.41	1.32	1.32	3.12	2.30	2.18	488.000	1.26	1.23	1.29
1900.000	1.43	1.34	1.34	3.13	2.30	2.18	500.000	1.26	1.24	1.30

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	12	13	67	43	65	55	68	29	40
1	-	22	0	30	14	30	67 > 69		63 > 69		63	34
2	95	51	50	53	50	54	58	66 > 68		> 66	65 > 69	
3	94	66	59	73	53	68	58 > 73		> 68	> 68	> 69	65
4	> 89	> 66	> 73	> 74	> 74	> 74	73 > 73		73 > 68		67 > 68	
5	> 91	> 67	66 > 74		73	70 > 75		> 73	> 73	> 74	64 > 68	
6	89	> 68	> 69	> 67	> 74	72	73 > 74		> 75	> 75	69	67
7	> 90	> 68	> 68	> 68	> 68	69 > 74		72	73 > 74		> 73	> 74
8	85	> 63	> 68	> 68	68	64 > 74		71 > 72		> 73	73 > 75	
9	84	> 63	61 > 68		67	> 68	> 66	70 > 74		> 73	> 74	73
10	> 85	> 64	> 64	62 > 68		68	67	62	73 > 74		> 73	70

Harmonic LO Order

test condition: RF IN:1600.10 MHz; -9.99 dBm
LO IN:1550.01 MHz; +9.96 dBm
IF OUT: 50.09 MHz; -17.29 dBm

RF ORDER HARMONIC

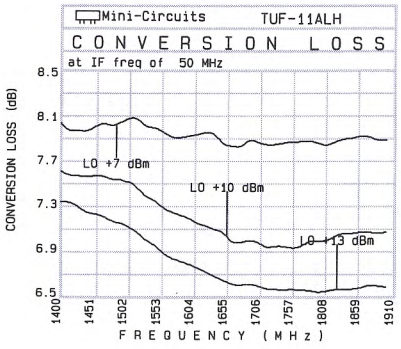
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	20	24	24 > 78		56	76	64	78	43	55
1	-	23	+0	32	15	34	74	73	76	77	73	46
2	90	42	40	45	45	48	53	77	75 > 78		75	78
3	> 90	45	41	56	36	52	42	51	75 > 78		78 > 79	
4	> 84	77	79	69	59	61	53	58	63 > 78	> 78	> 79	
5	> 86	> 79	> 77	66	59	77	51	65	55	67 > 79		> 78
6	> 85	77 > 79		74	79	68	73	73	70	72	76	77
7	84	77 > 78		77 > 78		82	74 > 83		67	70	66	79
8	> 80	> 74	> 78	> 78	> 79	> 78	82	80 > 83		77	74	79
9	> 80	> 72	71	76 > 79		> 79	> 76	> 83	> 84	> 83	81	83
10	> 81	> 74	> 73	71 > 77		> 79	> 79	73 > 84		> 84	> 83	> 85

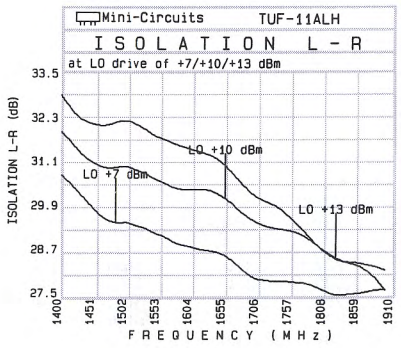
Harmonic LO Order

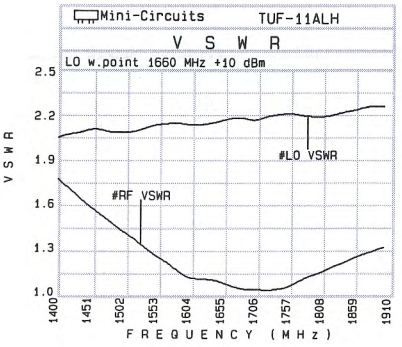
test condition: RF IN:1600.10 MHz; +.01 dBm
LO IN:1550.01 MHz; +9.96 dBm
IF OUT: 50.09 MHz; -7.17 dBm

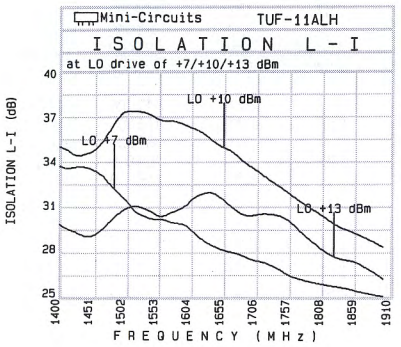
typical performance curves

(production unit)









In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 10 (+10 dBm LO, up to +5 dBm RF)

Model
TUF-860LH



computer-automated performance data
typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm	Isolation L-I (dB) LO +7 dBm	LO +10 dBm	LO +13 dBm
800.000	770.000	5.36	5.19	5.03	800.000	40.94	42.18	41.77	30.16	32.59	34.92
819.740	789.737	5.43	5.24	5.07	819.740	40.10	41.36	40.73	29.17	31.65	34.01
839.470	809.474	5.56	5.32	5.09	839.470	38.59	39.91	39.43	28.25	30.97	33.18
846.050	816.053	5.59	5.32	5.08	846.050	38.02	39.41	38.94	27.93	30.72	32.97
859.210	829.211	5.59	5.29	5.01	859.210	36.80	38.30	38.05	27.50	30.18	32.39
878.950	848.947	5.70	5.21	4.94	878.950	35.25	36.80	36.87	26.65	29.56	31.87
892.110	862.105	5.65	5.13	4.88	892.110	34.42	35.94	36.15	26.29	29.12	31.43
898.680	868.684	5.67	5.14	4.88	898.680	34.02	35.44	35.68	26.08	28.84	31.34
918.420	888.421	5.74	5.24	4.98	918.420	32.99	34.29	34.48	25.55	28.03	30.63
938.160	908.158	5.82	5.35	5.09	938.160	32.17	33.59	33.76	25.04	27.36	29.86
944.740	914.737	5.85	5.39	5.14	944.740	32.00	33.27	33.53	24.91	27.06	29.58
957.890	927.895	6.03	5.50	5.28	957.890	31.45	32.80	33.14	24.65	26.54	29.00
977.630	947.632	6.11	5.57	5.33	977.630	30.60	32.01	32.36	24.12	25.91	28.20
990.790	960.790	6.26	5.59	5.34	990.790	30.18	31.63	31.94	23.82	25.51	27.73
997.370	967.368	6.31	5.71	5.34	997.370	29.94	31.41	31.70	23.67	25.25	27.44
1000.000	970.000	6.37	5.71	5.34	1000.000	29.83	31.30	31.57	23.60	25.13	27.30
1017.110	987.105	6.72	5.87	5.42	1017.110	29.39	30.72	30.95	23.37	24.52	26.56
1036.840	1006.842	7.11	6.03	5.47	1036.840	28.99	30.35	30.77	22.95	23.82	25.67
1043.420	1013.421	7.18	6.07	5.49	1043.420	28.91	30.20	30.63	22.89	23.65	25.43
1050.000	1020.000	7.23	6.09	5.49	1050.000	28.88	30.15	30.56	22.84	23.53	25.19

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +7 dBm	LO +10 dBm	LO +13 dBm	VSWR LO port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	VSWR IF port LO +7 dBm	LO +10 dBm	LO +13 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
800.000	1.14	1.04	1.03	1.81	2.33	3.16	1.000	1.99	1.67	1.51	800.000	-320.10	1.05
818.750	1.16	1.06	1.03	1.83	2.33	3.15	2.000	1.99	1.67	1.51	819.737	-307.30	1.57
838.750	1.19	1.09	1.06	1.91	2.39	3.18	5.000	1.99	1.68	1.51	839.474	-295.46	2.02
845.000	1.20	1.11	1.08	1.90	2.37	3.15	10.000	2.00	1.68	1.51	846.053	-289.39	2.16
857.500	1.23	1.14	1.10	1.92	2.39	3.17	20.000	2.02	1.69	1.52	859.210	-282.73	2.50
877.500	1.28	1.19	1.15	1.97	2.46	3.24	40.000	2.03	1.70	1.53	878.947	-279.35	2.76
890.000	1.32	1.24	1.19	2.00	2.47	3.24	50.000	2.04	1.71	1.53	892.105	-279.34	2.73
896.250	1.34	1.25	1.21	2.02	2.50	3.27	67.000	2.05	1.72	1.55	898.684	-279.17	2.64
915.000	1.39	1.30	1.27	2.03	2.51	3.29	86.000	2.06	1.74	1.57	918.421	-289.20	2.55
935.000	1.46	1.39	1.33	2.06	2.52	3.27	100.000	2.08	1.75	1.58	938.158	-295.71	2.66
941.250	1.49	1.40	1.35	2.06	2.52	3.28	112.000	2.10	1.76	1.60	944.737	-294.68	2.68
953.750	1.52	1.44	1.40	2.07	2.55	3.34	125.000	2.12	1.78	1.61	957.895	-285.84	2.79
972.500	1.60	1.51	1.48	2.10	2.57	3.34	139.000	2.13	1.80	1.63	977.632	-274.82	2.93
986.250	1.66	1.58	1.53	2.11	2.57	3.33	158.000	2.15	1.82	1.66	990.790	-269.93	3.07
992.500	1.68	1.60	1.56	2.13	2.59	3.35	175.000	2.17	1.84	1.69	997.368	-269.68	3.37
1000.000	1.72	1.64	1.59	2.13	2.57	3.33	198.000	2.20	1.88	1.72	1000.000	-268.97	3.39
1017.500	1.82	1.72	1.68	2.13	2.54	3.26	217.000	2.24	1.91	1.75	1017.105	-270.03	3.87
1037.500	1.90	1.81	1.77	2.16	2.57	3.32	237.000	2.28	1.95	1.79	1036.842	-271.23	4.38
1043.750	1.94	1.84	1.80	2.16	2.57	3.32	243.000	2.29	1.96	1.80	1043.421	-274.02	4.44
1050.000	1.96	1.86	1.83	2.17	2.59	3.35	250.000	2.31	1.97	1.81	1050.000	-276.45	4.35

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	26	+1	10	14	25	33	27	34	37
1	-	7	0	26	11	32	40	21	42	50	46	43
2	95	58	44	71	50	64	47	68	59	67	> 63	60
3	> 95	69	70	> 72	68	68	66	> 71	> 71	64	> 70	> 63
4	> 96	> 72	> 69	> 71	> 71	> 71	> 72	69	69	> 70	> 71	> 71
5	> 96	70	> 71	70	69	> 71	> 71	71	69	> 69	> 71	> 72
6	> 90	64	70	70	> 71	> 70	68	> 72	70	> 71	> 69	> 71
7	> 89	63	> 64	70	> 71	70	> 71	70	> 71	> 71	> 71	69
8	88	> 65	> 64	> 65	> 71	> 71	> 70	> 70	> 69	> 72	> 72	> 71
9	> 90	62	> 65	64	> 64	> 71	67	> 71	67	70	70	> 71
10	> 89	> 65	63	> 65	> 65	> 65	> 71	70	70	> 70	> 69	> 71

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -15.03 DBM
LO IN: 970.01 MHZ; + 10.09 DBM
IF OUT: 30.09 MHZ; -20.52 DBM

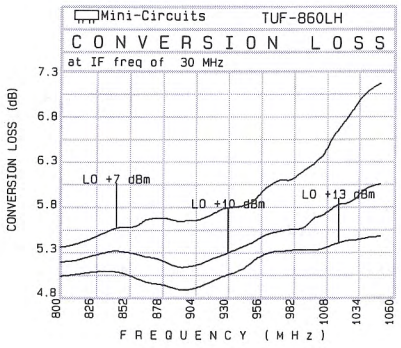
RF ORDER HARMONIC	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	41	10	20	24	35	43	37	44	48
1	-	7	0	26	11	31	39	22	42	54	49	45
2	92	50	33	58	40	53	37	60	50	61	64	53
3	92	56	51	55	48	52	47	56	61	44	69	72
4	> 95	76	> 80	75	72	71	66	66	73	72	75	76
5	> 97	71	77	> 81	77	77	> 81	76	72	79	79	70
6	> 90	74	> 82	78	> 80	79	> 81	> 81	> 82	80	> 76	80
7	> 88	73	> 74	78	> 82	> 79	> 80	> 81	> 81	80	> 81	79
8	> 90	> 75	> 74	> 75	> 81	> 81	> 80	> 81	> 82	> 81	> 81	80
9	> 89	> 73	> 75	74	> 74	> 81	80	79	> 80	> 81	> 81	> 82
10	> 89	> 75	> 74	> 75	> 75	> 75	> 80	80	79	80	> 81	> 80

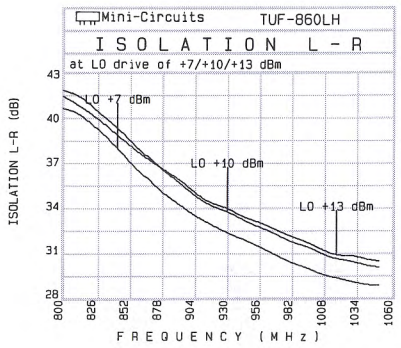
Harmonic LO Order

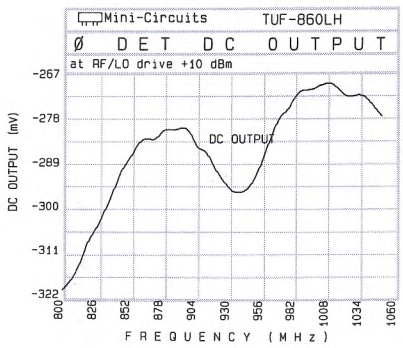
test condition: RF IN:1000.10 MHZ; -5.01 DBM
LO IN: 970.01 MHZ; + 10.09 DBM
IF OUT: 30.09 MHZ; -10.48 DBM

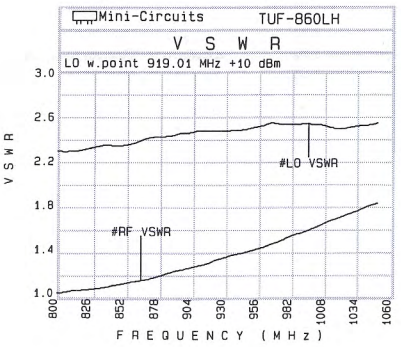
typical performance curves

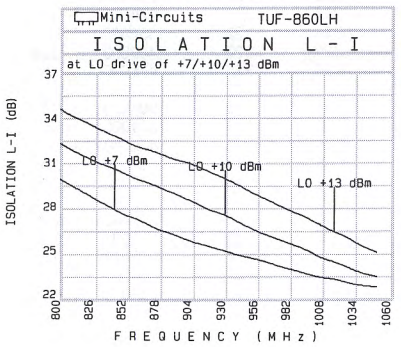
(production unit)

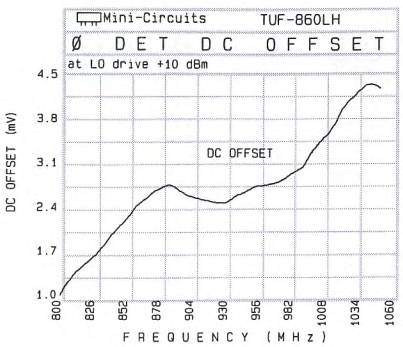












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
TUF-2MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
50.000	80.000	6.34	5.81	5.58	50.000	57.04	57.10	59.54	57.87	55.26	54.31
100.000	70.000	6.39	5.85	5.57	100.000	51.05	51.37	53.73	52.23	49.62	48.10
129.170	99.167	6.31	5.79	5.50	129.170	48.92	49.27	51.69	50.28	47.63	45.72
200.000	170.000	6.30	5.74	5.51	200.000	45.30	46.10	48.87	46.99	44.54	43.71
208.330	178.333	6.26	5.73	5.50	208.330	45.02	45.84	48.58	46.51	44.23	43.24
287.500	257.500	6.16	5.70	5.47	287.500	42.82	43.58	46.61	44.04	42.34	40.82
340.280	310.278	6.09	5.67	5.48	340.280	41.78	42.34	45.17	42.79	40.78	39.76
366.670	336.667	6.06	5.69	5.51	366.670	41.22	41.82	44.74	42.05	40.13	38.74
445.830	415.833	6.03	5.72	5.54	445.830	40.09	40.63	43.75	39.05	37.78	37.01
498.610	468.611	6.03	5.75	5.58	498.610	39.11	39.34	42.50	36.86	36.04	35.26
500.000	470.000	6.03	5.75	5.58	500.000	39.08	39.30	42.47	36.82	36.00	35.19
551.390	521.389	6.18	5.86	5.68	551.390	38.58	38.49	41.63	35.29	34.15	33.50
630.560	600.556	6.28	5.90	5.88	630.560	38.05	38.05	41.00	33.16	32.59	31.97
683.330	653.333	6.43	6.06	5.96	683.330	37.49	38.00	40.27	32.12	31.67	30.86
709.720	679.722	6.46	6.12	5.98	709.720	37.53	38.21	40.42	31.65	31.02	30.84
788.890	758.889	6.68	6.33	6.20	788.890	37.21	38.31	39.99	30.21	29.48	28.84
868.060	838.056	6.91	6.58	6.42	868.060	36.74	37.78	39.70	28.56	28.55	28.69
947.220	917.222	7.26	6.88	6.68	947.220	36.30	37.88	38.74	27.07	27.56	27.30
973.610	943.611	7.38	6.98	6.82	973.610	36.06	37.84	39.04	26.43	27.05	27.46
1000.000	970.000	7.54	7.05	6.89	1000.000	35.72	37.64	39.10	25.79	26.57	27.38

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
50.000	1.10	1.03	1.09	1.66	2.51	3.64	1.000	1.91	1.60	1.44
100.000	1.11	1.05	1.09	1.58	2.39	3.50	27.000	1.92	1.61	1.45
150.000	1.12	1.07	1.11	1.58	2.41	3.56	52.000	1.93	1.62	1.46
200.000	1.14	1.10	1.14	1.53	2.28	3.31	100.000	1.96	1.64	1.48
250.000	1.15	1.13	1.16	1.57	2.36	3.42	150.000	1.98	1.66	1.51
318.000	1.18	1.17	1.20	1.53	2.26	3.26	200.000	2.03	1.71	1.55
367.000	1.21	1.19	1.23	1.55	2.29	3.33	250.000	2.08	1.76	1.60
400.000	1.22	1.21	1.25	1.56	2.28	3.27	334.000	2.18	1.86	1.70
475.000	1.26	1.26	1.30	1.58	2.29	3.22	400.000	2.26	1.95	1.79
500.000	1.28	1.28	1.32	1.61	2.29	3.25	475.000	2.34	2.03	1.88
513.000	1.28	1.29	1.33	1.61	2.28	3.20	500.000	2.37	2.07	1.92
586.000	1.32	1.33	1.37	1.67	2.32	3.24	550.000	2.44	2.14	1.99
650.000	1.37	1.38	1.42	1.71	2.35	3.22	600.000	2.45	2.17	2.03
700.000	1.40	1.41	1.45	1.77	2.33	3.18	667.000	2.47	2.21	2.07
732.000	1.41	1.43	1.47	1.77	2.30	3.11	750.000	2.49	2.23	2.11
800.000	1.47	1.49	1.52	1.86	2.44	3.24	821.000	2.49	2.23	2.11
878.000	1.52	1.53	1.56	1.89	2.37	3.19	900.000	2.47	2.22	2.10
950.000	1.60	1.60	1.62	1.98	2.48	3.24	950.000	2.48	2.22	2.09
976.000	1.63	1.62	1.64	2.02	2.49	3.22	974.000	2.49	2.22	2.08
1000.000	1.65	1.64	1.66	2.04	2.45	3.17	1000.000	2.50	2.22	2.08

ϕ detection

FREQ. (MHz)	max DC output mV	DC offset mV
50.000	-490.90	0.21
100.000	-485.50	0.24
148.280	-495.60	0.31
200.000	-501.50	0.29
246.550	-502.80	0.18
312.070	-502.40	0.04
377.590	-525.90	0.10
400.000	-530.70	0.24
475.860	-506.40	0.28
500.000	-491.90	0.37
508.620	-490.80	0.34
600.000	-440.70	0.51
672.410	-441.00	1.11
705.170	-446.60	1.24
737.930	-454.30	1.23
800.000	-444.20	1.25
868.970	-390.00	0.51
934.480	-330.30	0.07
967.240	-339.60	0.75
1000.000	-362.10	1.10

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+4	16	18	20	15	32	31	38	39	33
1	-	8	+0	28	11	30	40	24	37	54	51	47
2	94	62	48	62	47	58	61	60	62	73	69	73
3	94	73	59	71	57	71	56	76	77	64	72	> 71
4	> 95	> 79	> 78	75	> 79	78	> 79	> 78	> 79	> 79	> 78	> 80
5	> 96	> 79	78	> 78	> 78	> 78	> 79	> 78	> 79	> 78	> 80	75
6	> 90	> 73	> 79	> 79	> 79	78	> 79	> 79	> 79	77	74	78
7	> 89	> 72	> 72	> 79	> 79	> 79	> 78	77	> 79	> 79	> 79	> 78
8	> 90	70	> 72	69	> 79	78	> 79	77	> 79	> 80	> 78	> 79
9	> 91	> 73	> 74	> 73	> 72	78	> 78	> 78	75	> 78	78	77
10	89	> 72	72	> 73	> 73	> 73	> 79	75	78	> 79	78	79

Harmonic LO Order

test condition: RF IN:1000.10 MHz; -10.03 dBm
LO IN: 970.01 MHz; +12.98 dBm
IF OUT: 30.09 MHz; -17.08 dBm

RF ORDER HARMONIC

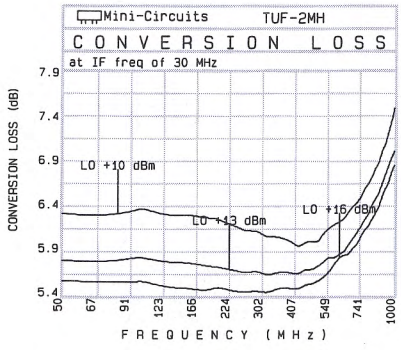
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	27	29	29	26	44	43	49	47	46
1	-	8	0	29	11	31	42	26	41	54	54	51
2	87	49	36	48	35	48	49	52	55	62	61	70
3	> 95	54	39	52	36	52	37	58	61	48	55	67
4	> 96	79	82	73	59	63	54	61	66	66	66	76
5	89	79	84	83	72	76	58	70	57	78	76	62
6	87	81	88	83	84	79	67	72	64	70	76	77
7	> 89	> 82	> 83	> 89	> 89	> 88	80	82	72	79	70	> 88
8	> 90	> 84	> 82	79	85	> 88	> 88	> 87	76	81	75	80
9	> 90	> 82	> 83	> 82	> 82	> 89	87	> 88	> 88	> 85	84	84
10	> 89	> 83	> 82	> 81	80	81	> 87	88	85	86	> 85	86

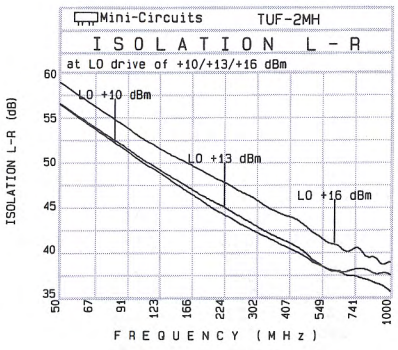
Harmonic LO Order

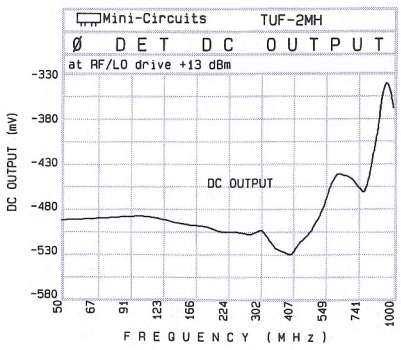
test condition: RF IN:1000.10 MHz; +.06 dBm
LO IN: 970.01 MHz; +12.98 dBm
IF OUT: 30.09 MHz; -7.10 dBm

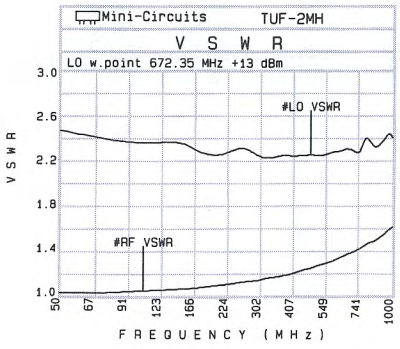
typical performance curves

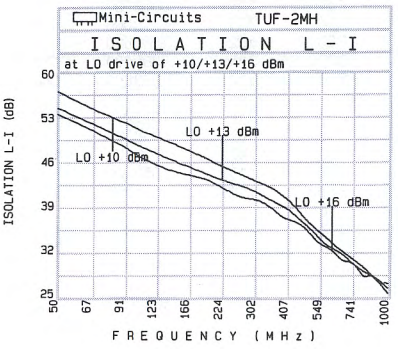
(production unit)

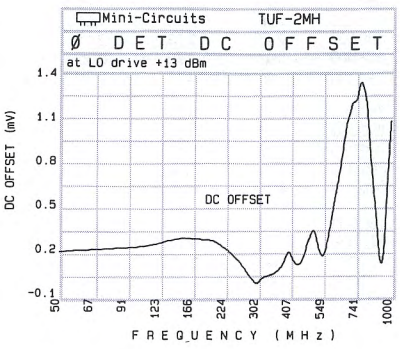












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
TUF-5MH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
20.000	50.000	6.39	5.87	5.53	20.000	65.84	65.81	64.84	49.39	50.21	50.60
50.000	80.000	6.10	5.57	5.24	50.000	58.21	58.31	57.35	42.06	42.94	43.60
100.000	70.000	5.91	5.41	5.13	100.000	52.10	52.44	51.84	36.17	37.15	38.07
158.750	128.750	5.89	5.37	5.13	158.750	48.51	48.96	48.57	32.75	34.29	35.15
200.000	170.000	5.95	5.43	5.20	200.000	46.79	47.29	47.65	31.34	32.96	33.26
297.500	267.500	5.93	5.51	5.27	297.500	44.21	45.30	46.22	29.18	30.09	30.33
436.250	406.250	6.23	5.79	5.45	436.250	42.99	45.57	48.43	26.22	27.35	27.95
500.000	470.000	6.44	5.90	5.56	500.000	42.69	45.56	48.33	24.87	26.32	27.21
575.000	545.000	6.77	6.21	5.87	575.000	42.05	44.68	48.92	23.86	25.44	26.70
713.750	683.750	7.78	6.95	6.23	713.750	40.89	43.61	45.83	22.46	24.34	26.31
750.000	720.000	7.96	7.16	6.50	750.000	40.72	43.15	45.02	22.28	24.17	26.13
760.000	730.000	7.97	7.15	6.56	760.000	40.64	43.01	44.85	22.23	24.16	26.18
852.500	822.500	8.07	7.16	6.65	852.500	40.07	41.36	41.87	22.06	23.95	25.76
991.250	961.250	8.34	7.16	6.51	991.250	39.14	39.32	39.27	21.48	22.75	23.21
1000.000	970.000	8.41	7.32	6.53	1000.000	39.04	39.30	39.25	21.38	22.64	23.00
1130.000	1100.000	8.06	7.38	6.79	1130.000	35.74	36.80	37.72	20.32	20.71	20.06
1222.500	1192.500	7.87	7.32	6.89	1222.500	37.55	38.30	39.00	18.83	18.60	17.80
1361.250	1331.250	7.68	7.13	6.85	1361.250	37.36	37.67	38.39	15.95	15.58	14.94
1453.750	1423.750	7.79	7.10	6.82	1453.750	37.48	37.62	38.02	14.11	13.78	13.23
1500.000	1470.000	7.70	7.00	6.71	1500.000	37.18	37.26	37.76	13.23	12.95	12.46

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
20.000	1.66	1.57	1.52	1.71	2.60	3.86	1.000	1.69	1.32	1.13	20.000	-487.40	0.16
50.000	1.48	1.38	1.29	1.67	2.52	3.67	2.000	1.69	1.32	1.13	40.000	-486.80	0.16
100.000	1.50	1.37	1.29	1.59	2.40	3.52	5.000	1.69	1.32	1.13	50.000	-488.70	0.16
200.000	1.60	1.48	1.40	1.53	2.28	3.32	10.000	1.69	1.32	1.13	100.000	-487.30	0.16
250.000	1.71	1.56	1.49	1.57	2.37	3.41	20.000	1.69	1.32	1.13	158.750	-484.10	-0.05
350.000	2.00	1.77	1.71	1.57	2.30	3.29	50.000	1.70	1.32	1.13	200.000	-489.10	-0.09
475.000	2.36	2.15	2.04	1.65	2.34	3.21	100.000	1.70	1.33	1.14	297.500	-488.20	0.12
500.000	2.45	2.23	2.11	1.66	2.33	3.22	167.000	1.70	1.33	1.14	436.250	-450.90	0.60
627.000	3.02	2.70	2.65	1.77	2.39	3.15	200.000	1.70	1.33	1.14	500.000	-426.20	0.46
740.000	3.46	3.13	2.95	1.85	2.40	3.14	278.000	1.68	1.33	1.15	575.000	-410.80	-0.06
750.000	3.50	3.17	2.98	1.87	2.43	3.18	350.000	1.65	1.32	1.14	713.750	-421.90	-0.10
800.000	3.65	3.31	3.15	1.94	2.44	3.09	450.000	1.61	1.30	1.13	750.000	-419.90	-0.05
900.000	3.85	3.52	3.33	2.06	2.50	3.10	500.000	1.57	1.28	1.12	852.500	-404.80	-0.49
1000.000	3.96	3.65	3.48	2.13	2.58	3.16	550.000	1.54	1.26	1.11	991.250	-391.40	-0.86
1045.000	4.01	3.71	3.53	2.16	2.59	3.18	650.000	1.46	1.21	1.10	1000.000	-389.70	-0.60
1158.000	3.95	3.70	3.52	2.28	2.62	3.12	722.000	1.37	1.16	1.10	1130.000	-402.70	0.02
1272.000	3.83	3.63	3.50	2.42	2.70	3.12	800.000	1.31	1.17	1.14	1268.750	-405.20	0.11
1400.000	3.60	3.42	3.31	2.59	2.64	2.97	900.000	1.25	1.21	1.27	1407.500	-409.50	0.29
1462.000	3.49	3.33	3.21	2.76	2.62	2.88	972.000	1.26	1.31	1.40	1453.750	-394.50	0.30
1500.000	3.38	3.23	3.11	2.78	2.57	2.89	1000.000	1.27	1.34	1.44	1500.000	-389.20	0.27

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+6	24	3	34	6	38	37	64	52	44
1	-	29	+0	35	32	39	33	45	46	57	47	51
2	95	75	50	73	49	74	46	70	45	74	65	72
3	> 95	72	72	> 78	54	78	70	74	65	74	72	> 71
4	> 96	> 78	74	> 78	74	> 78	76	78	76	78	76	> 78
5	92	> 79	> 79	74	> 78	> 78	> 78	77	> 79	> 77	75	> 78
6	> 90	> 73	> 79	> 78	> 79	> 78	77	> 78	> 79	> 79	> 78	> 79
7	> 90	71	71	75	75	> 79	> 79	73	> 78	> 78	> 79	> 79
8	> 90	> 74	69	> 72	78	> 79	> 78	77	> 78	> 78	> 79	76
9	89	72	72	72	> 73	78	> 78	> 79	> 78	> 79	> 79	> 79
10	> 90	73	> 74	> 72	> 73	> 73	> 79	> 77	> 80	78	77	> 79

Harmonic LO Order

test condition: RF IN:1000.10 MHz; -10.06 dBm
LO IN: 970.01 MHz; +12.91 dBm
IF OUT: 30.09 MHz;-16.76 dBm

RF ORDER HARMONIC

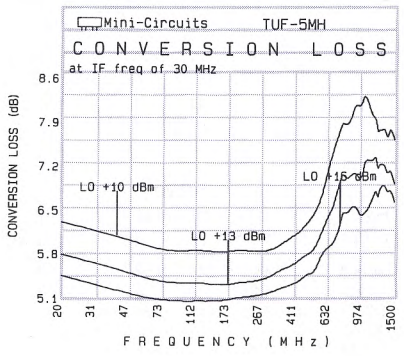
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	4	34	14	47	18	50	50	77	61	58
1	-	29	0	35	33	40	33	47	52	64	54	62
2	86	70	47	69	45	67	39	60	39	71	65	74
3	> 94	59	57	70	37	76	54	59	47	65	61	74
4	> 96	85	61	84	60	75	63	80	59	80	54	79
5	92	88	69	80	74	84	59	84	71	73	64	78
6	> 90	> 83	76	> 87	74	> 88	72	85	70	85	70	> 88
7	> 89	82	> 83	88	84	> 88	88	> 86	76	> 86	85	83
8	> 90	83	> 83	> 82	> 89	> 88	84	> 89	81	> 86	78	> 89
9	88	> 83	> 83	> 83	> 83	> 89	> 89	> 87	> 89	> 86	> 86	> 86
10	89	82	80	> 82	> 83	> 83	> 89	> 87	85	84	> 86	> 86

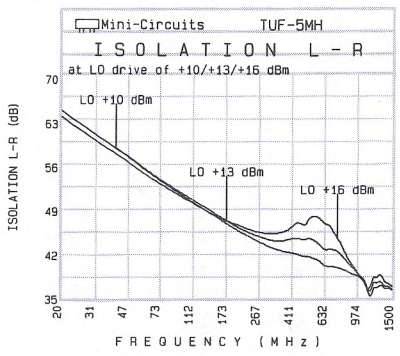
Harmonic LO Order

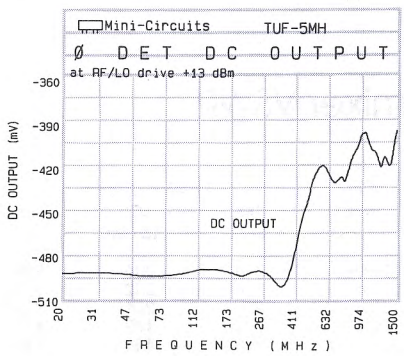
test condition: RF IN:1000.10 MHz; +.07 dBm
LO IN: 970.01 MHz; +12.91 dBm
IF OUT: 30.09 MHz;-7.16 dBm

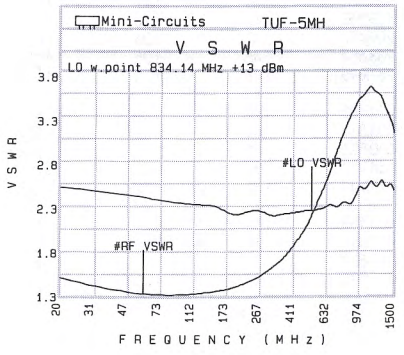
typical performance curves

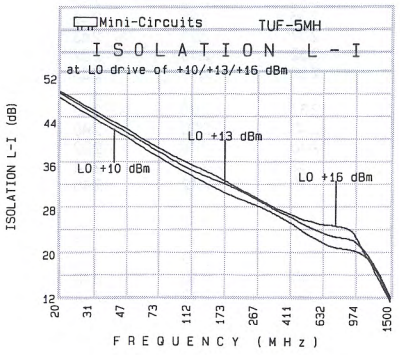
(production unit)

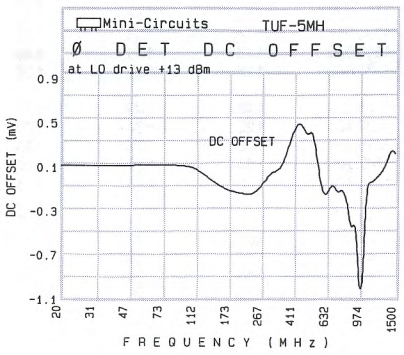












In Stock...Immediate Delivery

broadband, high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
TUF-11AMH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. MHz	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
1400.000	1430.000	7.61	7.21	7.01	1400.000	27.30	29.10	31.50	29.40	35.50	35.40
1426.316	1456.316	7.79	7.29	7.09	1426.316	27.10	28.80	31.00	28.30	34.80	37.10
1452.632	1482.632	7.88	7.38	7.18	1430.000	27.10	28.80	30.90	28.20	34.60	37.30
1478.947	1508.947	8.11	7.51	7.21	1456.316	26.90	28.70	30.80	27.30	33.90	38.50
1505.263	1535.263	8.14	7.54	7.24	1482.632	26.70	28.70	30.40	26.90	33.30	39.40
1531.579	1561.579	8.33	7.53	7.13	1508.947	26.30	28.40	30.30	26.40	32.70	40.10
1557.895	1587.895	8.31	7.51	7.11	1535.263	26.20	28.40	30.20	25.90	31.70	40.30
1584.211	1614.211	8.28	7.38	6.98	1561.579	26.10	28.40	30.20	25.00	30.60	39.80
1610.526	1640.526	8.37	7.47	7.07	1587.895	25.60	28.00	29.80	24.50	29.90	39.40
1636.842	1666.842	8.47	7.37	6.97	1614.211	25.50	27.80	29.50	24.20	29.50	38.50
1663.158	1693.158	8.54	7.34	6.94	1640.526	25.20	27.80	29.40	23.50	28.70	36.90
1689.474	1719.474	8.36	7.46	6.96	1666.842	25.00	27.50	29.30	23.00	27.60	35.70
1715.790	1745.790	8.43	7.43	6.93	1693.158	24.50	27.20	28.80	22.10	26.90	33.90
1742.105	1772.105	8.38	7.38	6.88	1745.790	24.30	26.80	28.60	21.50	25.80	32.40
1768.421	1798.421	8.62	7.32	6.82	1772.105	24.20	26.60	28.60	20.90	25.00	31.50
1794.737	1824.737	8.51	7.51	6.91	1798.421	23.90	26.50	28.40	20.20	24.40	30.30
1821.053	1851.053	8.56	7.46	6.96	1824.737	23.70	26.20	28.10	19.90	23.80	29.30
1847.368	1877.368	8.56	7.56	6.96	1851.053	23.80	26.40	28.20	19.40	23.40	28.60
1873.684	1903.684	8.65	7.45	6.95	1877.368	23.80	26.10	27.90	19.20	22.90	27.60
1900.000	1870.000	8.55	7.55	6.95	1900.000	23.70	26.20	28.00	18.80	22.50	27.10

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
1400.000	2.20	2.16	2.20	2.10	2.08	2.35	40.000	1.55	1.36	1.26
1426.316	2.16	2.12	2.18	2.14	2.20	2.52	64.211	1.53	1.32	1.20
1452.632	2.06	2.01	2.04	2.20	2.23	2.52	88.421	1.53	1.31	1.17
1478.947	1.94	1.89	1.94	2.20	2.16	2.46	112.632	1.52	1.30	1.16
1505.263	1.85	1.81	1.87	2.20	2.12	2.37	136.842	1.52	1.30	1.16
1531.579	1.74	1.70	1.74	2.23	2.16	2.43	161.053	1.51	1.29	1.15
1557.895	1.64	1.61	1.64	2.35	2.25	2.49	185.263	1.48	1.28	1.14
1584.211	1.54	1.51	1.54	2.37	2.23	2.43	209.474	1.47	1.26	1.14
1610.526	1.43	1.41	1.46	2.32	2.18	2.37	233.684	1.45	1.25	1.13
1636.842	1.28	1.29	1.34	2.32	2.18	2.35	257.895	1.44	1.25	1.14
1663.158	1.40	1.49	1.58	2.37	2.23	2.40	282.105	1.42	1.23	1.14
1689.474	1.28	1.34	1.40	2.40	2.20	2.40	306.316	1.40	1.23	1.15
1715.789	1.20	1.27	1.33	2.40	2.18	2.32	330.526	1.38	1.22	1.16
1742.105	1.13	1.22	1.28	2.32	2.12	2.14	354.737	1.37	1.22	1.17
1768.421	1.06	1.18	1.26	2.35	2.12	2.16	378.947	1.35	1.22	1.19
1794.737	1.01	1.17	1.25	2.40	2.16	2.14	403.158	1.34	1.23	1.22
1821.053	1.05	1.17	1.25	2.37	2.14	2.14	427.368	1.32	1.23	1.24
1847.368	1.11	1.19	1.26	2.37	2.10	2.12	451.579	1.30	1.25	1.27
1873.684	1.16	1.21	1.28	2.40	2.10	2.10	475.789	1.29	1.26	1.30
1900.000	1.22	1.25	1.31	2.40	2.12	2.12	500.000	1.28	1.28	1.34

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF CAL

RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	6	23	16	48	28	43	26	42	44	51
1	-	22	0	37	15	30	44	40	55	51	52	61
2	> 97	52	51	44	53	61	54	64	63	57	60	59
3	93	59	53	63	49	66	53	62	> 80	75	68	77
4	90	> 81	84	76	78	77	79	83	85	79	77	78
5	> 91	> 82	78	> 86	81	> 84	80	> 85	78	82	> 81	80
6	> 91	80	> 81	> 80	> 85	> 85	> 84	82	> 86	84	> 86	> 81
7	88	80	78	> 80	> 80	> 86	> 85	81	> 84	> 86	> 84	> 85
8	> 87	> 76	> 81	> 81	80	> 81	85	82	> 84	83	83	84
9	> 88	> 76	> 75	> 81	> 81	> 81	76	85	> 85	> 84	82	> 86
10	> 87	> 76	> 77	75	79	78	> 80	> 80	> 86	82	> 83	> 84

Harmonic LO Order

test condition: RF IN:1650.10 MHZ; -4.02 DBM
LO IN:1680.01 MHZ; + 13.03 DBM
IF OUT: 29.91 MHZ; -10.52 DBM

RF CAL

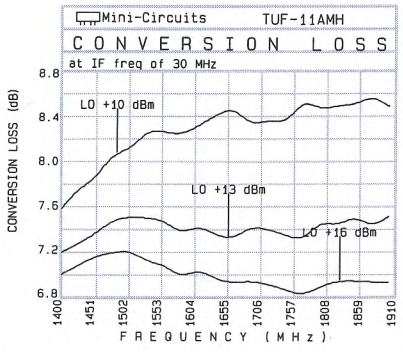
RF ORDER HARMONIC	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+9	6	8	38	21	25	32	30	45	48
1	-	22	0	31	17	34	56	48	53	42	42	63
2	> 97	59	> 73	54	61	59	66	> 71	70	> 71	71	62
3	> 97	> 76	73	70	67	> 70	70	72	> 72	> 72	> 72	> 72
4	> 91	> 72	74	> 76	> 73	> 75	> 71	> 76	> 76	> 71	> 70	> 71
5	91	> 72	69	75	> 77	71	> 76	> 70	> 76	> 75	> 71	> 70
6	88	71	68	71	> 77	> 77	> 73	> 76	> 72	> 78	> 76	> 71
7	90	71	> 72	> 72	> 71	> 77	> 77	> 73	> 74	> 70	> 77	> 76
8	86	> 67	71	> 72	> 71	> 71	> 76	> 76	> 71	> 75	> 71	> 77
9	> 87	> 67	> 67	> 71	> 72	> 71	> 71	> 77	> 76	> 72	> 76	> 71
10	> 88	66	> 67	> 66	71	> 72	> 71	> 71	> 77	> 76	> 72	> 76

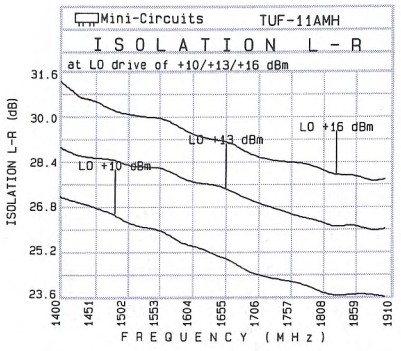
Harmonic LO Order

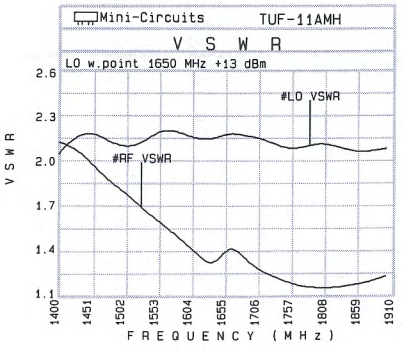
test condition: RF IN:1650.10 MHZ; -13.94 DBM
LO IN:1680.01 MHZ; + 13.02 DBM
IF OUT: 29.91 MHZ; -19.78 DBM

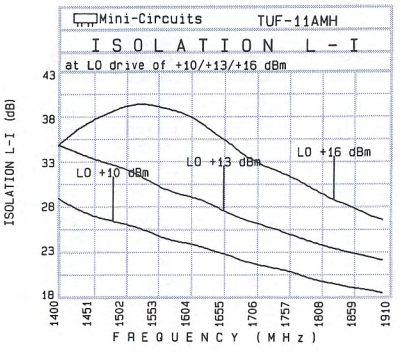
typical performance curves

(production unit)









broadband, high dynamic range

Frequency Mixers

LEVEL 13 (+13 dBm LO, up to +9 dBm RF)

Model
TUF-860MH

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. MHz	Isolation L-R (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm	Isolation L-I (dB) LO +10 dBm	LO +13 dBm	LO +16 dBm
800.000	770.000	5.66	5.33	5.17	800.000	37.81	39.13	39.39	26.14	28.16	29.08
819.740	789.737	5.64	5.36	5.19	819.740	36.36	38.29	38.63	25.17	27.23	28.44
839.470	809.474	5.77	5.35	5.14	839.470	34.14	36.76	37.44	24.28	26.25	27.55
846.050	816.053	5.88	5.39	5.17	846.050	33.61	36.42	37.13	24.12	25.98	27.28
859.210	829.211	6.03	5.47	5.21	859.210	32.80	35.77	36.54	23.90	25.54	26.95
878.950	848.947	6.15	5.50	5.23	878.950	31.74	34.77	35.89	23.76	25.00	26.48
892.110	862.105	6.29	5.60	5.28	892.110	31.34	34.17	35.54	23.81	24.77	26.32
898.680	868.684	6.34	5.65	5.30	898.680	31.06	33.59	35.12	23.77	24.65	26.14
918.420	888.421	6.48	5.81	5.41	918.420	29.91	31.73	33.34	23.72	24.34	25.49
938.160	908.158	6.70	6.07	5.54	938.160	29.00	30.37	31.92	23.62	24.13	25.05
944.740	914.737	6.79	6.15	5.60	944.740	28.77	30.14	31.53	23.56	24.05	24.93
957.890	927.895	6.81	6.23	5.57	957.890	28.34	29.60	30.78	23.47	23.94	24.74
977.630	947.632	6.99	6.40	5.73	977.630	27.94	29.08	29.88	23.36	23.93	24.55
990.790	960.790	7.23	6.57	5.91	990.790	28.10	29.24	30.01	23.18	23.75	24.44
997.370	967.368	7.23	6.60	5.98	997.370	28.13	29.33	29.98	23.07	23.70	24.38
1000.000	970.000	7.22	6.60	5.98	1000.000	28.10	29.29	29.90	23.03	23.67	24.36
1017.110	987.105	7.43	6.79	6.14	1017.110	27.53	28.57	29.02	22.76	23.50	24.23
1036.840	1006.842	7.63	7.07	6.49	1036.840	27.01	27.91	28.14	22.61	23.42	24.09
1043.420	1013.421	7.66	7.20	6.58	1043.420	26.86	27.74	27.94	22.53	23.36	24.03
1050.000	1020.000	7.71	7.22	6.65	1050.000	26.71	27.57	27.77	22.44	23.28	23.97

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +10 dBm	LO +13 dBm	LO +16 dBm	VSWR LO port LO +10 dBm	LO +13 dBm	LO +16 dBm	FREQ. (MHz)	VSWR IF port LO +10 dBm	LO +13 dBm	LO +16 dBm
800.000	1.24	1.23	1.27	1.80	2.28	3.12	1.000	3.08	2.49	1.98
805.000	1.23	1.22	1.27	1.81	2.29	3.12	2.000	3.08	2.49	1.98
827.000	1.21	1.21	1.27	1.89	2.33	3.13	5.000	3.08	2.49	1.98
834.000	1.18	1.17	1.22	1.91	2.35	3.14	6.000	3.08	2.49	1.98
847.000	1.16	1.14	1.20	1.91	2.37	3.14	9.000	3.08	2.49	1.98
868.000	1.13	1.08	1.16	1.95	2.41	3.18	10.000	3.09	2.49	1.98
881.000	1.11	1.04	1.15	1.96	2.44	3.20	20.000	3.09	2.50	1.99
888.000	1.10	1.03	1.15	1.96	2.45	3.21	50.000	3.13	2.52	2.01
908.000	1.11	1.05	1.17	1.98	2.48	3.25	55.000	3.14	2.52	2.01
928.000	1.14	1.11	1.21	1.98	2.50	3.29	80.000	3.16	2.55	2.03
935.000	1.15	1.12	1.21	1.99	2.51	3.30	100.000	3.18	2.57	2.06
949.000	1.20	1.16	1.25	1.99	2.51	3.31	110.000	3.18	2.58	2.07
969.000	1.29	1.25	1.33	2.00	2.51	3.32	125.000	3.20	2.59	2.09
982.000	1.34	1.30	1.37	2.00	2.50	3.31	141.000	3.21	2.61	2.11
989.000	1.36	1.35	1.38	2.00	2.50	3.31	164.000	3.23	2.64	2.14
1000.000	1.43	1.39	1.46	2.00	2.49	3.31	188.000	3.25	2.67	2.18
1016.000	1.50	1.47	1.53	1.98	2.48	3.31	211.000	3.28	2.69	2.21
1036.000	1.60	1.56	1.62	1.98	2.47	3.29	234.000	3.30	2.71	2.25
1043.000	1.65	1.60	1.66	1.98	2.46	3.29	242.000	3.31	2.72	2.26
1050.000	1.69	1.66	1.71	1.98	2.46	3.28	250.000	3.33	2.73	2.28

ϕ detection

FREQ. (MHz)	max DC output mV	DC offset mV
800.000	-448.70	5.05
821.430	-436.10	6.06
842.860	-406.70	8.55
850.000	-400.10	8.29
857.140	-395.80	7.74
878.570	-378.80	7.87
900.000	-358.90	6.27
907.140	-356.70	5.92
914.290	-355.60	6.10
935.710	-354.00	4.72
950.000	-358.80	4.58
964.290	-351.90	3.99
971.430	-350.00	3.99
992.860	-350.30	3.15
1000.000	-350.90	2.80
1000.000	-350.90	2.80
1021.430	-353.30	2.18
1035.710	-344.30	2.16
1042.860	-339.20	1.81
1050.000	-338.20	1.37

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+5	11	2	16	19	34	34	45	48	44
1	-	6	0	20	12	21	27	26	49	47	48	39
2	94	38	42	34	60	37	41	46	46	61	67	> 73
3	94	55	45	54	41	50	44	52	55	55	73	> 72
4	> 95	73	> 78	71	63	60	67	60	66	69	66	> 79
5	> 96	> 79	77	> 79	75	72	72	69	71	74	74	77
6	> 90	> 73	> 79	76	> 79	> 77	74	75	> 77	74	76	> 77
7	> 89	> 72	> 72	76	> 78	> 77	> 77	> 75	78	76	> 79	> 78
8	> 90	> 74	> 73	> 71	75	> 78	> 78	75	> 74	> 79	> 77	78
9	> 91	> 73	72	> 73	> 73	79	> 77	> 79	76	> 75	> 79	> 77
10	89	> 72	> 73	> 73	> 74	> 72	> 79	> 77	> 79	75	> 75	> 79

Harmonic LO Order

test condition: RF IN:1000.10 MHZ; -10.03 DBM
LO IN: 970.01 MHZ; + 12.98 DBM
IF OUT: 30.09 MHZ; -16.64 DBM

RF ORDER HARMONIC

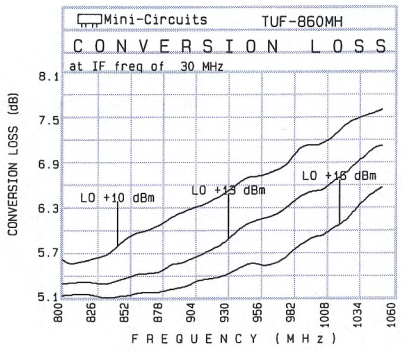
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	5	25	13	25	32	47	48	51	48	54
1	-	6	0	19	13	24	38	28	46	47	42	46
2	87	36	37	33	46	38	39	45	43	55	62	65
3	> 95	42	30	52	28	43	32	42	42	52	68	61
4	> 96	72	50	51	51	42	71	45	51	59	53	65
5	89	54	59	53	51	52	43	55	45	54	54	56
6	87	78	75	67	66	59	57	50	66	51	59	65
7	> 89	81	78	76	66	69	62	57	55	60	55	64
8	> 90	82	> 83	79	77	78	72	66	66	56	67	57
9	> 90	> 83	80	> 83	> 83	81	70	78	74	62	65	65
10	> 89	82	> 83	> 83	82	> 83	79	79	75	72	75	62

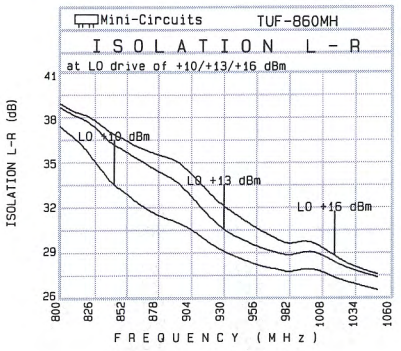
Harmonic LO Order

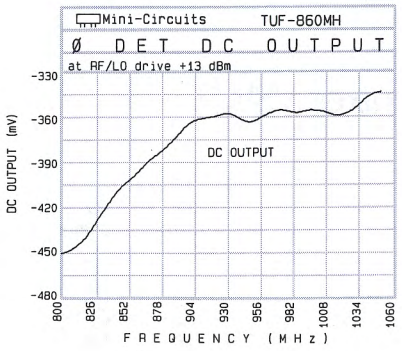
test condition: RF IN:1000.10 MHZ; + .06 DBM
LO IN: 970.01 MHZ; + 12.98 DBM
IF OUT: 30.09 MHZ; -6.57 DBM

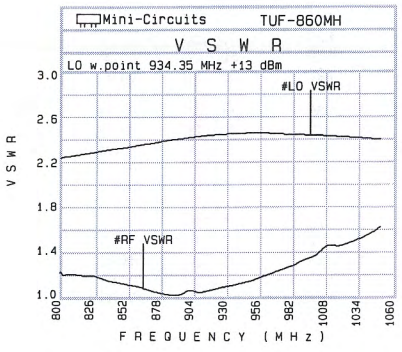
typical performance curves

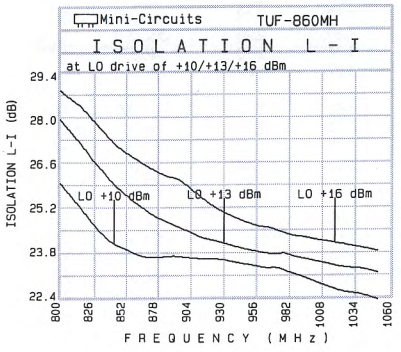
(production unit)

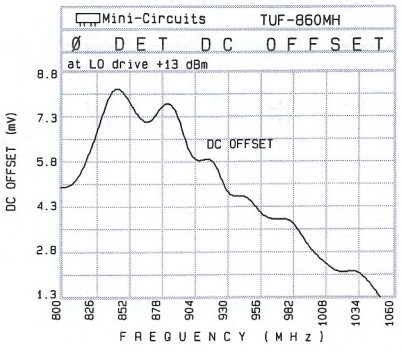












In Stock...Immediate Delivery

very low distortion

Frequency Mixers

LEVEL 17S (+17 dBm LO, up to +14 dBm RF)

Model
TUF-5H

computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF FREQ. (MHz)	FREQ. (MHz)	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
20.0000	50.0000	7.79	6.69	5.99	20.0000	78.70	76.70	71.60	53.50	54.80	55.70
50.0000	80.0000	7.47	6.37	5.67	45.0000	71.40	69.50	64.30	46.80	48.00	49.10
110.0000	140.0000	7.09	5.99	5.49	80.0000	67.10	65.00	60.10	41.90	43.50	44.80
200.0000	230.0000	6.98	5.98	5.58	140.0000	64.20	61.10	55.50	37.50	39.10	41.50
320.0000	350.0000	6.93	6.13	5.73	230.0000	60.70	58.30	53.80	33.90	36.40	37.80
500.0000	530.0000	7.29	6.49	6.09	350.0000	57.40	56.50	58.00	31.70	33.60	34.50
635.0000	665.0000	8.16	6.96	6.46	455.0000	50.30	50.80	56.80	29.60	31.50	32.70
740.0000	770.0000	8.89	7.59	6.69	530.0000	46.50	47.20	47.60	28.10	30.20	32.00
845.0000	875.0000	9.69	8.29	7.49	560.0000	45.60	46.10	46.60	27.70	29.80	31.70
950.0000	980.0000	9.48	8.38	7.48	665.0000	43.50	44.20	43.20	26.40	28.60	30.90
1000.0000	1030.0000	9.41	8.21	7.41	770.0000	40.40	41.40	40.50	26.00	27.80	29.90
1055.0000	1085.0000	8.97	7.97	7.27	875.0000	37.80	38.90	38.20	25.50	27.10	28.40
1100.0000	1130.0000	8.78	7.98	7.28	1000.0000	35.60	36.60	36.20	24.30	25.20	25.70
1200.0000	1230.0000	8.23	7.63	7.33	1085.0000	36.50	37.20	36.60	23.80	24.10	23.80
1250.0000	1280.0000	8.15	7.55	7.15	1190.0000	35.00	36.30	36.10	23.00	22.90	22.10
1300.0000	1330.0000	7.97	7.47	7.17	1280.0000	33.50	35.00	35.00	21.90	21.70	20.90
1350.0000	1380.0000	7.73	7.23	6.93	1330.0000	32.70	34.50	34.50	21.20	21.10	20.20
1400.0000	1430.0000	7.80	7.30	7.00	1380.0000	32.10	34.00	34.20	20.30	19.90	18.90
1470.0000	1500.0000	7.77	7.17	6.77	1400.0000	31.90	33.80	34.00	19.80	19.30	18.40
1500.0000	1470.0000	7.91	7.21	6.91	1500.0000	31.20	33.30	33.50	17.30	17.00	16.10

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
20.000	1.78	1.64	1.57	1.31	1.69	2.49	20.000	2.50	1.86	1.55	20.000	-852.20	0.34
58.000	1.68	1.53	1.45	1.29	1.71	2.50	57.000	2.49	1.87	1.54	40.000	-890.00	0.32
172.000	1.75	1.61	1.52	1.26	1.63	2.38	167.000	2.39	1.80	1.52	50.000	-913.20	0.32
200.000	1.80	1.64	1.55	1.27	1.63	2.35	204.000	2.34	1.80	1.50	100.000	-882.20	0.49
324.000	1.97	1.80	1.70	1.26	1.58	2.21	315.000	2.20	1.71	1.46	158.750	-863.30	0.28
399.000	2.13	1.94	1.83	1.24	1.62	2.18	388.000	2.11	1.68	1.44	200.000	-905.00	0.42
437.000	2.22	2.02	1.90	1.24	1.62	2.18	425.000	2.03	1.64	1.41	297.500	-915.90	1.01
551.000	2.56	2.32	2.18	1.28	1.69	2.26	536.000	1.89	1.56	1.35	436.250	-767.80	1.09
665.000	3.06	2.73	2.55	1.41	1.77	2.18	646.000	1.77	1.46	1.30	500.000	-761.00	3.09
750.000	3.38	3.05	2.83	1.51	1.89	2.42	720.000	1.64	1.37	1.22	575.000	-804.60	-0.16
779.000	3.54	3.16	2.94	1.51	1.86	2.34	774.000	1.62	1.43	1.35	713.750	-708.80	0.13
817.000	3.67	3.29	3.05	1.53	1.84	2.25	812.000	1.58	1.39	1.32	750.000	-687.20	0.99
931.000	3.97	3.59	3.35	1.66	1.93	2.30	927.000	1.48	1.35	1.36	852.500	-681.80	0.97
1045.000	4.03	3.70	3.48	1.73	2.03	2.46	1041.000	1.44	1.43	1.49	991.250	-687.50	3.49
1121.000	3.93	3.65	3.43	1.85	2.08	2.52	1118.000	1.46	1.54	1.63	1000.000	-699.60	3.93
1158.000	3.90	3.58	3.44	1.87	2.08	2.52	1156.000	1.49	1.60	1.73	1130.000	-731.90	4.42
1272.000	3.67	3.45	3.26	1.97	2.14	2.50	1271.000	1.70	1.91	2.12	1268.750	-724.00	2.86
1386.000	3.41	3.21	3.08	2.27	2.24	2.50	1385.000	2.17	2.43	2.65	1407.500	-718.80	-0.60
1462.000	3.26	3.06	2.94	2.34	2.24	2.38	1462.000	2.63	2.91	3.14	1453.750	-701.80	-0.53
1500.000	3.09	2.92	2.79	2.54	2.37	2.50	1500.000	2.91	3.19	3.42	1500.000	-709.00	-5.05

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL											
0	-	-	+5	16	37	54	38	>71	58	57	65	55
1	-	18	+0	30	37	61	56	68	73	66	68	55
2	69	58	48	50	48	65	76	>78	69	77	>70	>73
3	95	>77	70	63	53	62	69	>78	>78	77	>78	69
4	>97	>78	77	73	72	78	72	>78	74	>78	>78	>79
5	94	>79	>78	>79	>78	>78	>78	77	>76	76	>79	>78
6	>90	>73	>78	>78	>78	>77	>77	>78	76	>77	76	>79
7	>89	>71	68	77	>78	>78	>78	77	>78	78	>77	>77
8	>92	73	>72	71	75	>78	77	>76	75	>78	75	74
9	90	71	>74	>71	71	75	77	78	>77	>78	77	77
10	>91	71	71	>73	>72	68	>77	>77	>78	76	76	>79
		0	1	2	3	4	5	6	7	8	9	10

Harmonic LO Order

test condition: RF IN:1000.10 MHz; -5.01 dBm
LO IN: 970.01 MHz; +17.03 dBm
IF OUT: 30.09 MHz;-13.12 dBm

RF ORDER HARMONIC

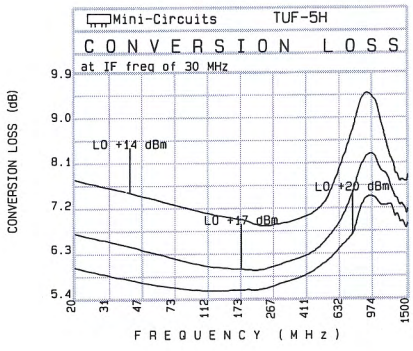
	RF CAL											
0	-	-	5	25	48	66	52	77	71	75	71	74
1	-	19	+0	32	38	64	60	71	82	73	78	65
2	50	51	48	41	41	60	79	80	66	87	73	81
3	>95	80	55	51	34	55	50	>88	78	84	>89	79
4	95	88	87	72	55	61	52	71	87	86	79	88
5	>95	>89	>88	87	78	61	54	61	66	>88	87	88
6	>90	>82	>87	>88	>89	81	66	72	64	78	86	>89
7	>89	>82	82	>88	86	>89	86	71	69	71	83	>88
8	>90	>84	>80	>82	86	>88	87	84	77	79	74	83
9	>91	>83	83	>81	81	>88	>89	85	>87	81	82	79
10	90	81	>83	>82	>81	>82	>88	>87	88	>87	84	85
		0	1	2	3	4	5	6	7	8	9	10

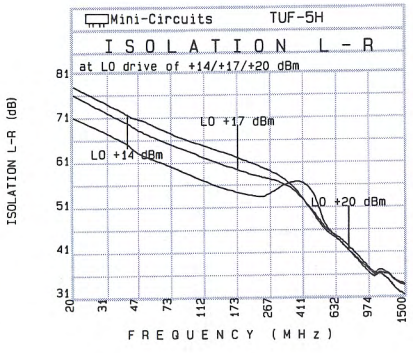
Harmonic LO Order

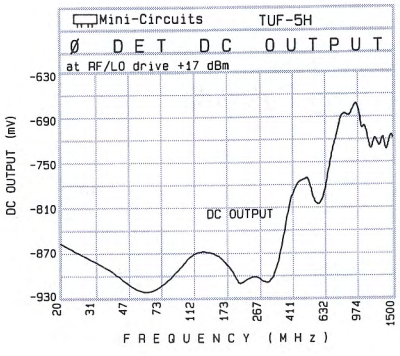
test condition: RF IN:1000.10 MHz; +5.02 dBm
LO IN: 970.01 MHz; +17.03 dBm
IF OUT: 30.09 MHz;-2.85 dBm

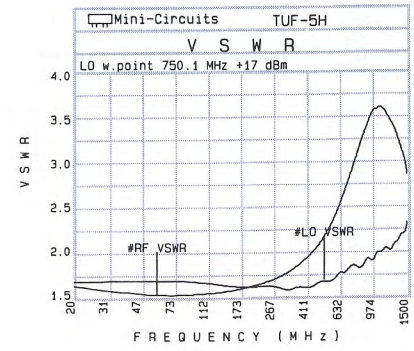
typical performance curves

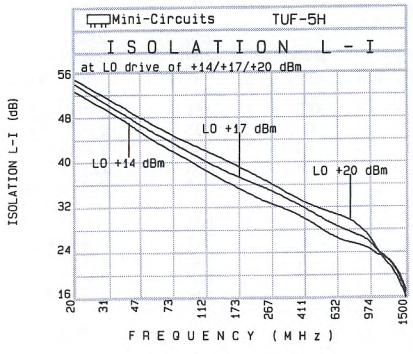
(production unit)

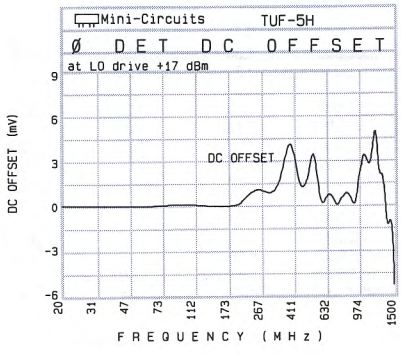












very low distortion

Frequency Mixers

LEVEL 17S (+17 dBm LO, up to +14 dBm RF)

Model
TUF-11AH



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
1400.000	1350.000	7.85	7.77	7.80	1400.000	30.53	31.27	32.16	31.96	32.09	29.95
1439.470	1389.474	7.83	7.67	7.61	1440.540	29.73	30.76	31.83	30.90	31.93	30.12
1478.950	1428.947	7.66	7.43	7.34	1481.080	29.17	30.37	31.60	29.87	32.04	30.70
1492.110	1442.105	7.60	7.32	7.23	1494.590	29.12	30.35	31.68	29.59	32.12	30.89
1505.260	1455.263	7.47	7.19	7.08	1508.110	29.12	30.39	31.76	29.18	32.21	31.09
1544.740	1494.737	7.31	7.04	6.91	1548.650	28.98	30.61	32.19	28.19	31.36	31.05
1571.050	1521.053	7.31	6.98	6.82	1562.160	29.00	30.75	32.35	27.78	30.93	31.04
1584.210	1534.211	7.26	6.93	6.79	1575.680	29.00	30.78	32.42	27.56	30.41	30.85
1623.680	1573.684	7.07	6.83	6.72	1616.220	28.76	30.74	32.40	26.66	29.48	30.56
1663.160	1613.158	7.05	6.76	6.68	1656.760	28.81	30.90	32.79	25.82	28.37	29.89
1676.320	1626.316	6.98	6.70	6.65	1670.270	28.80	30.97	32.87	25.55	28.01	29.52
1702.630	1652.632	6.93	6.67	6.63	1697.300	28.70	30.92	32.73	24.84	27.27	28.81
1742.110	1692.105	6.86	6.61	6.58	1737.840	28.51	31.00	32.89	24.05	26.47	28.16
1768.420	1718.421	6.92	6.63	6.58	1764.860	28.62	31.24	33.32	23.63	26.03	27.61
1781.580	1731.579	6.86	6.59	6.52	1778.380	28.63	31.22	33.50	23.34	25.77	27.32
1821.050	1771.053	6.90	6.59	6.52	1818.920	28.63	30.92	33.01	22.71	25.12	26.62
1860.530	1810.526	6.94	6.68	6.63	1859.460	28.60	30.65	32.31	22.13	24.63	26.37
1873.680	1823.684	6.89	6.67	6.63	1872.970	28.55	30.61	32.30	21.92	24.43	26.26
1886.840	1836.842	7.00	6.74	6.72	1886.490	28.58	30.60	32.27	21.70	24.19	26.09
1900.000	1850.000	7.00	6.79	6.75	1900.000	28.65	30.64	32.22	21.61	24.07	25.97

mixer VSWR

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm
1400.000	2.21	2.14	2.04	2.07	2.49	3.00	40.000	1.30	1.24	1.25
1437.500	2.03	1.96	1.87	2.02	2.36	2.93	50.000	1.27	1.21	1.21
1477.500	1.85	1.78	1.70	2.05	2.40	2.96	75.000	1.20	1.13	1.14
1490.000	1.80	1.73	1.65	2.05	2.42	2.99	100.000	1.16	1.08	1.09
1515.000	1.69	1.63	1.56	2.03	2.40	2.98	110.000	1.15	1.07	1.08
1555.000	1.53	1.47	1.43	2.03	2.41	2.92	145.000	1.14	1.04	1.06
1580.000	1.41	1.37	1.35	2.04	2.43	2.95	182.500	1.13	1.03	1.05
1592.500	1.37	1.35	1.35	2.02	2.40	2.94	200.000	1.13	1.02	1.05
1630.000	1.30	1.30	1.32	2.03	2.39	2.92	227.500	1.13	1.02	1.06
1670.000	1.21	1.25	1.30	2.04	2.39	2.87	250.000	1.13	1.02	1.06
1682.500	1.18	1.24	1.29	2.03	2.39	2.85	275.000	1.13	1.03	1.07
1707.500	1.14	1.22	1.30	2.01	2.37	2.84	287.500	1.13	1.03	1.08
1745.000	1.10	1.20	1.29	2.02	2.38	2.87	312.500	1.13	1.04	1.10
1772.500	1.08	1.19	1.28	2.02	2.38	2.88	347.500	1.13	1.06	1.12
1785.000	1.08	1.19	1.29	2.02	2.37	2.85	382.500	1.13	1.09	1.14
1822.500	1.09	1.21	1.32	2.01	2.36	2.85	400.000	1.14	1.10	1.16
1862.500	1.14	1.25	1.36	2.00	2.37	2.98	430.000	1.14	1.12	1.18
1875.000	1.16	1.27	1.38	2.00	2.35	2.93	465.000	1.16	1.15	1.21
1887.500	1.19	1.29	1.40	2.00	2.33	2.86	487.500	1.17	1.17	1.23
1900.000	1.22	1.31	1.41	2.00	2.31	2.81	500.000	1.18	1.18	1.24

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	2	12	8	70	47	67	48	62	25	31
1	-	17	0	28	14	31	68	68	72	72	65	39
2	95	53	56	53	67	62	57	> 74	> 74	> 74	> 73	> 74
3	> 95	69	63	75	58	68	59	72	> 74	> 73	> 73	73
4	> 90	71	> 79	78	> 79	> 79	75	75	> 79	> 74	71	> 74
5	> 91	71	> 72	79	78	> 79	> 79	> 79	76	> 79	> 73	> 74
6	> 90	69	> 73	> 71	> 79	> 79	> 78	79	78	> 79	> 78	> 73
7	> 90	72	> 73	> 73	73	> 79	> 78	> 78	> 80	79	> 78	> 79
8	> 85	67	73	> 73	71	70	76	> 79	77	> 80	> 79	> 79
9	> 85	67	67	> 73	> 73	> 73	> 71	> 79	> 80	77	> 80	> 79
10	83	> 69	> 68	67	> 73	> 74	> 75	70	75	> 79	77	79

Harmonic LO Order

test condition: RF IN:1600.10 MHz; -4.95 dBm
LO IN:1550.01 MHz; + 16.95 dBm
IF OUT: 50.09 MHz; -11.98 dBm

RF ORDER HARMONIC

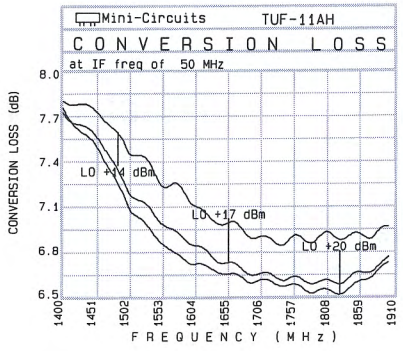
	RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	11	24	18	79	59	77	61	71	37	43
1	-	17	0	28	14	35	74	74	75	76	74	44
2	> 96	43	45	36	41	40	45	79	79	83	> 81	81
3	> 96	48	43	53	39	45	41	49	> 84	> 82	> 83	80
4	> 90	> 83	67	54	58	44	53	58	66	> 83	> 82	> 84
5	> 91	82	81	65	57	66	54	58	60	70	82	> 83
6	> 90	> 82	> 84	82	83	61	67	58	59	71	83	81
7	> 91	81	> 82	83	> 83	81	70	79	79	70	71	> 88
8	> 86	78	> 84	> 83	> 83	82	85	81	87	70	77	81
9	> 83	77	> 77	82	> 83	> 84	> 81	> 88	82	83	71	72
10	85	77	75	> 77	> 82	83	> 84	> 80	88	81	86	69

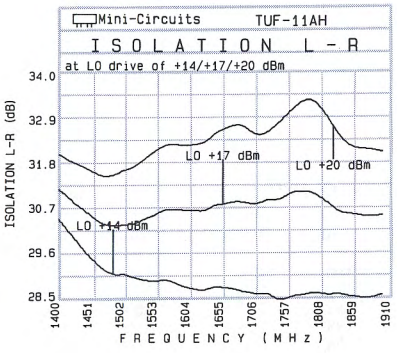
Harmonic LO Order

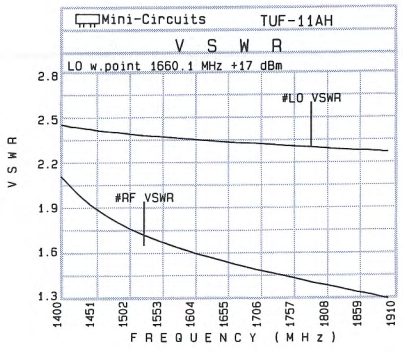
test condition: RF IN:1600.10 MHz; + 5.06 dBm
LO IN:1550.01 MHz; + 16.95 dBm
IF OUT: 50.09 MHz; -2.30 dBm

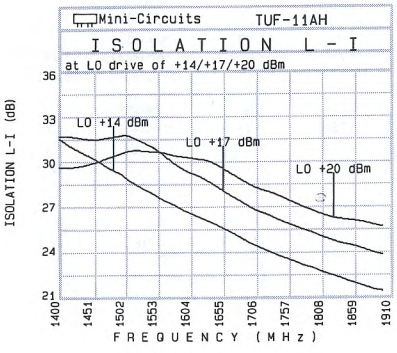
typical performance curves

(production unit)









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very low distortion

Frequency Mixers

LEVEL 17S (+17 dBm LO, up to +14 dBm RF)

Model
TUF-860H



computer-automated performance data

typical production unit / for data of other models consult factory

mixer conversion loss and isolation

RF MHz	LO MHz	Conversion Loss (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	Isolation L-R (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm	Isolation L-I (dB) LO +14 dBm	LO +17 dBm	LO +20 dBm
800.000	770.000	5.77	5.50	5.53	800.000	40.22	42.94	42.74	27.72	32.30	35.52
819.740	789.737	5.77	5.46	5.47	819.740	37.95	39.99	39.77	26.85	29.95	33.28
839.470	809.474	5.99	5.60	5.54	839.470	36.44	38.50	39.38	26.99	29.66	32.91
846.050	816.053	6.04	5.64	5.56	846.050	35.98	37.79	38.82	26.88	29.59	32.82
859.210	829.211	6.17	5.71	5.57	859.210	35.14	36.58	37.70	26.88	28.89	31.95
878.950	848.947	6.31	5.84	5.55	878.950	35.21	36.32	37.47	27.66	28.63	31.54
892.110	862.105	6.51	5.88	5.57	892.110	34.84	35.24	35.81	27.80	28.30	30.92
898.680	868.684	6.54	5.89	5.53	898.680	34.60	34.75	35.09	27.90	28.11	30.63
918.420	888.421	6.67	6.10	5.56	918.420	34.43	34.28	34.27	28.69	28.64	30.50
938.160	908.158	7.04	6.44	5.73	938.160	34.35	34.32	34.19	28.84	28.87	30.30
944.740	914.737	6.98	6.51	5.81	944.740	34.47	34.65	34.64	29.11	29.01	30.29
957.890	927.895	7.03	6.57	5.83	957.890	35.24	35.85	36.30	29.78	29.81	30.72
977.630	947.632	7.39	6.86	6.17	977.630	35.28	36.15	36.66	29.91	30.31	31.30
990.790	960.790	7.52	6.97	6.46	990.790	34.75	35.55	35.69	29.99	30.56	31.42
997.370	967.368	7.58	7.03	6.56	997.370	34.58	35.23	35.03	30.03	30.76	31.55
1000.000	970.000	7.58	7.05	6.54	1000.000	34.58	35.11	34.70	30.01	30.86	31.53
1017.110	987.105	7.81	7.26	6.84	1017.110	33.85	33.80	32.86	29.35	30.51	31.20
1036.840	1006.842	7.96	7.35	6.86	1036.840	33.04	32.91	31.85	29.04	30.12	30.51
1043.420	1013.421	7.98	7.37	6.89	1043.420	32.92	32.80	31.73	28.84	29.93	30.26
1050.000	1020.000	8.07	7.43	6.93	1050.000	32.69	32.67	31.58	28.57	29.64	29.94

mixer VSWR

ϕ detection

FREQ. (MHz)	VSWR RF port LO +14 dBm	LO +17 dBm	LO +20 dBm	VSWR LO port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	VSWR IF port LO +14 dBm	LO +17 dBm	LO +20 dBm	FREQ. (MHz)	max DC output mV	DC offset mV
800.000	1.63	1.55	1.52	1.97	1.64	1.96	1.000	3.39	2.78	2.03	800.000	-831.00	-9.84
818.750	1.60	1.53	1.48	2.02	1.74	2.08	2.000	3.39	2.78	2.03	819.740	-823.20	-10.33
838.750	1.58	1.51	1.46	2.04	1.82	2.15	5.000	3.39	2.78	2.03	839.470	-801.60	-9.02
845.000	1.56	1.49	1.46	2.04	1.83	2.16	10.000	3.39	2.79	2.03	846.050	-793.10	-7.50
857.500	1.57	1.49	1.42	2.05	1.86	2.14	20.000	3.40	2.80	2.04	859.210	-781.60	-5.10
877.500	1.55	1.48	1.38	2.03	1.86	2.11	40.000	3.40	2.82	2.04	878.950	-774.50	-5.12
890.000	1.55	1.45	1.35	2.01	1.84	2.08	50.000	3.42	2.82	2.05	892.110	-758.10	-6.60
896.250	1.55	1.45	1.34	2.00	1.83	2.06	67.000	3.43	2.84	2.07	898.680	-748.30	-7.57
915.000	1.52	1.42	1.29	1.97	1.79	2.01	86.000	3.45	2.86	2.09	918.420	-723.60	-10.06
935.000	1.51	1.39	1.25	1.98	1.75	1.98	100.000	3.47	2.88	2.10	938.160	-739.00	-11.09
941.250	1.50	1.38	1.24	1.99	1.75	1.98	112.000	3.48	2.89	2.12	944.740	-735.10	-10.71
953.750	1.49	1.35	1.21	2.02	1.74	2.02	125.000	3.50	2.90	2.14	957.890	-729.10	-9.87
972.500	1.49	1.34	1.19	2.05	1.72	2.05	139.000	3.50	2.92	2.15	977.630	-715.10	-9.13
986.250	1.49	1.33	1.17	2.05	1.72	2.07	158.000	3.51	2.93	2.18	990.790	-711.00	-9.21
992.500	1.45	1.40	1.11	2.05	1.72	2.07	175.000	3.51	2.94	2.20	997.370	-710.40	-8.97
1000.000	1.48	1.32	1.15	2.05	1.70	2.07	200.000	3.51	2.95	2.23	1000.000	-709.40	-8.77
1017.500	1.49	1.31	1.14	2.02	1.67	2.01	204.000	3.50	2.95	2.23	1017.110	-712.50	-9.18
1037.500	1.50	1.30	1.14	2.00	1.61	1.88	224.000	3.50	2.96	2.26	1036.840	-694.70	-10.05
1043.750	1.50	1.31	1.15	2.00	1.59	1.83	243.000	3.51	2.98	2.29	1043.420	-690.00	-10.18
1050.000	1.50	1.34	1.16	2.01	1.56	1.80	250.000	3.51	2.99	2.30	1050.000	-696.30	-10.31

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Mini-Circuits

ULTRA-REL™ MIXERS

5-YR. GUARANTEE *

mixer harmonic intermodulation

(relative to desired IF output)

RF ORDER HARMONIC

RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	+1	17	35	45	45	49	56	58	48	44
1	-	6	0	17	16	61	60	54	69	69	68	57
2	70	60	41	54	41	56	73	78	77	> 78	> 72	> 74
3	> 95	> 78	48	55	46	51	48	> 79	> 79	> 79	79	> 71
4	96	76	78	67	60	65	63	64	78	> 80	> 79	78
5	> 96	> 79	78	76	70	74	67	71	69	77	76	78
6	> 90	> 73	79	> 79	> 79	77	79	79	77	> 78	77	> 79
7	88	> 73	> 74	> 79	78	> 79	74	> 79	79	78	> 79	77
8	89	> 75	> 73	> 72	> 79	76	> 79	77	> 80	79	> 79	> 79
9	> 90	73	> 74	> 74	> 73	> 79	> 78	> 79	78	> 78	> 79	> 79
10	89	70	> 74	> 74	72	72	> 78	> 78	> 80	> 78	> 79	79

Harmonic LO Order

test condition: RF IN:1000.10 MHz; -5.05 dBm
LO IN: 970.01 MHz; +17.00 dBm
IF OUT: 30.09 MHz; -12.20 dBm

RF ORDER HARMONIC

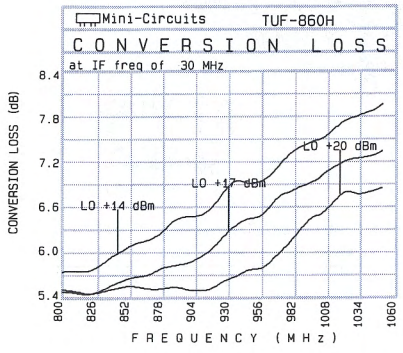
RF CAL	0	1	2	3	4	5	6	7	8	9	10
0	-	-	10	27	47	54	54	59	66	72	61	60
1	-	6	0	21	18	69	62	58	83	76	72	68
2	50	43	30	65	35	69	67	73	67	81	78	80
3	90	86	30	38	28	35	32	80	89	76	84	80
4	> 91	88	85	58	44	57	56	55	83	85	79	88
5	> 92	75	88	> 90	47	51	44	50	46	87	> 89	84
6	82	83	> 90	88	> 90	58	50	56	55	63	87	86
7	> 85	82	> 83	86	> 90	> 90	61	63	55	62	56	> 88
8	> 87	83	> 83	> 84	> 89	88	> 89	64	59	62	61	66
9	84	> 83	83	82	> 84	88	> 89	> 90	67	66	61	68
10	85	> 85	> 84	> 84	83	83	> 89	86	> 90	74	66	67

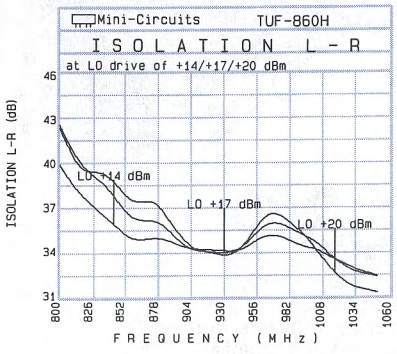
Harmonic LO Order

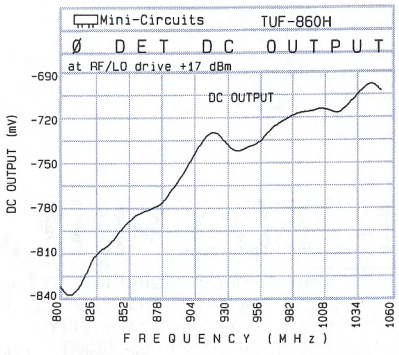
test condition: RF IN:1000.10 MHz; +5.01 dBm
LO IN: 970.01 MHz; +17.00 dBm
IF OUT: 30.09 MHz; -1.94 dBm

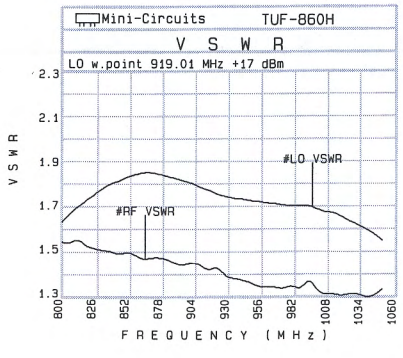
typical performance curves

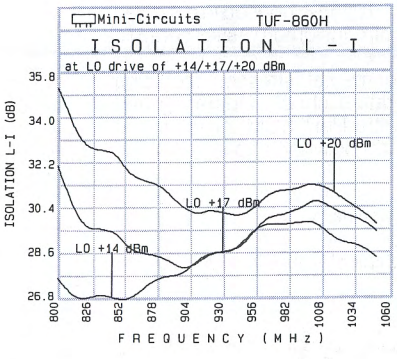
(production unit)

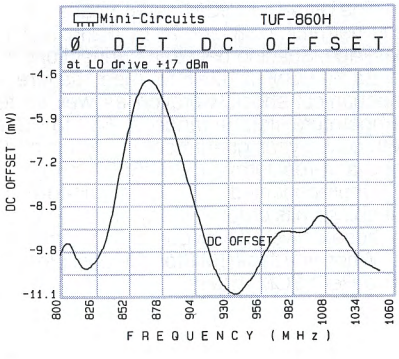












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SURFACE MOUNT MIXERS



ULTRA•REL™ MIXERS
*5-YR. GUARANTEE **

1-2500 MHz FROM $3.30 (1000 qty)

The opportunity for automated, low-cost assembly is a key benefit of surface-mount technology but is often wiped out by the high price of surface-mount components. Now Mini-Circuits offers a new series of mixers to meet the pricing and quality demands of SMT... only $3.30 in 1,000 quantity ($3.95 in quantity of 10)... lower than most conventionally-packaged mixers.

The Ultra-Rel™ SCM-series spans 1 to 2500 MHz and is housed in a rugged non-hermetic 0.38 by 0.75 by 0.2 in. high (max. dimensions) plastic/ceramic package. Spacing between connections is 0.2 in.

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Unprecedented 4.5 sigma unit-to-unit repeatability is also guaranteed, meaning units ordered today and next year will provide performance identical to those delivered for your initial prototype design.

When you think SMT for low-cost production, think of Mini-Circuits' low-cost Ultra-Rel™ SCM mixers.

***ULTRA•REL™ MIXERS 5 yr. Guarantee**
with extra long life due to unique HP monolithic diode construction, 300°C high temp. storage, 1000 cycles thermal shock, vibration, acceleration, and mechanical shock exceeding MIL requirements.

SPECIFICATIONS

MODEL	SCM-1		SCM-2		SCM-5		SCM-2500	
Freq. Range (MHz)								
LO, RF	1-500		10-1000		1250-1800		500-2500	
IF	DC-500		DC-500		DC-500		DC-500	
Conversion Loss (dB)								
mid-band	6.0		6.0		5.5		5.7	
total range	6.5		7.0		5.5		6.4	
Isolation (dB)	(L-R)	(L-I)	(L-R)	(L-I)	(L-R)	(L-I)	(L-R)	(L-I)
low-band	60	50	50	55	28	18	35	18
mid-band	45	45	40	40	28	18	35	18
high-band	40	40	35	30	28	18	35	18
PRICE (1000 qty)	3.30		4.15		8.85		8.85	
(1-9 qty)	4.25		5.45		11.95		11.95	

Units are shipped in anti-static plastic "tubes" or "sticks" for automatic insertion.

finding new ways...
setting higher standards

Mini-Circuits

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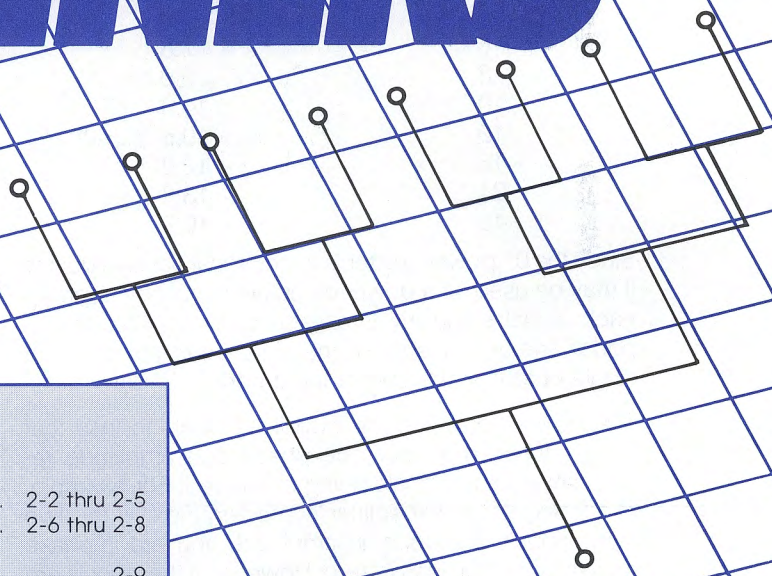
POWER SPLITTER COMBINERS



contents of this section

technical

understanding splitters/combiners . . . . . 2-2 thru 2-5
most often asked questions . . . . . 2-6 thru 2-8
specifications check list
a guide form for requirements 2-9

product specifications

2 way-0° . . . . . 2-10 thru 2-12
2 way resistive 2-13
2 way-90° 2-14, 2-15
2 way-180° 2-16
2 way 0°/180° 2-17
3 way-0° 2-18, 2-19
4 way-0° 2-20, 2-21
5 way-0° 2-22
6 way-0° 2-23
8 way-0° 2-24
10 way-0° 2-25
12 way-0° 2-25
16 way-0° 2-26
24 way-0° 2-27
48 way-0° 2-27

computer data and curves

CAPD information . . . . . 2-28 thru 2-120

understanding power splitters . . .

how they work, what parameters are critical, and how to select the best value for your application.

Basically, a 0° splitter is a passive device which accepts an input signal and delivers multiple output signals with specific phase and amplitude characteristics. The output signals theoretically possess the following characteristics:

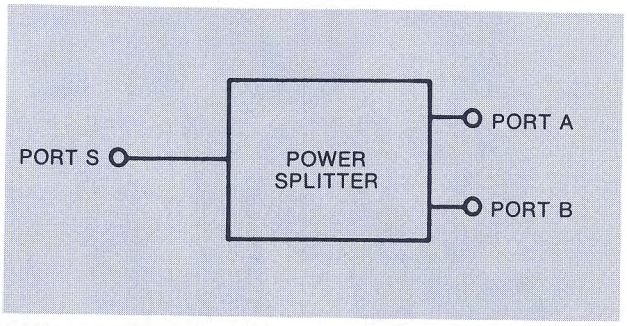
- equal amplitude
- 0° phase relationship between any two output signals
- high isolation between each output signal
- insertion loss as follows:

Number of Output Ports	Theoretical Insertion Loss (dB)
2	3.0
3	4.8
4	6.0
5	7.0
6	7.8
8	9.0
10	10.0
12	10.8
16	12.0
24	13.8
48	16.8

Since the 0° power splitter is a reciprocal passive device it may be used as a power combiner simply by applying each signal singularly into each of the splitter output ports. The vector sum of the signals will appear as a single output at the splitter input port.

The power combiner will exhibit an insertion loss that varies depending upon the phase and amplitude relationship of the signals being combined. For example, in a 2 way 0° power splitter/combiner, Fig. 1 if the two input signals are equal in amplitude and are in-phase then the insertion loss is zero. However, if the signals are 180° out-of-phase the insertion loss is infinite. And, if the two signals are at different frequencies, the insertion loss will equal the theoretical insertion loss shown above.

The power combiner will also exhibit isolation between the input ports. The amount of isolation will depend upon the impedance termination at the combiner output or sum port. For example, in the 2 way 0° power splitter/combiner of Fig. 1 if port S is open then the isolation between ports A and B would be 6dB. And, if port S is terminated by a matched impedance (for maximum power transfer) then the isolation between ports A and B would be infinite.

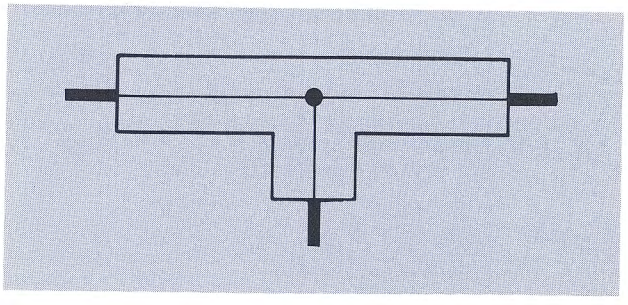


1. When used as a 0° power splitter, the input is applied to port S and equal outputs appear at ports A and B. When used as a power combiner, both inputs are applied to ports A and B and the sum taken from port S.

The following signal processing functions can be accomplished by power splitter/combiners:

1. Add or subtract signals vectorially.
2. Obtain multi in-phase output signals proportional to the level of a common input signal.
3. Split an input signal into multi-outputs.
4. Combine signals from different sources to obtain a single port output.
5. Provide a capability to obtain RF logic arrangements.

let's analyze a basic power splitter



1A. Basic 2 way 0° power splitter, simple "T".

The most basic form of a power splitter is a simple "T" connection, which has one input and two outputs. If the "T" is mechanically symmetrical, a signal applied to the input will be divided into two output signals, equal in amplitude and phase. The arrangement is simple and it works, with limitations.

The two obvious limitations are impedance mismatch

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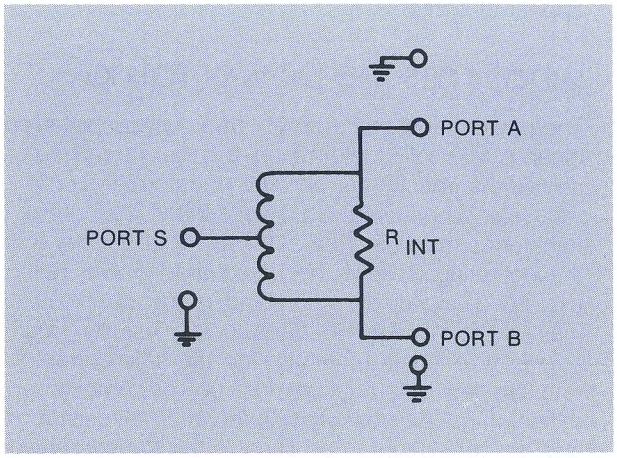

2. In two-way splitter/combiner, equal and opposite currents flow through the internal resistor and transformer, cancel each other, and provide high isolation between ports A and B.

and poor isolation. In a 50-ohm system, each output would be connected to a 50-ohm impedance, thus offering a 25-ohm impedance to the input port. Thus, the impedance looking into the common or input port would present a mismatch in a 50-ohm system. To correct this mismatch, a 25 to 50-ohm matching transformer would be necessary for the simple "T."

Now, consider the second serious limitation of a simple "T," poor isolation. Suppose, for example, that two antennas were fed to a receiver input using a simple "T" as a combiner. If one antenna appears as a short at its resonant frequency, it would load down the other antenna and, in effect, wipe out the receiver input. However, a properly designed power combiner would provide high isolation between inputs so that the antenna "short condition" at one input would have little influence on the other input and would cause approximately a 3:1 VSWR mismatch at the output port, in this case, the receiver input.

In a simple "T" circuit power combiner the isolation between input ports will depend upon the impedance termination at the output port. If the output port is open then the input ports wouild have zero isolation between them. And, if the output port is terminated by a matched impedance the isolation would be 3dB.

Improving upon the simple "T" circuit, consider the basic lumped element power splitter/combiner circuit of Fig. 2. The transformer has an equal number of turns from the center tap to each end. Therefore, as an auto transformer (2 to 1 turns ratio) the impedance across the output ends is 4 times larger than the impedance across the center tap to one end.

Let's examine how this circuit enables high isolation between ports A and B. As a power combiner, an input signal applied to port A will cause a current to flow through the transformer and experience a 180° phase shift by the time it arrives at port B. Similarly, a current will also flow through the resistor, R int and will not experience a phase shift by the time it arrives at port B. When R int equals the impedance value across the transformer ends then, the currents appearing at port B will be equal in amplitude but opposite in phase and cancel. The net result is that no voltage appears at port B from the input signal applied at port A. Thus, there is theoretically infinite isolation between the ports.

Further examining the circuit of Fig. 2, let's determine the theoretical insertion loss between port S and ports A and B. As a power splitter, a signal applied at port S will be split so that identical signals appear at ports A and B, due to the circuit symmetry. If the impedance values are matched then maximum power transfer will take place and half the input power would appear at each port resulting in a 3dB theoretical loss at each port. Furthermore, under the conditions described the circuit is lossless since the voltage across R int is zero.

Let's take an example to illustrate the concepts described. Suppose we have a 50 ohm system so that ports A and B are each terminated in 50 ohms. They appear across the transformer in series so that a 100 ohm transformer impedance is required for optimum power match. Since the transformer has a 4 to 1 impedance ratio, the impedance at port S is 25 ohms. In this example we must add a 2 to 1 (50 to 25 ohm) transformer at port S so that the S port impedance is matched to the 50 ohm system. Remembering the value of R int equals the transformer impedance (to obtain maximum isolation), R int equals 100 ohms. We have now completely specified the circuit values of the 50 ohm 2 way 0° power splitter.

mismatch effect on isolation

Consider the ideal situation in a two-way power combiner where there is infinite isolation between the two input ports. A signal applied to port A will be routed to port S, minus a 3 dB loss in the internal resistor; since isolation is perfect, none of the input signal will reach the other input port. Now, if port S is properly terminated, the sum signals will be absorbed and nothing will be reflected back to the input ports. Fine, as long as port S is properly terminated and thus no mismatch.

Now, let's consider two examples of mismatch at port S, one slight and another large. Assume a +20 dBm signal is applied to port A; with perfect isolation, none of this signal reaches port B. Since there is a 3 dB loss be-

understanding power splitters . . .

tween input A and port S due to the loss in the internal resistor, +17 dBm arrives at port S ignoring any slight transformer loss. If a slight impedance mismatch exists at port S, which causes a −20 dB signal reflection, then a signal of −3 dBm (+17 dBm attenuated by 20 dB) is sent back to ports A and B. This −3 dBm signal experiences a 3 dB loss as it is fed to port B, and the mismatch has now resulted in a −6 dB signal at input B from port A. Now isolation between both input ports is not infinite; there is a +20 dBm signal at port A and a −6 dBm signal at port B for an isolation of 26 dB. Reason? Slight impedance mismatch at port S.

What about a more serious mismatch? Suppose the +17 dBm signal arrives at port S and a mismatch produces a −10 dB signal reflection. Now +7 dBm is fed back to port B (+17 dBm with 10 dB loss); add the additional return 3 dB loss, and a +4 dBm signal appears at port B. Now isolation is only 16 dB, the difference between port A's 20 dBm and the 4 dBm signal at port B due to the mismatch.

Important point: make sure port S is properly matched to eliminate reflections and thus maintain high isolation. Mismatch at either port A or B is not critical if port S of a power combiner is properly matched. If cancellation through the transformer and internal resistor is taking place, there will not be any voltage drop across port A and B and thus no effect on isolation.

Let's take it one step further and assume port S and port A are properly terminated but port B is shorted. As a power combiner, port A would still be isolated from port B and "would not see the short at port B." However, the impedance looking into the S port of the power combiner would be lower. As an example, for a 50 ohm power combiner the impedance at the S port would change from 25 ohms to 8 1/3 ohms as the termination impedance at port B changes from 50 ohms to a short.

mismatch effect on insertion loss

For the power splitter of Fig. 2, consider the situation where one output port, B, is shorted. A signal applied to port S would result in half the power appearing at each port, A and B. Since port B is shorted, all the power appearing there would be reflected back into the power splitter. Half of this power reflected would be dissipated in the internal resistor and the other half would appear at port S. The power loss within the power splitter would therefore be 1/4 or 6dB below the signal power originally applied to port S.

In a practical power splitter/combiner where R int does not exactly equal the impedance across the transformer, there would be less than a 3dB loss at port A because part of the reflected power from port B would appear at port A.

what limits the power rating?

The power handling capability of a power splitter/combiner is basically determined by the internal resistor across the transformer and the transformer's core and wire size. When used as power splitter, the core of the transformer may saturate at the lower frequency end of the operating band if the designated power rating is exceeded; signal distortion and reduction in isolation may result. At high RF frequencies, usually small diameter wire is used thus limiting the safe current level that can flow before failure. In a power combiner application, the power loss across the internal resistor must also be considered in addition to the transformer core effects. For example, in a 2 way power combiner, the internal resistor must be able to dissipate half the power applied to each port. The specifications for the internal load dissipation rating for each power combiner N way group is given on the individual specification pages.

If an application demands an internal resistor power rating larger than available as a standard catalog item, Mini-Circuits can supply a unit without an internal resistor. And a higher power rating resistor can be outboarded. Of course, the performance of the final combination will depend on the external resistor's characteristics, the way it is wired, and its capacitance to the board on which it is mounted.

how to measure isolation

The isolation of the two-way splitter is obtained by measuring the attenuation between ports A and B when the common port is terminated in the correct value of impedance, generally 50 ohms. An RF generator signal is applied to port A and an RF voltmeter reading is taken at port B. The difference in dB represents the isolation between the two ports.

When high isolations are encountered, in the range of 50 dB, the accuracy of the measurement can be improved by replacing the RF voltmeter with a spectrum analyzer and/or by inserting a filter between the port A (or B) and the RF voltmeter. The filter reduces the effects of harmonics from the RF generator. This is especially significant when the isolation of the power splitter/combiner differs by more than 10 dB over the frequency range covering the RF generator frequency and its harmonics.

The technique for measuring isolation of more than a two-way splitter is exactly the same as that just described; just make sure all unused ports are terminated with the appropriate impedance. However, the accuracy

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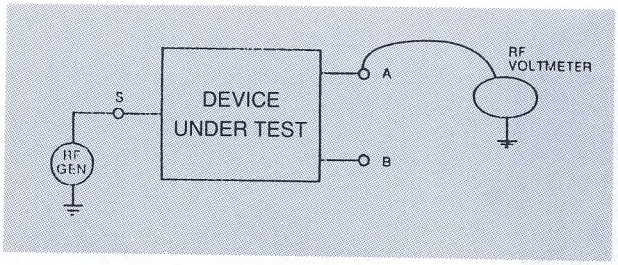


3. To improve insertion loss measurement, first a 3dB standard attenuation is placed between points A and S, and an RF voltmeter reading is taken. Then the attenuator is removed and the power splitter/combiner is connected to A, B, and S.

of this termination impedance is not very critical since there is usually high isolation between ports.

It is quite important, however, that the terminating impedance at the common or S-port be very accurate. Deviations from the correct impedance value will cause significant errors. Typically, a termination impedance with a VSWR of 1.05 to 1 is used at Mini-Circuits for isolation testing.

get tight specs at lower cost

Generally, engineering designs exist in a world of tradeoffs. Mixers, for example, can be designed so that isolation can be improved at the expense of conversion loss; similarly, an amplifier's noise figure can be improved if a reduction in dynamic range can be accepted in exchange.

Not so, fortunately with power splitters. The key parameters are influenced in the same direction during the design stage. A well-designed power splitter will offer high isolation, low insertion loss and good VSWR. You just don't encounter a power splitter with high isolation and poor VSWR, nor high isolation with a poor insertion loss spec. Why? Because poor insertion loss specs generally result from an improper matching transformer (winding not exactly symmetrical) or slight variations in stray capacitances at each end of the transformer; these effects, however, adversely affect insertion loss as well as isolation.

This raises a significant point. There is no need to specify a number of tight spec parameters when you need a power splitter for a particularly stringent requirement. Simply specify a tight improved spec on the key parameter most critical to the task and you'll find the remaining specs will also be upgraded. If you insist on writing tight specs on a number of parameters, you may be paying extra money for a device you would have received anyway. Of course, you can specify one tight parameter, as suggested, and request support data on the other parameters to monitor their characteristics.

In some applications, it is possible for several parameters to be important. In other applications, only one parameter may be considerably significant while others are not. For example, in a power combiner used to add the outputs of two amplifiers, insertion loss is a critical factor while isolation may not be deemed essential.

On the other hand, consider a test setup for two-tone, third-order IM measurement. Here it is common to operate two RF generators that are close to each other in frequency, resulting in one generator "talking to the other" or "pulling." To avoid this measurement pitfall, a power combiner is placed between both RF generators; here the isolation spec is very significant while other parameters, such as phase or amplitude unbalance, have no importance at all.

You can lower your demands, and your cost, by analyzing what parameters must be met while understanding others that can be ignored.

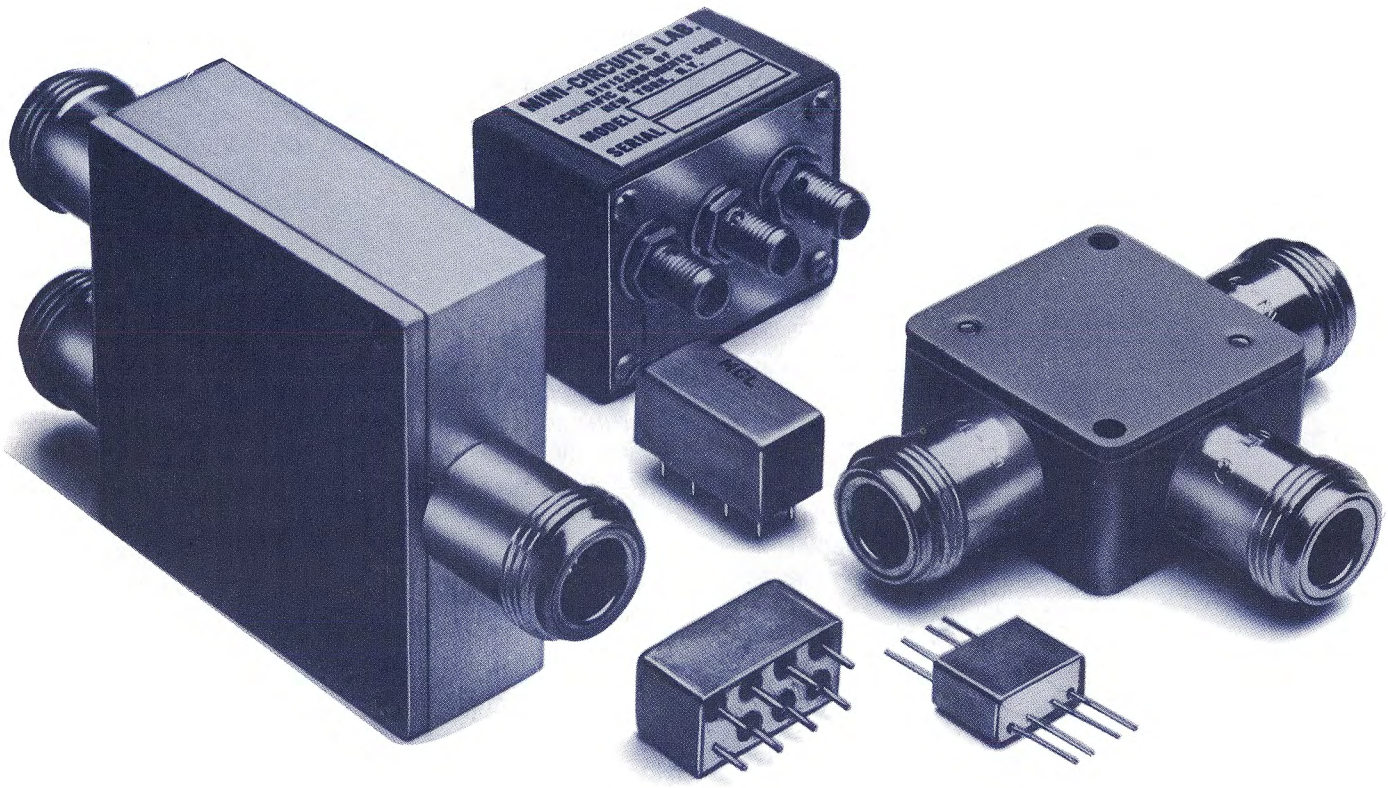
how to measure insertion loss

To measure insertion loss, first terminate all ports properly with 50 (or 75) ohm pads and then set the RF generator to the test frequency. An RF voltmeter reading is taken at port A and then at port S. The difference between the two levels, in dB, represents the insertion loss of the splitter. Repeat for ports B and S.

Although the above procedure is simple, the accuracy of the measurement is limited by the accuracy of the RF voltmeter. An improved technique requires a standard 3 dB attenuator placed between test points A and S (see Fig. 3) with the two-way power splitter disconnected from the test set-up. The RF generator level is set so that the RF voltmeter reading is near the top of the scale, its most accurate region. Then the 3 dB standard attenuator is removed and the power splitter is connected to test points A, B and S. The difference between the first and the new RF voltmeter reading represents the additional power splitter loss over the 3 dB theoretical value. Thus, the insertion loss is 3 dB plus this incremental RF voltmeter reading. Repeat for port B.

The procedure for measuring insertion loss for more than a two-way splitter is essentially the same as previously described. The difference is that the standard attenuator value should be close to the theoretical minimum insertion loss for the power splitter under test. Remember that all ports should be terminated in the correct value of impedance. Practically speaking, the terminations do not have to be perfectly matched but will influence measurement accuracy.

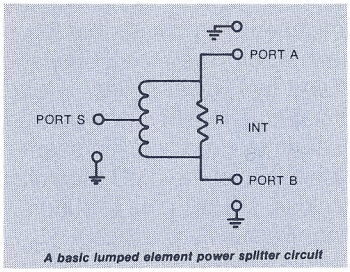
most often asked questions about power splitter/combiners



Q. *What do the terms "internal load dissipation" and "matched power rating" mean?*

A. The matched power rating specifies the maximum power level that can be applied to the input when the output ports are terminated with the specified load resistance.

The internal load dissipation refers to the power rating of the internal terminations within the power divider.



A basic lumped element power splitter circuit

This level is given because improperly matched terminations on the output ports can result in reflected signals that could exceed the power limits of the internal terminations.

The matched power rating is usually several times higher than the internal load dissipation.

Q. *Can performance parameters be traded off when specifying power splitter/combiners?*

A. Once frequency range has been designated, there is not too much leeway in tradeoffs between the various spec parameters. Usually all the performance parameters of a well designed power splitter simultaneously fall off as a function of frequency. However, near the band edge, isolation may be improved at the expense of VSWR by adjusting the value of the internal load resistor Zo.

Q. *What factors influence the power rating of a power splitter/combiner?*

A. The power-handling capability of a power splitter/combiner is basically determined by the internal resistor across the transformer and the transformer's core and wire size. When used as power splitter, the core of the transformer may saturate at the lower frequency end of the operating band if the designated power rating is exceeded; an increase in insertion loss will result. In a power combiner application, the power loss across the internal resistor determines the power rating of the power splitter/combiner. If two signals at different RF frequencies, are being added; then each signal will appear at the S port with a 3 dB loss. The internal resistor absorbs the 3 dB power loss for each signal. Note: If the two signals were equal in phase, and the power splitter/combiner were a 2 Way 0° type, then there would not be a 3 dB loss for each sig-

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nal and thus the power rating of the power splitter/combiner would be increased, and limited by the wire size of the transformer.

Q. *Suppose my application requires a power rating higher than a popular, low-cost "off-the-shelf" model. What can I do to keep costs down?*

A. If an application demands an internal resistor power rating larger than available as a standard catalog item, it is possible to request from Mini-Circuits a unit with a higher rating internal resistor or a unit without an internal resistor. Then a higher power rating resistor can be outboarded; of course, the performance of the final combination will depend on the external resistor's characteristics, the way it is wired, and its capacitance to the board on which it is mounted. In most applications this should not be a problem.

Q. *High isolation between output ports is critical in my application; insertion loss is not. Can I specify a power splitter design that trades one spec off for another?*

A. The key performance parameters of a power splitter are usually influenced in the same direction during the design stage. A well-designed power splitter will offer high isolation, low insertion loss and good VSWR. You don't design a power splitter for high isolation and poor VSWR, nor for high isolation with a poor insertion loss. However, the design of the power splitter can, by reducing the bandwidth of the power splitter, be optimized on this narrower frequency range and improved isolation characteristics can be obtained to satisfy your application.

Q. *I want to combine the output of two amplifiers. What parameter is most critical to spec?*

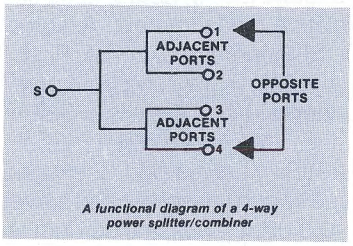
A. Insertion loss is the critical spec since it will reduce the maximum power output that can be obtained. Isolation may not be a serious consideration.

Q. *Is intermodulation distortion critical in a power splitter/combiner?*

A. Distortion in a power splitter is caused by saturation of the transformer, usually a toroidal type. With the present state of transformer technology, distortion is insignificant except at the low end of the specified frequency range where the ferrite core is providing most of the magnetic field.

Q. *I am making a two-tone, third-order IM measurement and the 2-way power combiner arrangement I am using does not provide adequate isolation for the low-level readings I am taking. What can I do?*

A. Use a four-way splitter/combiner instead of a two-way. A general characteristic of a four-way combiner is 20 dB or more higher isolation between opposite ports than adjacent ports. Therefore, terminate ports 2 and 3 and apply inputs to ports 1 and 4 to obtain up to 40 dB isolation.

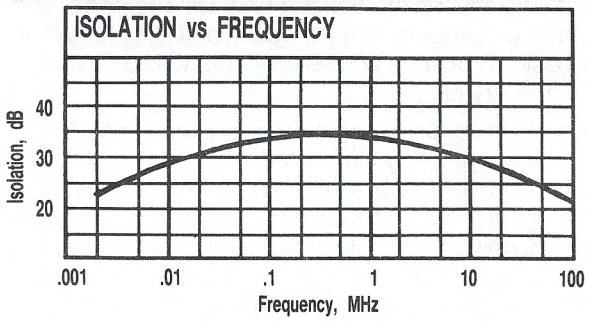


A functional diagram of a 4-way power splitter/combiner

Q. *What effect will a slight mismatch at sum port have on power splitter/combiner isolation performance?*

A. Consider the situation in an ideal two-way power combiner where there is infinite isolation between ports A and B. A signal applied to port A will be routed to port S, minus a 3 dB loss. Since port S is properly terminated, the signal will be absorbed and nothing will be reflected back to ports A and B. Fine, as long as port S is properly terminated and thus no mismatch.

Now let's consider a slight mismatch at port S. Assume a +20 dBm signal is applied to port A. Since there is a 3 dB loss between ports A and S, the incident power at port S is +17dBm, ignoring any slight transformer loss. If a slight impedance mismatch exists at port S, which causes a −20 dB signal reflection, then a signal of −3 dBm (+17 dBm attenuated by 20 dB) is sent back to ports A and B. This −3 dBm signal experiences a 3 dB loss as it is fed to port B, and the mismatch at port S has now resulted in a −6 dBm signal at port B. Now the measured isolation between ports A and B is not infinite; there is a +20 dBm signal at port A and a −6 dBm signal at port B, for an isolation of 26 dB. In this case, one might incorrectly conclude the splitter has an isolation of 26 dB when in fact it is infinite.



Typical curve of isolation vs. frequency for a 2-way power splitter/combiner.

Q. *I have been doing digital design work until last month when I was assigned to an RF project. My boss told me to test the isolation of a power splitter and to make sure port S was properly terminated. What does he mean "properly terminated?"*

A. Ideally, a 50-ohm device should be terminated in a 50-ohm impedance so there will be no reflected power. However, in a real world situation, you won't find an ideal termination. So let's consider the consequences.

If you used a 55-ohm termination, VSWR would be 1.1 (55 ÷ 50) for a return loss of 26 dB. Let's see how this affects an isolation measurement. Assume a 0 dBm input from the RF generator at port A. First, the signal experiences a 3 dB loss traveling from port A through the power splitter and thus there is −3 dBm signal at port S. Now, due to the 1.1 VSWR, a −26dB reflected signal (or −29dBm) leaves port S, experiences another 3 dB loss through the splitter and arrives at port B at a level of −32 dBm. Thus, the 55-ohm termination contributed 26 dB loss to the inherent 6 dB loss of a two-way splitter.

Now, assume a "more perfect" termination of 51 ohms was used. Now VSWR is 1.02 (51 ÷ 50) which produces a return loss of 39 dB, an improvement of 13 dB over the 55-ohm termination.

Just how hard should you strive for a "perfect" match? Use this rule of thumb. The return loss of the termination at S should be at least equal to the highest isolation you intend to measure; and remember, a 2-way coupler has an inherent 6 dB loss. Thus, if you wish to check a power splitter with a 30 dB isolation spec, the termination return loss should be at least 30 dB, requiring a termination VSWR of 1.06 or better. If you are concerned with a 20 dB isolation spec, a VSWR of 1.2 would be acceptable.

Q. *Will mismatch at either port A or B of a 2-way power splitter/combiner cause significant performance degradation?*

A. One of the main advantages of a power splitter is that mismatch at either port A or B is not critical if port S of a power combiner is properly matched. When current cancellation through the transformer and internal resistor is taking place, the effect on isolation between ports A and B is negligible.

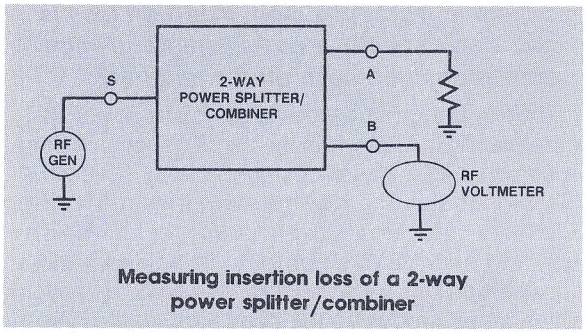
Let's take it one step further and assume port S and port A are properly terminated but port B is shorted. In a basic "T," a short across one input would obviously short everything.

In a practical power splitter/combiner, if port A and port S are properly terminated, but port B is shorted, there will be a 2 dB or so loss at port A. This is because the signal fed to port B will be reflected back to port S. If the termination at S is not perfect then a reflected signal will appear at port A, adding to the original signal level at A, thus slightly reducing the loss between port A and port S.

Q. *I need to accurately check the insertion loss spec of a two-way power splitter. How can I do it?*

A simple, popular (but not too accurate) approach is to terminate all unused ports with 50 (or 75) ohms. Next, set the RF generator to the frequency desired and measure its power output. Connect the generator to port S and measure the power at port A. The insertion loss is the difference between the two readings. Repeat for port B.

A more accurate measurement involves the use of a calibrated 3 dB attenuator inserted between test points A and S, with the power splitter removed from the test setup. The output level of the RF generator is set so the RF voltmeter reading is near the top of the scale, its most accurate region. Then, the 3 dB attenuator is removed and the power splitter is connected to test points A, B and S. The difference between the first RF voltmeter reading and the new reading at point A indicates the additional insertion loss over the theoretical 3 dB value. Thus, the insertion loss of the power splitter under test is 3 dB plus the incremental reading. Repeat the procedure for port B.



Measuring insertion loss of a 2-way power splitter/combiner

Q. *I am using a 2-way power splitter in a military system and must calculate the reliability of the splitter. What is its MTBF?*

A. Mini-Circuits 2-way splitters consist of two toroidal transformers, one ceramic NPO capacitor, and a hi-rel resistor exceeding MIL-R-10509. The ceramic capacitor reliability will be the determining factor in the reliability of the unit. Therefore, considering *your* application, refer to MIL Handbook 217 to make your calculation.

Q. *What is a two-way, 180° power splitter?*

A. A 180° power splitter provides two signals at its output—the signals are 180° out-of-phase with each other. Generally, one of the signals will be in phase with the input.

Q. *How can I tell if a 2-way power splitter/combiner is operating properly?*

A. A 2-way power splitter should offer 25 to 30 dB isolation in its mid-band range. Measure the isolation with the sum port properly terminated; 25 to 30 dB should be read. Now remove the termination. If isolation drops to 6 dB, the power splitter is OK; if isolation is still high, there is an open circuit in the power splitter.

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Mini-Circuits

Power Splitter/Combiners

SPECIFICATIONS CHECKLIST

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application:

☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

No. of way _____, ☐ Splitter ☐ Combiner
Phase ☐ 0° ☐ 90° ☐ 180°
Frequency range _____ MHz
Phase unbalance _____ deg. max.
Amplitude unbalance _____ dB max.
Isolation between ports _____ dB min.
VSWR or return loss (dB)
☐ 50 ohms ☐ 75 ohms ☐ Other
Input _____ Output _____
Insertion loss (above ideal) _____ dB max.
Internal load dissipation _____ watt
Max. power rating _____ watt
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____

No. Way	2	3	4	5	6	8	10	12	16	24	48
Insertion Loss dB Ideal	3	4.8	6	7	7.8	9	10	10.8	12	13.8	16.8

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N ☐ Other

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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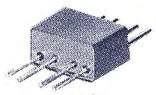
Power Splitter/Combiners

2 WAY–0°

4 KHz to 2 GHz

case style selection

outline drawings see Table of Contents


LPS


PSC–2


LRPS

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 3dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		*M		U		L		*M		U		L	*M	U	L	*M	U		FACTORY	LOCAL
		f_L–f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1–9)		
LRPS o□	LRPS–2–1	5–500	50	25	33	24	30	23	0.25	0.5	0.3	0.6	0.5	1.2	1.0	2.0	3.0	0.15	0.2	0.3	8.95	●	●
case QQQ130 o□	LRPS–2–4	10–1000	25	20	23	16	19	14	0.3	0.5	0.4	0.9	0.8	1.5	1.0	3.0	5.0	0.15	0.2	0.4	19.95	●	●
LPS	LPS–109	10–500	35	25	30	25	30	25	0.3	0.5	0.4	0.6	0.5	1.1	2.0	3.0	4.0	0.15	0.2	0.3	17.95	●	●
case BB48																							
PSC–2	PSC–2–1	0.1–400	20	15	25	20	25	20	0.2	0.6	0.4	0.75	0.6	1.0	2.0	3.0	4.0	0.15	0.2	0.3	10.95	●	●
case A01	PSC–2–1W	1–650	25	20	35	20	25	20	0.3	0.6	0.5	0.9	0.7	1.0	2.0	3.0	4.0	0.15	0.2	0.3	16.95	●	●
◇	PSC–2–2	0.004–60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	0.15	0.25	0.3	23.95	●	●
	PSC–2–4	10–1000	30	25	25	20	25	20	0.6	1.0	0.6	1.2	0.7	1.3	2.0	4.0	8.0	0.15	0.2	0.4	23.95	●	●
	PSC–2–5	10–1400	28	18	22	17	24	17	0.3	0.6	0.6	1.0	0.9	1.6	2.0	3.0	4.0	0.15	0.2	0.4	29.95	●	●
	PSC–2–45	700–900			20	17					0.2	0.4				3.0			0.2		22.95	●	●
■	PSC–2–1–75	0.25–300	20	15	30	20	20	15	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	0.15	0.2	0.3	13.45	●	●
case A06 :■	PSC–2–1–75A	1–200	35	27	46	35	36	25	0.1	0.3	0.2	0.4	0.35	0.6	1.0	1.0	2.0	0.1	0.15	0.15	14.45	●	●
■	PSC–2–1V–75	40–450			31	27					0.5	1.0				4.0			0.3		14.45	●	●
∴■	PSC–2–1W–75	30–600	30	22	—	—	30	20	0.4	0.8	—	—	0.6	1.2	2.0	—	4.0	0.20	—	0.3	18.95	●	●
◇ ■	PSC–2–2–75	0.008–60	35	20	40	25	30	22	0.1	0.4	0.15	0.4	0.3	0.8	1.0	1.0	1.0	0.15	0.15	0.15	23.95	●	●
■	PSC–2–4–752	10–850	31	20	32	23	23	15	0.3	0.5	0.4	0.6	0.5	1.0	2.0	5.0	10.0	0.1	0.2	0.5	23.95	●	●
■	PSC–2375	55–85			35	25					0.3	0.5				1.0			0.1		23.95	●	●

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

NOTES:

* When only spec for M range given, specification applies to entire frequency range.

◇ 1dB compression derates approximately 13 dB from the upper to the lower limits of frequency range L.

■ Denotes 75 ohm models

o Available on tape and reel. Please consult factory.

□ NON-HERMETIC

: VSWR for low, mid and upper range, 1.1 typical, low and upper range, 1.2 max., mid range 1.15 max.

∴ VSWR for low range, 1.1 typical, 1.3 max., upper rnage, 1.15 typical, 1.25 max.

▼ For LRPS, pin 1 is ground, pins 2 and 5 are not used.

1. For Quality Control procedures, see Table of Contents.
2. For environmental specifications, see Table of Contents.
3. Absolute maximum rating: All models are 1W, internal load discipation 0.125W

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MSC-2



TSC-2



SCP-2



TO5SC-2

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 3dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L-f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1-9)		
MSC-2 case A03	MSC-2-1	0.1-450	20	15	30	20	30	20	0.3	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	0.15	0.2	0.3	18.95	•	•
	MSC-2-1W	2-650	22	18	30	20	22	18	0.3	0.5	0.5	0.8	0.8	1.2	1.0	2.0	4.0	0.3	0.2	0.3	20.95	•	•
	MSC-2-5	5-1500	18	16	20	16	20	14	0.6	0.8	0.6	0.8	0.6	1.1	2.0	3.0	5.0	0.2	0.3	0.4	24.95	•	•
	MSC-2-11	5-2000	18	16	20	16	18	11	0.6	0.8	0.6	0.8	1.2	1.8	2.0	3.0	5.0	0.2	0.3	0.5	29.95	•	•
TSC-2 case B02	TSC-2-1	1-400	30	25	30	25	30	20	0.25	0.5	0.4	0.75	0.8	1.0	2.0	3.0	4.0	0.15	0.2	0.6	15.95	•	•
□oSCP-2 case YY101	SCP-2-1	0.1-400	25	15	30	20	25	20	0.3	1.2	0.2	0.6	0.4	1.1	2.0	2.0	3.0	0.15	0.2	0.3	10.45	•	•
	SCP-2-1A	1-550	25	20	25	20	25	20	0.3	0.6	0.3	0.6	0.7	1.3	2.0	2.0	3.0	0.15	0.2	0.4	10.45	•	•
TO5SC-2 case LLL163	TO5SC-2-1	1-500	30	20	28	20	26	20	0.2	0.5	0.3	0.7	0.7	1.5	2.0	1.0	2.5	0.25	0.25	0.4	24.95	•	•

L=low range (f_L to 10 f_L) M=mid range (10 f_L to $f_U/2$) U=upper range ($f_U/2$ to f_U)

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Case Ground
LPS	1	4	5	2,3,6,7,8
▼LRPS	6	4	3	—
PSC-2	1	5	6	2,3,4,7,8
MSC-2	1	5	6	2.3.4.7.8
SCP-2-1	1	5	6	2,3,4,7,8
TSC-2	1	2	4	3
T05SC-2	2	1	3	4,5

MIL-P-23971/15, NSN GUIDE

MCL NO.	NSN	MIL-P-23971/15*
MSC-2-1	6625-01-124-8595	02
PSC-2-1	6625-00-548-0739	01
PSC-2-1W	5985-01-190-7701	
PSC-2-2	6625-01-143-2571	
PSC-2-4	6625-01-230-0492	
TSC-2-1	5895-01-332-8100	

* units are not QPL listed

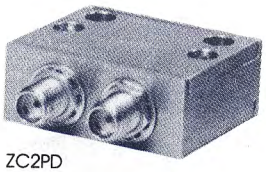
Power Splitter/Combiners

2 WAY–0°

2 KHz to 10 GHz

case style selection

outline drawings see Table of Contents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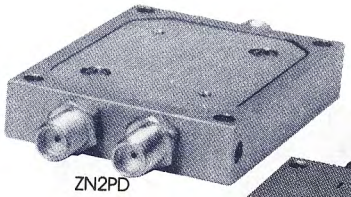
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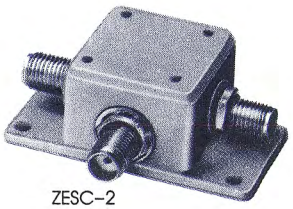
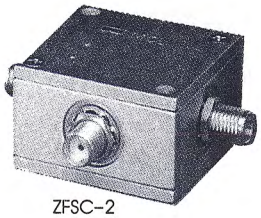
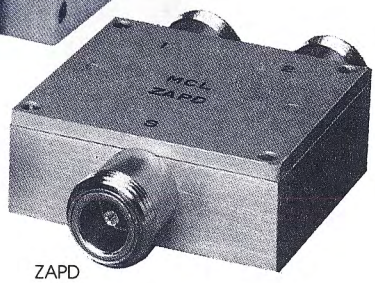

ZESC–2


ZFSC–2



ZAPD

	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	*M Typ.	*M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 3dB L Typ.	L Max.	*M Typ.	*M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	*M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	*M Max.	U Max.	VSWR (:1) S Typ.	S Max.	OUT Typ.	OUT Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZESC–2 case V37	ZESC-2-11	10–2000	19	10	18	13	20	11	0.5	0.9	0.5	1.0	0.6	1.2	1	3	6	0.2	0.3	0.5					71.95	●	
ZFSC–2	ZFSC-2-1	5–500	30	25	28	20	25	20	0.2	0.5	0.3	0.6	0.6	0.8	2.0	4.0	4.0	.15	.15	0.3					44.95	●	
case K18 ■	ZFSC-2-1-75	0.25–300	20	15	30	25	20	20	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	.15	0.2	0.3					45.95	●	
	ZFSC-2-1W	1–750	30	20	28	20	25	20	0.2	0.5	0.4	0.8	0.8	1.0	2.0	4.0	4.0	.15	.15	0.3					48.95	●	
	ZFSC-2-2	10–1000	30	20	25	20	23	18	0.2	0.5	0.5	1.0	0.9	1.2	2.0	4.0	4.0	.15	.15	0.3					51.95	●	
	ZFSC-2-4	0.2–1000	20	15	25	20	23	18	0.2	0.5	0.5	1.0	0.9	1.2	2.0	4.0	4.0	.15	.15	0.3					55.95	●	
	ZFSC-2-5	10–1500	25	15	30	20	25	18	0.25	0.6	0.5	1.0	0.8	1.5	2.0	3.0	4.0	.15	0.2	0.5					59.95	●	
◇:	ZFSC-2-6	0.002–60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3					49.95	●	
◇■	ZFSC-2-6-75	0.004–60	30	20	35	20	25	20	0.5	0.8	0.4	0.8	0.7	1.0	1.0	2.0	3.0	.15	0.2	0.3					51.95	●	
	ZFSC-2-11	10–2000	14	10	16	14	20	15	1.2	1.5	1.2	1.5	1.0	2.2	1	2	4	0.2	0.3	0.5					64.95	●	
△	ZFSC-2-2500	10–2500	16	11	17	14	17	14	0.5	0.8	0.6	1.4	0.8	1.5	1	4	8	0.2	0.3	0.4					74.95	●	
		GHz	L1		U1				L1		U1				L1		U1	L1		U1							
case JJJ-142	ZFSC-2-9G	3.5–9.0	18	12	20	12			0.5	1.5	0.6	1.2			7		10	0.3	0.5						59.95	●	
	ZFSC-2-10G	2.0–10.0	15	9	20	12			0.5	1.5	0.6	1.6			7		12	0.6	0.5						69.95	●	
		GHz																									
ZAPD	ZAPD-1	0.5–1.0	25	19	25	19	25	19	0.25	0.6	0.25	0.6	0.25	0.6		2			0.2						54.95	●	
case F14	ZAPD-2	1.0–2.0	25	19	25	19	25	19	0.25	0.6	0.25	0.6	0.25	0.6		2			0.2						54.95	●	
	ZAPD-4	2.0–4.2	25	19	25	19	25	19	0.4	0.8	0.4	0.8	0.4	0.8		6			0.4						59.95	●	
case F53	ZAPD-21	0.5–2.0	25	18			25	18	0.25	0.8			0.25	1.0		3			0.2						59.95	●	
		MHz																									
ZMSC–2	ZMSC-2-1	0.1–400	20	15	25	20	25	20	0.2	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3					49.95	●	
case M21	ZMSC-2-1W	1–650	25	20	35	20	25	20	0.3	0.5	0.5	0.8	0.7	1.0	2.0	3.0	4.0	.15	0.2	0.3					54.95	●	
:◇	ZMSC-2-2	0.002–60	27	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3					59.95	●	
ZSC–2	ZSC-2-1	0.1–400	20	15	25	20	25	20	0.2	0.5	0.4	0.75	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3					47.95	●	
case M22	ZSC-2-1W	1–650	25	20	35	25	25	20	0.3	0.5	0.5	0.8	0.7	1.0	2.0	3.0	4.0	.15	0.2	0.3					49.95	●	
:◇	ZSC-2-2	0.002–60	25	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3					52.95	●	
:◇■	ZSC-2-2-75	0.002–60	25	20	30	20	27	20	0.3	0.6	0.3	0.6	0.6	1.0	2.0	3.0	4.0	.15	.25	0.3					53.95	●	
	ZSC-2-4	10–1000	25	20	35	20	25	20	0.2	0.5	0.5	0.8	0.7	1.3	2.0	4.0	6.0	.15	0.2	0.3					52.95	●	
■	ZSC-2375	55–85	35	25	35	25	35	25	0.3	0.5	0.3	0.5	0.3	0.5		1.0			0.1						52.95	●	
■	ZSC-2-1-75	0.25–300	20	15	30	20	20	15	0.4	0.75	0.4	0.75	0.4	1.0	2.0	3.0	5.0	.15	0.2	0.3					49.95	●	
ZC2PD case YYY-183	ZC2PD-900	800–900			30	20					0.1	0.4				2.0			0.2		1.1	1.3	1.1	1.3	64.95	●	
ZN2PD	ZN2PD-920	800–920			30	20					0.15	0.4				2.0			0.2		1.1	1.2	1.04	1.2	59.95	●	
case VVV-180	ZN2PD-920W	700–1050			22	15					0.15	0.5				3.0			0.3		1.2	1.5	1.04	1.2	54.95	●	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

L1=F_L 6GHZ U1=6GHZ F_U

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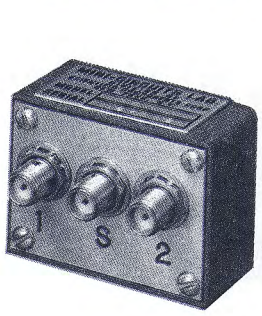
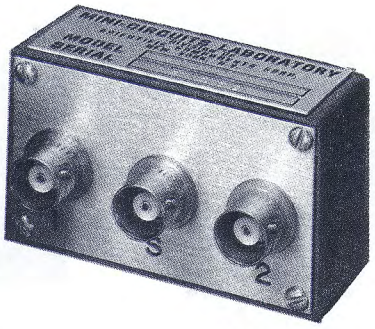
Mini-Circuits

2 WAY–0° RESISTIVE

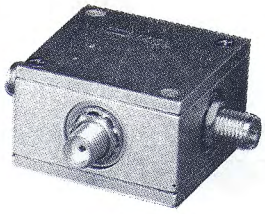
DC to 4.2 GHz



ZMSC–2



ZSC–2



ZFRSC



PRSC

	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB **L Typ.	ISOLATION dB M Typ.	ISOLATION dB U Typ.	INSERTION LOSS, dB Above 6dB **L Typ.	**L Max.	INSERTION LOSS, dB Above 6dB M Typ.	M Max.	INSERTION LOSS, dB Above 6dB U Typ.	U Max.	PHASE UNBALANCE Degrees **L Max.	PHASE UNBALANCE Degrees M Max.	PHASE UNBALANCE Degrees U Max.	AMPLITUDE UNBALANCE dB **L Max.	AMPLITUDE UNBALANCE dB M Max.	AMPLITUDE UNBALANCE dB U Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZFRSC case K18	△ZFRSC–42	DC–4200	6.2	6.5	7.0	0.1	0.2	0.1	0.5	0.4	1.4	1	3	5	0.1	0.2	0.5	59.95	●	
	■ZFRSC–2075	DC–2000	6.2	6.6	7.0	0.1	0.2	0.3	0.6	0.5	1.4	1	2	5	0.1	0.2	0.5	59.95	●	
	▲ZFRSC–2050	DC–2000	6.2	6.6	7.0	0.1	0.2	0.3	0.6	0.5	1.4	1	2	5	0.1	0.2	0.5	59.95	●	
PRSC case III-145	PRSC–2050	DC–2000	6.0	6.2	6.5	0.1	0.3	0.2	0.7	0.5	1.0	1	3	5	0.1	0.3	0.5	29.95	●	●

**L=DC–100MHz M=mid range (100MHz to $f_U/2$) U=upper range ($f_U/2$ to f_U)

Above models are resistive power dividers to enable frequency coverage from dc to the highest rated frequency. Since resistive power dividers do not provide a high degree of isolation (basically isolation equals the insertion loss between ports), an amplifier such as Mini-Circuits' ZFL series is recommended when high isolation is required. Matched power rating 0.75W, internal load dissipation 0.375W.

NOTES:

- * When only spec for M range given, specification applies to entire frequency range.
- ■ 75 ohm BNC connections are standard
- △ Available only with SMA connector
- : Isolation specified to 0.004 MHz.
- ▲ Available only with BNC connectors.
- ◇ 1 dB compression derates approximately 13 dB from low range to mid range
1. Absolute Maximum Ratings. Matched power rating ZAPD, ZN2PD, ZC2PD is 10W, all other models 1W, internal load dissipation 0.125W.
2. For connector types and case mounting options, see case style outline drawing.
3. Prices and specifications subject to change without notice.

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Case Ground
PRSC	12	3	8	1,2,4,5,6 7,9,10,11

MIL-P-23971/15, NSN GUIDE

MCL NO.	NSN	MCL NO.	NSN
ZAPD–1 (TNC)	5985–01–250–4883	ZMSC–2–1	5985–01–333–1128
ZAPD–2 (SMA)	5895–01–229–7431	ZMSC–2–1B	5895–01–253–2445
ZAPD–4	6625–01–173–1887	ZMSC–2–1BR	5985–01–338–9329
ZFSC–2–1	6625–01–139–3499	ZMSC–2–1W	5895–01–127–0232
ZFSC–2–1 (SMA)	6625–01–213–6490	ZSC–2–1 (TNC)	6625–01–310–2129
ZFSC–2–1 (BNC)	5985–01–176–4551	ZSC–2–1	5895–01–214–6032
ZFSC–2–1–75	5895–01–325–4795	ZSC–2–1B	6625–01–018–1066
ZFSC–2–1W (SMA)	6625–01–200–5094	ZSC–2–1B (TNC)	6625–01–109–3706
ZFSC–2–2 (SMA)	6625–01–333–1127	ZSC–2–1 (BNC)	5895–01–036–6254
ZFSC–2–2B	5895–01–330–4416	ZSC–2–1B (BNC)	6625–00–270–3055
ZFSC–2–4(TNC)	5985–01–250–4882	ZSC–2–1W	5895–01–283–0850
ZFSC–2–5	6625–01–253–2444	ZSC–2–1WB	6625–01–264–8985
ZFSC–2–6B	5985–01–315–2869	ZSC–2–1–75B	5895–01–136–8182
ZFRSC–2050B	5985–01–310–5746	ZSC–2–2B	5820–01–136–7245
ZFRSC–2075	5985–01–266–6144	ZSC–2–2–75B	5915–01–012–8162
ZFRSC–42	5985–01–332–3083		

*units are not QPL listed

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Power Splitter/Combiners

2 WAY–90°

0.42 MHz to 4.2 GHz

case style selection

outline drawings see Table of Contents



SYPQ



PSCQ–2



SCPQ



LRPQ

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB Typ.	ISOLATION dB Min.	INSERTION LOSS, dB Avg. of Coupled Outputs less 3 dB Typ.	INSERTION LOSS, dB Avg. of Coupled Outputs less 3 dB Max.	PHASE UNBALANCE Degrees Max.	AMPLITUDE UNBALANCE dB Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PSCQ–2	PSCQ–2–0.455	0.42–0.51	30	25	0.1	0.5	3.0	1.2	25.95		
case A01	PSCQ–2–1.25	1.13–1.38	29	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–1.5	1.4–1.7	29	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–3.4	3.0–3.8	30	25	0.4	0.7	3.8	1.2	19.95	●	●
	PSCQ–2–4.0	3.5–4.5	36	25	0.4	0.7	3.0	1.5	14.95	●	●
	PSCQ–2–6.4	5.8–7.0	30	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–7.5	7.0–8.0	35	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–10.5	9.0–11.0	25	20	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–13	12–14	29	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–14	12–16	30	25	0.3	0.6	3.0	1.8	19.95	●	●
	PSCQ–2–17.5	16–19	28	25	0.6	0.7	3.0	1.6	14.95	●	●
	PSCQ–2–21.4	20–23	30	25	0.4	0.7	3.0	1.2	14.95	●	●
	PSCQ–2–26	14–30	25	20	0.4	0.7	3.0	1.5	23.95	●	●
	PSCQ–2–40	23–40	21	18	0.3	0.7	3.0	1.5	19.95	●	●
	PSCQ–2–50	25–50	30	20	0.3	0.7	3.0	1.5	23.95	●	●
	PSCQ–2–70	40–70	30	20	0.3	0.7	3.0	1.5	23.95	●	●
	PSCQ–2–70N	66–74	22	19	0.2	0.5	0.8	0.25	23.95	●	●
	PSCQ–2–90	55–90	30	20	0.3	0.7	3.0	1.2	23.95	●	●
	PSCQ–2–120	80–120	25	18	0.3	0.7	3.0	1.5	23.95	●	●
	PSCQ–2–160	100–160	24	19	0.3	0.7	3.0	1.5	23.95	●	●
	PSCQ–2–180	120–180	23	15	0.3	0.7	4.0	1.2	23.95	●	●
	PSCQ–2–250	150–250	30	22	0.4	0.8	4.0	1.5	23.95	●	●
	PSCQ–2–300	220–300	27	20	0.3	0.7	3.0	1.3	23.95	●	●
	PSCQ–2–400	250–400	23	16	0.5	0.9	4.0	1.5	23.95	●	●
	PSCQ–2–450	350–450	23	16	0.5	0.9	5.0	1.5	23.95	●	●
	PSCQ–2–550	450–550	19	15	0.4	0.7	5.0	1.5	23.95	●	●
case A05	PSCQ–2–1000	800–1000	27	20	0.28	0.6	3.0	1.3	25.95	●	●
□○SCPQ	SCPQ–21.4	20–23	32	25	0.15	0.5	2.5	1.0	13.95	●	●
case YY101	SCPQ–90	55–90	26	20	0.2	0.7	3.0	1.2	13.95	●	●
	●SCPQ–180	120–180	20	16	0.3	0.7	3.0	1.2	13.95	●	●
	●SCPQ–400	250–400	20	16	0.3	0.7	3.0	1.2	14.95	●	●
*□○LRPQ	LRPQ–70	65–75	30	20	0.1	0.5	3.0	1.0	9.95	●	●
case QQQ130	LRPQ–700	500–700	23	18	0.2	0.6	3.0	1.5	9.95	●	●
	LRPQ–980	820–980	28	20	0.15	0.5	4.0	1.0	11.95	●	●
□○SYPQ	SYPQ–21.4	20–23	33	25	0.1	0.4	3.0	1.1	13.95	●	●
case AH202	SYPQ–70	65–75	31	24	0.1	0.4	3.0	1.1	13.95	●	●

Models available at frequencies other than shown in chart above. Please consult factory.

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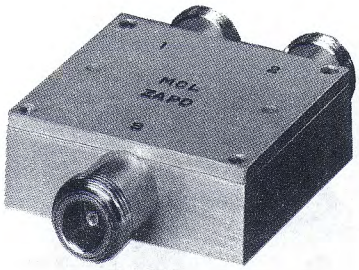


ZAPDQ



ZMSCQ-2



ZSCQ-2

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB Typ.	ISOLATION dB Min.	INSERTION LOSS, dB Avg. of Coupled Outputs less 3 dB Typ.	INSERTION LOSS, dB Avg. of Coupled Outputs less 3 dB Max.	PHASE UNBALANCE Degrees Max.	AMPLITUDE UNBALANCE dB Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZAPDQ case F14	ZAPDQ-2	1000-2000	22	16	0.4	1.4	6.0	0.8	79.95	●	
	ZAPDQ-4	2000-4200	22	16	0.4	0.9	8.0	1.0	79.95	●	
ZMSCQ-2 case M21	ZMSCQ-2-21.4	20-23	30	25	0.4	0.7	3.0	1.2	61.95	●	
	ZMSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	61.95	●	
	ZMSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	61.95	●	
	ZMSCQ-2-120	80-120	25	18	0.3	0.7	3.0	1.5	61.95	●	
	ZMSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	61.95	●	
ZSCQ-2 case M22	ZSCQ-2-50	25-50	30	20	0.3	0.7	3.0	1.5	54.95	●	
	ZSCQ-2-90	55-90	30	20	0.3	0.7	3.0	1.2	54.95	●	
	ZSCQ-2-180	120-180	23	15	0.3	0.7	4.0	1.2	54.95	●	

Models available at frequencies other than shown in chart above. Please consult factory.

NOTES:

□ NON-HERMETIC
● case YY161
○ Available on tape and reel. Please consult factory.
◆ Pin 4 is ground
* LRPQ units have bottom barrier ground plane insulated with glass barrier
1. For quality control procedures and reliability, see Table of Contents.
2. For environmental specifications see Table of Contents.
3. Absolute Maximum Ratings, Matched power rating ZAPDQ (10W), all other models (1W), Internal load dissipation (0.125W).
4. For connector types and case mounting options, see case style outline drawings.
5. Prices and specifications subject to change without notice.

pin and coaxial connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Case Ground	Terminate 50 ohms	GND
PSCQ-2	1	2	5	3,4,7,8	6	—
◆PSCQ-2-1000	1	2	8	3,5,6	7	—
LRPQ	6	4	1	—	3	2,5
SCPQ	1	2	5	3,4,7,8	6	—

NSN GUIDE

MCL NO.	
PSCQ-2-180	6625-01-186-4456
PSCQ-2-90	6625-01-160-0151
PSCQ-2-70	5985-01-292-8834
PSCQ-2-550	5895-01-347-0206

Power Splitter/Combiners

2 WAY–180°

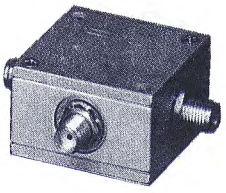
10 kHz to 2000 MHz

case style selection

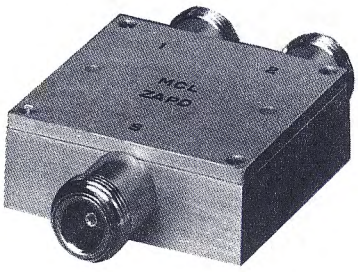
outline drawings see Table of Contents



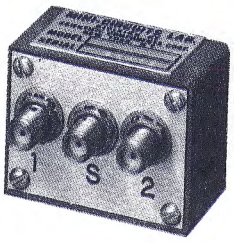
PSCJ-2



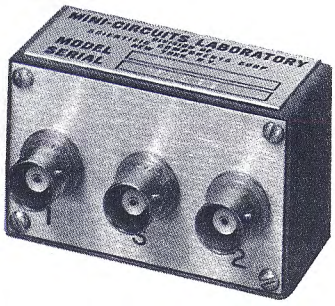
ZFSCJ-2



ZAPDJ-2



ZMSCJ-2



ZSCJ-2

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 3dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L–f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1–9)		
PSCJ–2	PSCJ-2-1	1–200	35	30	35	25	30	23	.75	1.0	0.5	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	23.95	●	●
case A01	◇ PSCJ-2-2	0.01–20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	34.95	●	●
	■ PSCJ-2-1-75	1–200	35	30	31	25	26	20	0.6	1.2	0.8	1.2	1.2	1.6	2.0	4.0	6.0	.15	0.2	0.5	23.95	●	●
ZFSCJ–2	ZFSCJ-2-1	1–500	30	20	33	25	30	18	1.0	1.5	1.0	1.5	1.0	1.5	2.0	4.0	6.0	.15	0.2	0.5	59.95	●	
case K18	△◇ ZFSCJ-2-2	0.01–20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	57.95	●	
	ZFSCJ-2-3	5–300	30	20	33	25	30	18	1.0	1.5	1.0	1.5	1.0	1.5	2.0	4.0	6.0	.15	0.2	0.5	49.95	●	
	△ ZFSCJ-2-4	50–1000	30	20	—	—	25	18	1.2	1.9	—	—	1.6	2.4	6.0	—	7.0	0.6	—	0.6	69.95	●	
ZMSCJ–2	ZMSCJ-2-1	1–200	35	30	35	25	30	23	.75	1.0	0.6	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	57.95	●	
case M21	◇ ZMSCJ-2-2	0.01–20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	67.95	●	
ZSCJ–2	ZSCJ-2-1	1–200	35	30	35	25	30	23	.75	1.0	0.6	0.8	.75	1.2	2.0	2.5	4.0	.15	.15	0.3	51.95	●	
case M22	◇ ZSCJ-2-2	0.01–20	35	25	30	25	25	18	0.3	0.8	0.2	0.5	0.3	0.6	1.0	2.0	2.5	0.1	0.1	0.2	59.95	●	
ZAPDJ–2																							
case F14	ZAPDJ-2	1000–2000	22	18	22	18	22	18	1.3	1.8	1.3	1.8	1.3	1.8	6	6	6	0.8	0.8	0.8	71.95	●	

L = low range (f_L to 10 f_L) M = mid range (10 f_L to f_U/2) U = upper range (f_U/2 to f_U)

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Mini-Circuits

2 WAY–0°/180°

5 to 200 MHz



PMT

	MODEL NO.	FREQ. RANGE MHz	ISOLATION[1] dB						INSERTION LOSS, dB[2] Above 3dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE[3] dB			PRICE	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L–f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1–9)		
PMT	PMT-1	5–200	22	20	24	20	24	18	0.8	1.0	0.9	1.1	1.0	1.5	2	4	8	0.1	0.2	0.5	23.95	●	●
case A01	■ PMT-1-75	5–200	22	18	22	18	22	18	1.0	1.3	1.0	1.4	1.0	1.5	2	4	8	0.1	0.2	0.5	23.95	●	●

L = low range (f_L to 10 f_L) M = mid range (10 f_L to f_U/2) U = upper range (f_U/2 to f_U)

1. S–J ports, typical isolation is 40 dB.
2. For in-phase ports, typ. insertion loss is 0.2 dB.
3. Input S or J ports, output ports 1 and 2

NOTES:

◇ 1 dB compression derates approximately 13 dB from 10f_L to f_L.
■ Denotes 75 ohm models.
△ Available only with SMA connectors.
1. For connector types and case mounting options see case style outline drawings.
2. Prices and specification subject to change without notice.

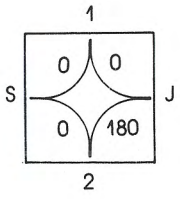
NSN GUIDE

MCL NO.	NSN
PSCJ-2-2	5985-01-332-3084
ZSCJ-2-2	5895-01-340-7761

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Case Ground	Terminate 50 ohms
PSCJ-2 PMT	1	5	6	2,3,4,7,8	—



S PORT	1
J PORT	4
1 PORT	2
2 PORT	3
case ground	5,6,7,8

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Power Splitter/Combiners

3 WAY–0°

10 kHz to 4.2 GHz

case style selection

outline drawings see Table of Contents



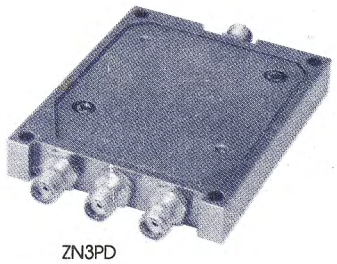
PSC–3



SCP–3



ZFSC–3



ZN3PD

MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	ISOLATION dB L Min.	ISOLATION dB M Typ.	ISOLATION dB M Min.	ISOLATION dB U Typ.	ISOLATION dB U Min.	INSERTION LOSS, dB Above 4.8 dB L Typ.	INSERTION LOSS, dB Above 4.8 dB L Max.	INSERTION LOSS, dB Above 4.8 dB M Typ.	INSERTION LOSS, dB Above 4.8 dB M Max.	INSERTION LOSS, dB Above 4.8 dB U Typ.	INSERTION LOSS, dB Above 4.8 dB U Max.	PHASE UNBALANCE Degrees L Max.	PHASE UNBALANCE Degrees M Max.	PHASE UNBALANCE Degrees U Max.	AMPLITUDE UNBALANCE dB L Max.	AMPLITUDE UNBALANCE dB M Max.	AMPLITUDE UNBALANCE dB U Max.	VSWR (:1) S Typ.	VSWR (:1) S Max.	VSWR (:1) OUT Typ.	VSWR (:1) OUT Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PSC–3	PSC–3–1	1–200	45	30	40	30	40	25	0.6	1.0	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3					23.95	●	●
case A01	PSC–3–1A	1–300	38	30	33	23	29	22	0.2	0.5	0.2	0.7	0.6	1.5	1.0	3.0	5.0	0.2	0.3	0.6		See			26.95	●	●
	PSC–3–1W	5–500	25	20	31	15	25	15	0.4	0.8	0.4	1.4	0.8	1.4	6.0	14.	20.	0.1	0.3	0.6					35.95	●	●
	◇PSC–3–2	0.01–30	35	30	40	25	30	25	.25	.45	0.15	0.45	.45	.75	1.0	2.0	4.0	0.2	0.3	0.4		Performance			35.95	●	●
	■ PSC–3–1–75	1–200	35	23	35	25	35	25	0.6	1.0	0.3	0.7	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3		Data			23.95	●	●
	■ PSC–3–1–75–2	10–300	28	20	25	20	28	20	0.2	0.4	0.3	0.5	0.4	0.7	2.0	3.0	4.0	.15	0.2	0.3					27.95	●	●
	PSC–3–13	1–200	45	35	45	30	37	30	.25	0.5	.35	0.6	.35	0.6	1.0	3.0	4.0	0.1	0.2	0.2		and			29.95	●	●
	PSC–3–13–39	0.5–50	47	33	46	35	40	33	.15	0.4	.15	0.4	.15	0.4	1.0	1.0	2.0	0.1	0.1	0.1		Curves			29.95	●	●
□ SCP	SCP–3–1	1–300	30	25	25	20	20	15	0.3	0.6	0.4	0.8	0.7	1.5	1.0	2.0	4.0	0.1	0.15	0.5					16.95	●	●
case YY101																											
ZN3PD	ZN3PD–900	800–900	—	—	30	20	—	—	—	—	0.2	0.4	—	—	—	—	—	—	0.5	—	1.09	1.3	1.09	1.3	74.95	●	
case WWW181	ZN3PD–900–W	650–1050	—	—	22	15	—	—	—	—	0.3	0.8	—	—	—	—	—	—	0.8	—	1.09	1.8	1.09	1.3	69.95	●	

MIL–P–23971/15, NSN GUIDE

MCL NO.	NSN
PSC–3–1	6625–01–015–6027
PSC–3–1W	5985–01–295–5898
PSC–3–13	6625–01–249–9011
ZFSC–3–4 (SMA)	6625–01–333–1126
ZFSC–3–1	6625–01–235–6873
ZFSC–3–13	5895–01–335–1824
ZMSC–3–2B	6625–01–303–4624
ZMSC–3–1B (SMA)	6625–01–170–0102
ZSC–3–1	6625–01–327–4755
ZSC–3–1B (BNC)	6625–01–008–9566
ZSC–3–2BR	5985–01–315–2870
ZSC–3–2B (BNC)	5820–01–120–9320

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Port 3	Case Ground
PSC–3 except PSC–3–1W, PSC–3–1–75–2	6	1	2	5	3,4,7,8
PSC–3–1W					
PSC–3–1–75–2	1	5	7	8	2,3,4,6
SCP–3	6	1	2	5	3,4,7,8

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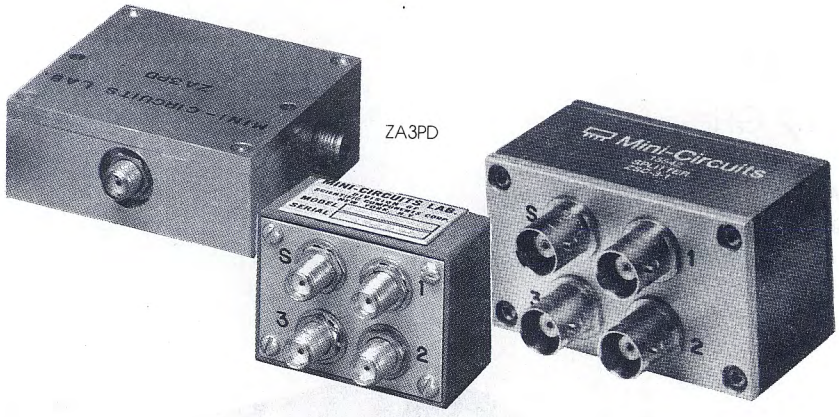

	MODEL NO.	FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 4.8dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
ZFSC-3 case J17	ZFSC-3-1	1-500	30	20	30	20	25	18	0.4	.75	0.5	0.9	0.8	1.2	2.0	3.0	4.0	0.2	0.3	0.4	51.95	●	
	ZFSC-3-1W	2-750	30	20	30	20	25	18	0.4	.75	0.5	1.0	1.0	1.6	3.0	5.0	7.0	0.2	0.3	0.5	53.95	●	
	ZFSC-3-13	1-200	45	30	48	35	37	30	.25	0.5	.35	0.6	.35	0.6	1.0	3.0	5.0	0.1	0.2	0.2	51.95	●	
	ZFSC-3-4	1-1000	35	20	20	18	20	17	0.2	0.5	0.7	1.4	1.0	2.0	3.0	6.0	10.	0.2	0.4	0.9	59.95	●	
		GHz																					
ZA3PD case CC51	ZA3PD-1	0.5-1.0	20	14	20	14	20	14	0.3	0.6	0.3	0.6	0.3	0.6	—	—	—	0.4	0.4	0.4	89.95	●	
	ZA3PD-1.5	0.75-1.5	20	14	20	14	20	14	0.3	0.7	0.3	0.7	0.3	0.7	—	—	—	0.4	0.4	0.4	89.95	●	
	ZA3PD-2	1-2	20	15	20	15	20	15	0.3	0.6	0.3	0.6	0.3	0.6	—	—	—	0.3	0.3	0.3	89.95	●	
	ZA3PD-4	2-4.2	18	14	18	14	18	14	0.7	1.0	0.7	1.0	0.7	1.0	—	—	—	0.9	0.9	0.9	89.95	●	
		MHz																					
ZMSC-3 case P26**	ZMSC-3-1	1-200	45	35	40	25	40	25	0.3	0.5	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3	57.95	●	
	◇ZMSC-3-2	0.01-30	35	30	40	25	30	25	.25	.45	0.15	0.45	.45	.75	1.0	2.0	4.0	0.2	0.3	0.4	67.95	●	
ZSC-3 case P25**	ZSC-3-1	1-200	45	30	40	25	40	25	0.3	0.5	0.4	0.7	0.6	1.0	1.0	2.0	4.0	.15	0.2	0.3	51.95	●	
	◇ZSC-3-2	0.01-30	35	30	40	25	30	25	.25	.45	0.15	0.45	.45	.75	1.0	2.0	4.0	0.2	0.3	0.4	61.95	●	
	■ZSC-3-1-75	1-200	35	30	35	25	35	25	0.6	1.0	0.4	0.7	0.6	1.0	2.0	3.0	4.0	.15	0.2	0.3	52.95	●	
	◇■ZSC-3-2-75	0.02-20	35	30	35	25	30	20	0.2	0.5	.25	0.6	.45	.75	2.0	3.0	4.0	0.2	0.3	0.4	62.95	●	

L = low range (f_L to 10 f_L) M = mid range (10 f_L to f_U/2) U = upper range (f_U/2 to f_U)

NOTES:

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.
☐ Non-hermetic
◇ 1 dB compression derates approximately 13 dB from 10 f_L to f_L
○ Available on tape and reel. Please consult factory.
** Isolation 25 dB, −55°C to 0° over 0.01-0.1 MHz.

1. For quality control procedures, see Table of Contents.
2. For environment specifications, see Table of Contents.
3. Absolute maximum ratings: matched input power rating for ZA3PD and ZN3PD (10W), all other models (1W), internal load dissipation (0.375W).
4. For connector types and case mounting options; see case style outline drawing.
5. Prices and specifications subject to change without notice.

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PowerSplitter/Combiners

4 WAY–0°

2 KHz to 4.2 GHz

case style selection

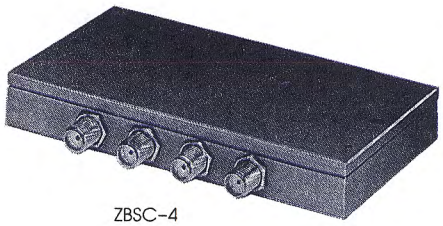
outline drawings see Table of Contents



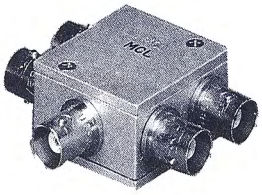
PSC–4



PSC–4A



ZBSC–4



ZFSC–4

	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 6 dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PSC–4	PSC–4–1	0.1–200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	4.0	6.0	8.0	.15	.20	.25	35.95	●	●
case A01	PSC–4–1W	1–500	29	20	27	18	25	18	0.4	0.8	0.5	1.0	0.8	1.5	1.0	3.0	5.0	0.2	0.3	0.5	38.95	●	●
	■PSC–4–1–75	1–200	30	20	25	20	25	20	0.4	0.7	0.5	0.9	0.7	1.2	2.0	3.0	4.0	.15	.20	0.3	32.95	●	●
	PSC–4–3	0.25–250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	4.0	6.0	8.0	.15	.20	.25	31.95	●	●
	PSC–4–5	1–800	29	20	24	18	25	17	0.4	0.8	0.6	1.5	1.3	2.5	1.0	4.0	5.0	0.2	0.5	0.6	45.45	●	●
	◇PSC–4–6	0.01–40	35	18	32	25	25	18	0.4	0.8	0.3	0.5	0.5	1.0	2.0	2.0	2.0	.10	.15	.20	36.95	●	●
case A05	PSC–4–1W–75	5–650	38	22	40	22	25	18	0.6	0.9	0.65	1.2	0.9	1.5	1.0	3.0	5.0	0.2	0.3	0.6	39.95	●	●
PSC–4A	PSC–4A–4	10–1000	25	20	21	15	18	15	0.5	0.8	0.8	1.8	1.5	2.5	4.0	16.0	20.0	0.2	0.5	0.7	64.95	●	●
case C07	■PSC–4A–475	10–800	30	20	33	20	25	18	0.4	0.7	0.6	0.9	1.2	1.6	—	—	—	0.2	0.4	0.8	64.95	●	●
	..■PSC–4A–1W–75	30–600	27	20	—	—	22	18	0.6	0.8	—	—	0.8	1.1	2	—	5	0.2	—	5	49.95	●	●
ZBSC–4																							
case UU102	ZBSC–413	10–800	26	20	18	15	18	15	0.6	1.0	1.0	1.5	1.6	2.0	4.0	8.0	8.0	0.2	0.4	0.6	99.95	●	
ZFSC–4	ZFSC–4–1	1–1000	25	20	23	18	20	15	0.4	1.2	0.6	1.5	1.6	2.5	4.0	8.0	8.0	0.2	0.4	0.7	89.95	●	
case G15	ZFSC–4–1W	10–500	23	20	23	20	23	20	0.6	1.5	0.6	1.5	0.6	1.5	4.0	8.0	8.0	0.2	0.3	0.4	84.95	●	
	ZFSC–4–3	10–300	32	28	38	30	38	30	0.5	0.8	0.6	0.9	0.9	1.2	4.0	6.0	8.0	0.1	0.1	0.2	78.95	●	
	■ZFSC–4375	50–90	34	30	34	30	34	30	0.3	0.8	0.3	0.8	0.3	0.8	4.0	6.0	8.0	0.15	0.15	0.15	89.95	●	
**	●■ZFSC–4–2–75–1	200–800	25	20	—	—	25	20	0.8	1.6	—	—	1.0	1.6	4.0	16.0	20.0	0.2	—	0.4	84.95	●	
	■ZFSC–4–175	10–1000	35	25	38	20	22	18	0.5	0.8	0.6	1.2	0.9	2.0	—	—	—	0.2	0.3	0.6	89.95	●	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

**L=low range (f_L to f_U/2)

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Port 3	Port 4	Case Ground
PSC–4	4	7	8	1	2	3,5,6
PSC–4A	2	8	12	5	9	1,3,4,6,7,10 11,13,14,15,16

MIL-P-23971/15, NSN GUIDE

MCL NO.	NSN	MIL-P-23971/15*
PSC–4–1	5895–01–065–0106	–10
PSC–4–2	5825–01–044–8945	
PSC–4–3	5895–01–105–6189	–11
PSC–4–6	5985–01–332–3086	
PSC–4A–4	5895–01–347–0205	
ZFSC–4–1	6625–01–303–4623	
ZFSC–4–1A	5825–01–227–6681	
ZFSC–4–3B	5985–01–253–2843	
ZSC–4–1B	5820–00–270–3056	
ZSC–4–2B	5820–01–120–5238	
ZSC–4–2B(BNC)	5820–01–120–5238	
ZSC–4–3B	6625–01–038–8553	
ZSC–4–1B(BNC)	6625–00–270–3056	
ZSC–4–1B(TNC)	6625–01–109–3707	

*units are not QPL listed

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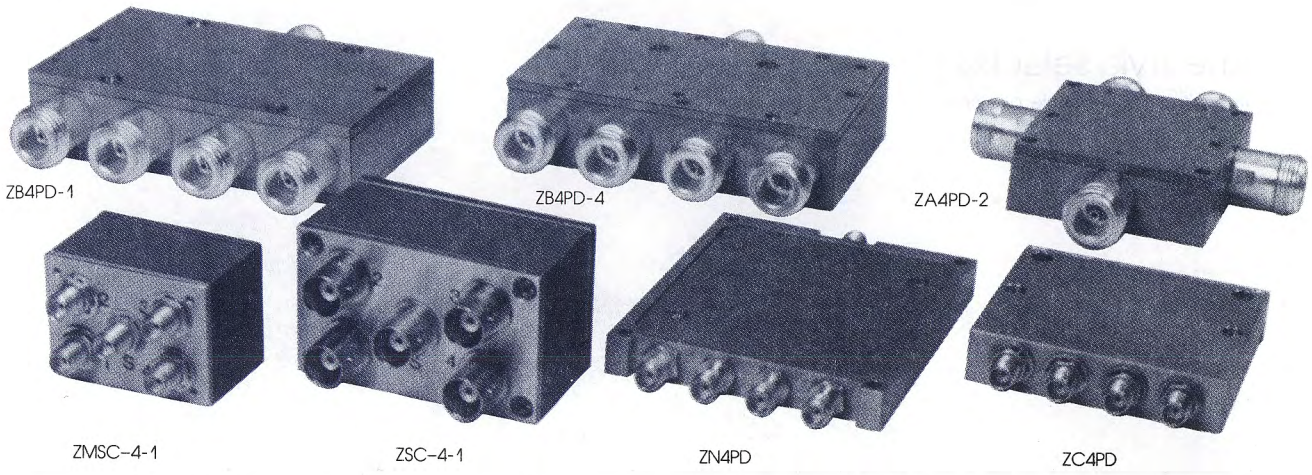

MODEL NO.		FREQ. RANGE MHz f_L-f_U	ISOLATION dB L Typ.	L Min.	*M Typ.	*M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 6dB L Typ.	L Max.	*M Typ.	*M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	*M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	*M Max.	U Max.	VSWR (:1) S Typ.	S Max.	OUT Typ.	OUT Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
ZMSC-4	ZMSC-4-1	0.1-200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	1.0	2.0	3.0	.15	.20	.25					66.95	●	
case N24	◇ZMSC-4-2	0.002-20	30	20	33	25	33	25	.45	.75	0.3	0.5	0.7	1.0	4.0	6.0	8.0	.15	.20	.25	See				76.95	●	
	ZMSC-4-3	0.25-250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	4.0	6.0	10.0	.15	.20	.25					64.95	●	
ZSC-4	ZSC-4-1	0.1-200	33	20	30	20	27	20	0.4	0.6	0.5	.75	0.7	1.0	4.0	6.0	8.0	.15	.20	.25	Performance				59.95	●	
case N27	■ZSC-4-1-75	1-200	30	20	25	20	25	20	0.4	0.7	0.5	0.8	0.7	1.2	0.4	6.0	10.0	.15	.20	0.3	Data				59.95	●	
	◇ZSC-4-2	0.002-20	30	20	33	25	33	25	.45	.75	0.3	0.5	0.7	1.0	4.0	6.0	8.0	.15	.20	.25					74.95	●	
	ZSC-4-3	0.25-250	33	20	30	20	27	20	0.4	0.7	0.5	.75	0.7	1.2	4.0	6.0	10.0	.15	.20	.25	and				56.95	●	
	■ZSC-4-3-75	0.25-250	28	20	30	20	27	20	0.4	0.8	0.3	0.7	0.5	1.0	1.0	2.0	3.0	.15	.20	.25					56.95	●	
		GHz																			Curves						
ZA4PD	ZA4PD-2	1-2	25	16	25	16	25	16	0.3	1.0	0.3	1.0	0.3	1.0		6.0		0.7	0.7	0.7					89.95	●	
case DD52	ZA4PD-4	2-4.2	25	16	25	16	25	16	0.5	1.0	0.3	1.0	0.3	1.0		16.0		0.8	0.8	0.8					89.95	●	
ZB4PD	ZB4PD-42	1.7-4.2	23	16	23	16	23	16	0.5	1.4	0.5	1.4	0.5	1.4		8.0		0.8	0.8	0.8					99.95	●	
case EE54	ZB4PD-4	3.7-4.2	24	15	24	15	24	15	0.6	1.1	0.6	1.1	0.6	1.1		8.0		0.8	0.8	0.8					94.95	●	
ZB4PD1	ZB4PD1-930	850-930			30	20					0.3	0.5				5.0			0.25		1.1	1.25	1.09	1.25	99.95	●	
case AE-188	ZB4PD1-930W	.725-1050			22	15					0.3	0.8				5.0			0.4		1.2	1.8	1.1	1.3	94.95	●	
ZC4PD	ZC4PD-900	800-900			30	20					0.3	0.6				3.0			0.2		1.08	1.25	1.17	1.3	89.95	●	
case ZZZ-184																											
ZN4PD	ZN4PD-920	800-920			30	20					0.25	0.5				2.0			0.2		1.08	1.25	1.07	1.25	84.95	●	
case XXX-182	ZN4PD-920W	670-1000			22	15					0.3	0.6				3.0			0.2		1.2	1.6	1.07	1.25	79.95	●	

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

NOTES:

- ■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.
- ● On Model ZFSC-4-2-75-1, up to 15V and 15mA DC may be passed from input to all outputs.
- ◇ 1 dB compression derates approximately 13 dB from low range to mid range
- * When only spec for M range given, specification applies to entire frequency range.
- . . Max VSWR: input 1.5:1, output 1.3:1

1. For quality control procedures, see Table of Contents.
2. For environment specifications, see Table of Contents.
3. Absolute Maximum Ratings:
   Matched input power rating ZA4PD, ZB4PD, ZN4PD, ZC4PD (10W). PSC-4-5 & PSC-4-1W (0.5W), all other models (1W). Internal load dissipation. 1 for ZB4PD1, ZN4PD, ZC4PD (0.375W), for all others (0.25W).
4. For connector types and case mounting options; see case style outline drawing.
5. Prices and specifications subject to change without notice.

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CAPD now available! computer-automated performance data see model index

Power Splitter/Combiners

5 WAY-0°

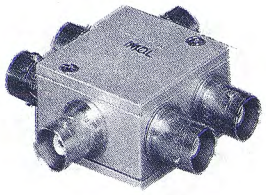
1 MHz to 300 MHz

case style selection

outline drawings see Table of Contents



PSC-5



ZFSC-5

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 7.0dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L–f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1-9)		
PSC-5	PSC-5-1	1-300	25	20	23	18	20	17	0.2	0.5	0.6	1.0	1.5	2.0	2.0	4.0	8.0	0.2	0.3	0.6	64.45	•	•
case C07 ■	PSC-5-1-75	1-300	35	20	30	18	25	17	0.4	0.6	0.6	0.9	0.9	1.3	2.0	4.0	8.0	0.2	0.3	0.6	64.45	•	•
ZFSC-5																							
case G15	ZFSC-5-1	1-300	25	20	23	18	20	17	0.2	0.5	0.6	1.0	1.5	2.0	2.0	4.0	8.0	0.2	0.3	0.6	99.95	•	

L = low range (f_L to 10 f_L) M = mid range (10 f_L to $f_U/2$) U = upper range ($f_U/2$ to f_U)

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Case Ground	Not Used
PSC-5	1	4	8	12	16	15	—	2,5,7,11,13,14	3,6,9,10
PSC-6	1	3	4	8	12	16	15	2,5,7,11,13,14	6,9,10

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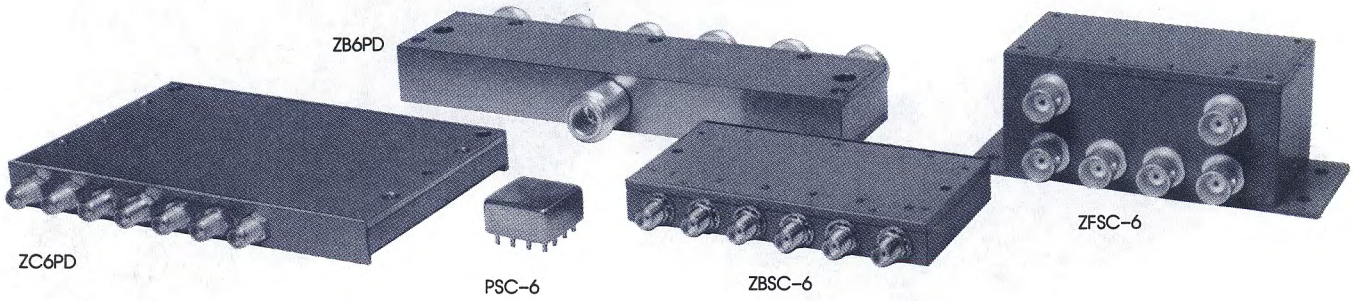
Mini-Circuits

6 WAY–0°

1 MHz to 2 GHz



	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	*M Typ.	*M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 7.8 dB L Typ.	L Max.	*M Typ.	*M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	*M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	*M Max.	U Max.	VSWR (:1) S Typ.	S Max.	OUT Typ.	OUT Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PSC–6	PSC-6-1	1–175	30	24	26	18	26	18	0.5	0.8	0.7	1.0	1.0	1.5	4.0	6.0	12.0	0.2	0.4	0.8					74.95	•	•
case C07■	PSC-6-1-75	1–300	35	25	30	23	25	18	0.4	0.9	0.6	1.1	0.6	1.3	2.0	4.0	8.0	0.2	0.3	0.6					78.95	•	•
ZC6PD	ZC6PD-960	890-960			30	20					0.4	0.8			—	—	—		0.4		1.2	1.5	1.1	1.5	124.95	•	
case AB-185	ZC6PD-960W	700-1000			28	15					0.4	1.0			—	—	—		0.6		1.3	1.5	1.2	1.5	119.95	•	
	ZC6PD-1900	1700-1900			30	20					0.4	0.8			—	—	—		0.5		1.1	1.4	1.1	1.5	134.95	•	
	ZC6PD-1900W	1500-2000			30	15					0.5	1.0			—	—	—		0.6		1.1	1.68	1.1	1.5	129.95	•	
ZBSC–6	ZBSC-611	10–200	28	22	26	20	23	20	0.5	0.8	0.7	1.0	0.9	1.2	4.0	5.0	6.0	0.2	0.3	0.5					114.95	•	
case UU102	ZBSC-615	1–500	30	25	26	18	24	18	0.5	0.8	0.7	1.2	1.0	2.2	4.0	5.0	20	0.2	0.4	1.2					119.95	•	
ZB6PD1	ZB6PD1-900	800-900			32	20					0.3	0.7			—	—	—		0.5		1.1	1.5	1.13	1.35	139.95	•	
case AD-187	ZB6PD1-960	890-960			35	20					0.3	0.8			—	—	—		0.6		1.1	1.3	1.1	1.3	139.95	•	
	ZB6PD1-1900	1700-1900			32	20					0.4	0.8			—	—	—		0.6		1.1	1.3	1.09	1.4	149.95	•	
ZFSC–6	ZFSC-6-1	1–175	27	22	26	20	26	20	0.75	1.0	0.75	1.2	0.8	1.2	2.0	6.0	12.0	0.2	0.4	0.6					99.95	•	
case Q28■	ZFSC-6-1-75	1–200	30	25	30	22	20	18	0.75	1.0	0.75	1.0	0.9	1.2	2.0	6.0	12.0	0.2	0.4	0.6					102.95	•	
	ZFSC-6-110	1–500	35	25	26	20	25	20	0.5	0.8	0.6	1.1	1.0	1.7	2.0	6.0	12.0	0.3	0.3	0.8					109.95	•	

L = low range (f_L to 10 f_L) M = mid range (10 f_L to f_U/2) U = upper range (f_U/2 to f_U)

NOTES:

- ■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.
- * When only spec for M range given, specification applies to entire frequency range.

1. Matched power rating, all models (1W) except 10W for ZB6PD and ZC6PD, internal load dissipation, 0.5 watts for all models, except ZB6PD1and ZC6PD, 0.875 watt.
2. Refer to Table of Contents for quality control procedures, environmental specifications, and absolute maximum ratings.
3. For connector types, see case style outline drawing.
4. Prices and specifications subject to change without notice.

NSN GUIDE

MCL NO.	NSN
PSC-5-1	6625-01-255-3143
ZFSC-6-1 (BNC)	6625-01-225-6965
ZFSC-6-1 (SMA)	6625-01-263-9871
PSC-6-1	6625-01-249-6012

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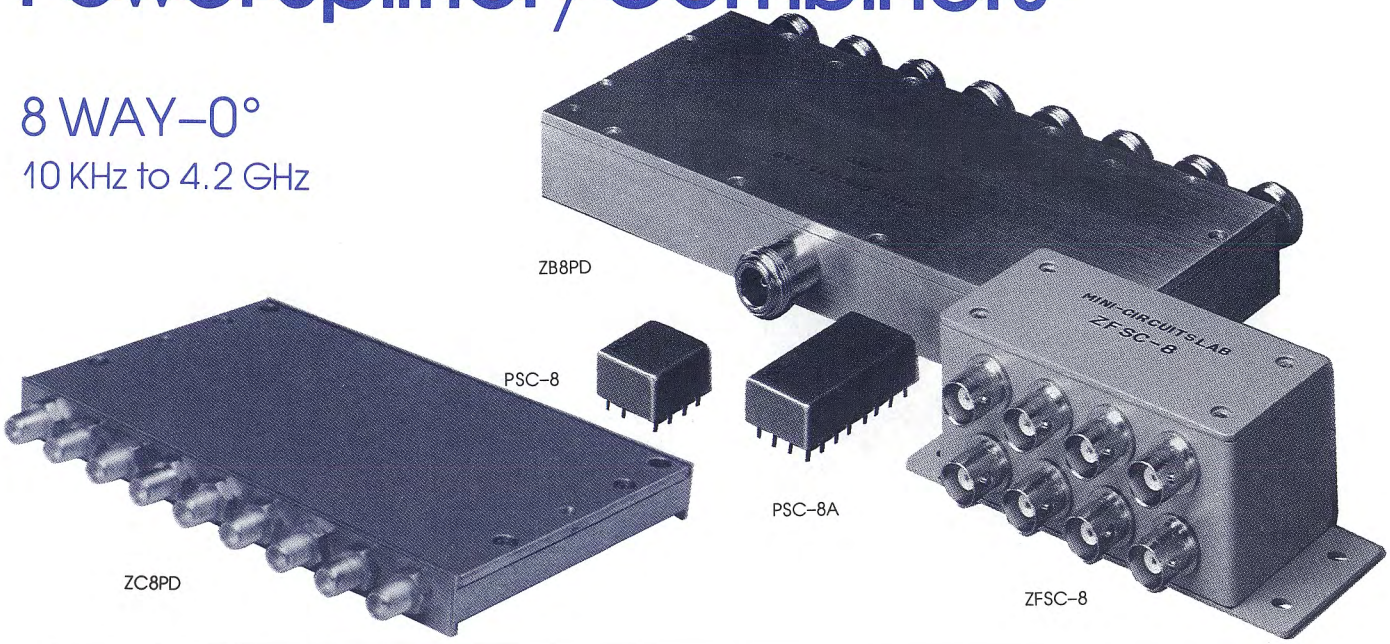
Power Splitter/Combiners

8 WAY–0°

10 KHz to 4.2 GHz



	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 9dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	LOCAL
PSC–8 case C07	PSC–8–1	0.5–175	30	25	30	20	25	18	0.8	1.2	0.8	1.2	1.0	1.6	1.0	2.5	5.0	0.2	0.3	0.5	74.95	●	●
	■PSC–8–1–75	0.5–175	25	20	30	20	25	20	0.5	1.0	0.6	1.1	0.7	1.3	1.0	2.5	5.0	0.2	0.2	0.3	78.95	●	●
	PSC–8–6	0.01–10	40	20	40	25	28	23	0.3	0.7	0.5	1.0	0.6	1.1	1.0	2.5	4.0	0.1	0.2	0.3	93.95	●	●
PSC–8A case E10	PSC–8A–4	5–500	25	20	23	18	20	15	0.7	1.2	1.0	1.8	1.4	2.5	3.0	8.0	16.0	0.2	0.3	0.5	103.95	●	●
	■PSC–8A4–75	1–300	26	20	30	25	30	23	0.8	1.2	0.7	1.1	0.9	1.3	1.0	3.0	8.0	0.2	0.2	0.4	93.95	●	●
ZC8PD case AC186	ZC8PD–900	800–900			30	20					0.4	0.7				5			0.4		158.95	●	
ZFSC–8 case R29	ZFSC–8–1	0.5–175	30	25	30	20	25	18	0.8	1.2	0.8	1.2	1.0	1.6	1.0	2.5	5.0	0.2	0.2	0.3	99.95	●	
	■ZFSC–8–1–75	0.5–175	25	20	30	20	25	20	0.5	1.0	0.6	1.1	0.7	1.3	1.0	2.5	5.0	0.2	0.3	0.5	102.95	●	
	■ZFSC–82–75	10–900	35	17	23	17	20	15	0.6	0.9	0.9	1.6	1.6	2.7	2.0	4.0	10.0	0.2	0.5	1.2	139.95		
	■ZFSC–84–75	1–300	26	20	30	25	30	23	0.8	1.5	0.7	1.1	0.9	1.5	1.0	3.0	8.0	0.2	0.2	0.4	119.95	●	
	■ZFSC–8375	50–90	30	25	30	25	25	25	1.0	1.0	1.0	1.3	1.3	1.3	2.0	2.0	2.0	0.2	0.2	0.2	119.95	●	
	ZFSC–8–4	5–700	35	20	25	17	20	17	0.8	1.2	1.2	1.8	1.8	2.5	2.0	5.0	15.0	0.2	0.4	0.7	128.95	●	
	ZFSC–8–43	10–1000	23	20	25	20	26	20	1.0	1.6	1.4	1.8	2.1	2.9	5.0	10.0	20.0	0.2	0.4	0.7	138.95	●	
	ZFSC–8–6	0.01–10	35	20	40	25	35	25	0.3	0.7	0.2	0.6	0.3	0.7	1.0	2.0	3.0	0.1	0.2	0.3	109.95	●	
		GHz																					
ZB8PD case Z40	ZB8PD–2	1–2	24	17	24	17	24	17	0.8	1.3	0.8	1.3	0.8	1.3			18	0.8	0.8	0.8	138.95	●	
	ZB8PD–4	2–4.2	23	16	23	16	23	16	0.8	1.8	0.8	1.8	0.8	1.8	10	10	10	0.9	0.9	0.9	138.95	●	

NOTES: L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.

VSWR: input 1.06:1 typical, 1.2:1 max.
output 1.17:1 typical, 1.35:1 max

1. Matched power rating, ZB8PD, ZC8PD, ZC10PD (10W), all other models (1W). internal load dissipation, 0.62 watts, for all 10 and 12 way models, 0.87 watts.
2. Refer to Table of Contents for quality control procedures, environmental specifications, and absolute maximum ratings.
3. For connector types, see case style outline drawing.
4. Prices and specifications subject to change without notice.
5. ZFSC–8–6, PSC–8–6: below 0.1 MHz power handling decrease as to typically 15 dBm at 0.01 MHz, 23 dBm at 0.025 MHz, & 29 dBm at 0.05 MHz.

NSN GUIDE

MCL NO.	NSN	MCL NO.	NSN	MCL NO.	NSN	MCL NO.	NSN
ZFSC–8–1 (BNC)	5820–01–136–7244	ZFSC–8–1 (SMA)	6620–01–223–1235	ZFSC–8–43 (SMA)	6625–01–333–1125	ZFSC–8–1–75	5895–01–326–8664

pin connections

see case style outline drawing

Series	Sum Port	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8	Port 9	Port 10	Port 11	Port 12	Case Ground	Do Not Use
PSC–8	2	1	5	9	13	16	12	8	4					3,6,7,14,15	10,11
*PSC–8A	29	7	16	31	24	9	2	26	17					All other pins	
PSC–10–1	29	7	16	31	24	9	2	26	17	4	5			All other pins	15
**PSC–12–1	5	7	8	1	2	31	32	25	26	22	30	19	27	All other pins	11,14,21

*Pins 4, 5 and 15 must be grounded externally for PSC-8A-4. Pin 15 must be grounded externally for PSC-8A4-75.
**Pin 4 must be grounded externally.

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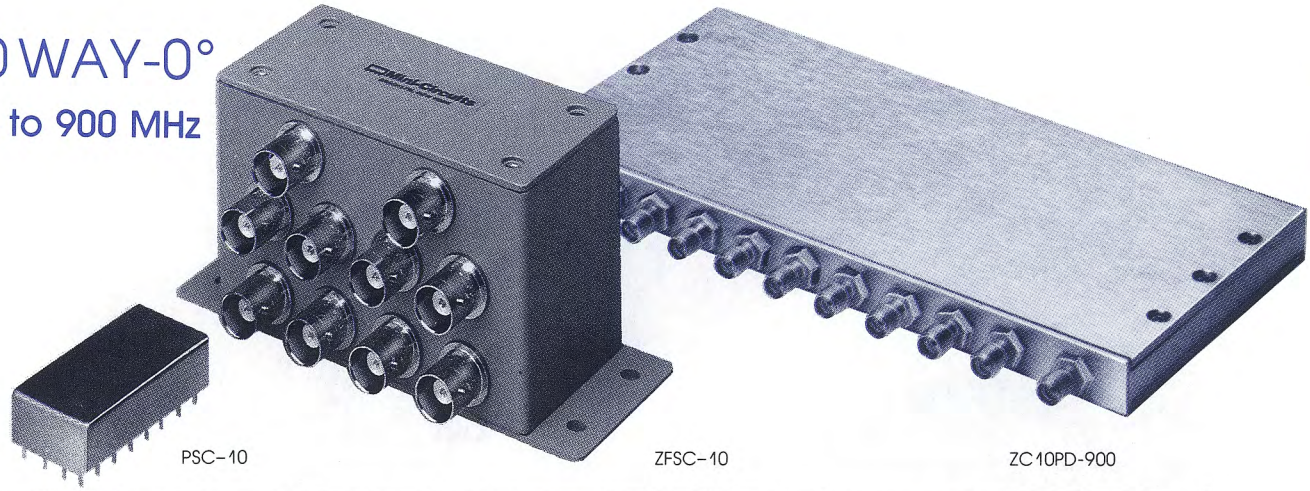
Mini-Circuits

10 WAY-0°

0.5 to 900 MHz



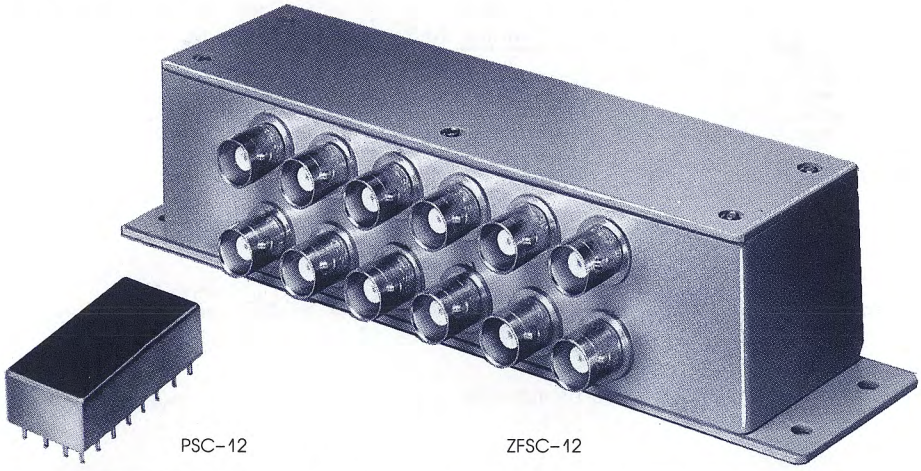
PSC-10 ZFSC-10 ZC10PD-900

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 10dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L-f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1-9)		
PSC-10 case E10	PSC-10-1	1-150	36	23	27	23	23	18	0.3	0.6	0.4	0.8	1.0	1.3	1	4	10	0.1	0.2	0.3	85.95	•	•
ZFSC-10 case RR93	ZFSC-10-1	0.5-100	28	20	30	24	27	20	0.5	0.8	0.4	1.0	0.8	1.5	2	6	10	0.2	0.3	0.4	119.95	•	
ZC10PD case AJ204	ZC10PD-900	800-900	—	—	25	20	—	—	—	—	1.5	2.0	—	—		—			0.8		178.95	•	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

12 WAY-0°

1 MHz to 500 MHz



PSC-12 ZFSC-12

	MODEL NO.	FREQ. RANGE MHz	ISOLATION dB						INSERTION LOSS, dB Above 10.8dB						PHASE UNBALANCE Degrees			AMPLITUDE UNBALANCE dB			PRICE $	DISTRIBUTOR	
			L		M		U		L		M		U		L	M	U	L	M	U		FACTORY	LOCAL
		f_L-f_U	Typ.	Min.	Typ.	Min.	Typ.	Min.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Qty. (1-9)		
PSC-12 case E10	PSC-12-1	1-200	35	30	27	20	21	18	0.5	0.8	0.8	1.2	1.0	1.4	1	4	6	0.2	0.4	0.7	88.95	•	•
ZFSC-12 case R67	ZFSC-12-1	1-200	30	25	35	20	28	20	0.8	1.2	1.1	1.4	1.3	1.6	4.0	8.0	16.0	0.1	0.2	0.3	174.95	•	
	ZFSC-12-11	10-300	28	20	33	25	28	20	1.1	1.3	1.1	1.5	1.5	1.8	2.0	4.0	6.0	0.2	0.3	0.4	174.95	•	
	■ZFSC-12-1-75	10-200	35	27	—	—	27	20	0.5	0.8	—	—	0.8	1.3	—	—	—	0.25	—	0.4	179.95	•	
	■ZFSC-12-175	10-500	23	20	24	20	22	18	0.9	1.2	1.0	1.3	1.2	1.6	—	—	—	0.4	0.5	0.8	197.95	•	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

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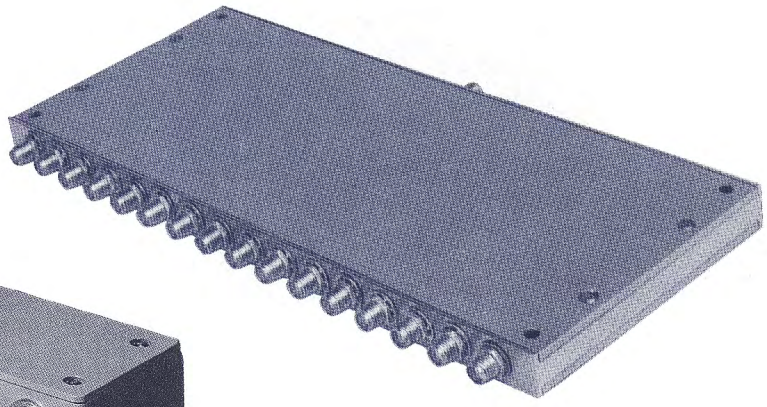
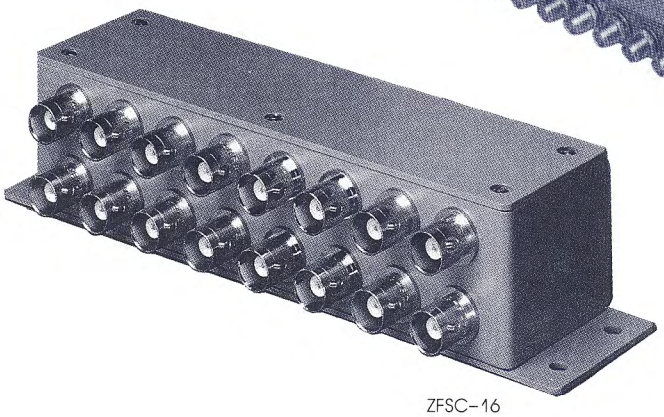
Power Splitter/Combiners

16 WAY–0°
10 KHz to 2100 MHz



ZC16PD



ZFSC–16

	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	*M Typ.	*M Min.	U Typ.	U Min.	INSERTION LOSS, dB Above 12dB L Typ.	L Max.	*M Typ.	*M Max.	U Typ.	U Max.	PHASE UNBALANCE Degrees L Max.	*M Max.	U Max.	AMPLITUDE UNBALANCE dB L Max.	*M Max.	U Max.	VSWR (:1) S Typ.	S Max.	OUT Typ.	OUT Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZFSC–16	ZFSC–16–1	0.5–125	30	24	25	18	20	15	1.0	1.2	1.1	1.3	1.2	1.4	1.0	3.0	5.0	0.1	0.2	0.5	See				172.95	●	
case R30	■ZFSC–16–1–75	1–150	30	25	30	25	25	20	0.8	1.1	0.7	1.1	1.0	1.3	1.0	3.0	5.0	0.1	0.2	0.4	Performance				182.95	●	
	ZFSC–16–3	1–30	45	35●	45	40●	41	35●	0.5	0.9	0.5	0.9	0.5	0.9	1.0	2.0	3.0	0.1	0.1	0.1	Data				172.95	●	
	◇■ZFSC–16–675	0.01–25	25	20	40	25	25	20	0.8	1.1	0.4	0.8	1.0	1.6	1.0	3.0	5.0	0.1	0.2	0.4	and Curves				189.95	●	
	ZFSC–16–12	0.1–200	33	20	27	20	26	20	0.6	1.5	0.7	1.0	0.9	1.2	2.0	6.0	9.0	0.4	0.2	0.4					189.95	●	
ZC16PD	ZC16PD–900	800–900			30	20					0.5	1.0						0.5			1.06	1.2	1.06	1.2	295.00	●	
case UUU179	ZC16PD–960	890–960			28	20					0.5	1.0						0.5			1.06	1.3	1.06	1.2	295.00	●	
	ZC16PD–960W	700–1000			26	15					0.5	1.3						0.6			1.1	1.6	1.06	1.3	265.00	●	
	ZC16PD–1900	1700–1900			30	20					0.5	1.0						0.8			1.15	1.35	1.06	1.3	349.00	●	
	ZC16PD–1900W	1500–2100			30	15					0.7	1.4						0.8			1.25	1.6	1.15	1.35	319.00	●	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

NSN GUIDE

MCL NO.	NSN
ZFSC–16–1 (BNC)	5820–01–120–9321

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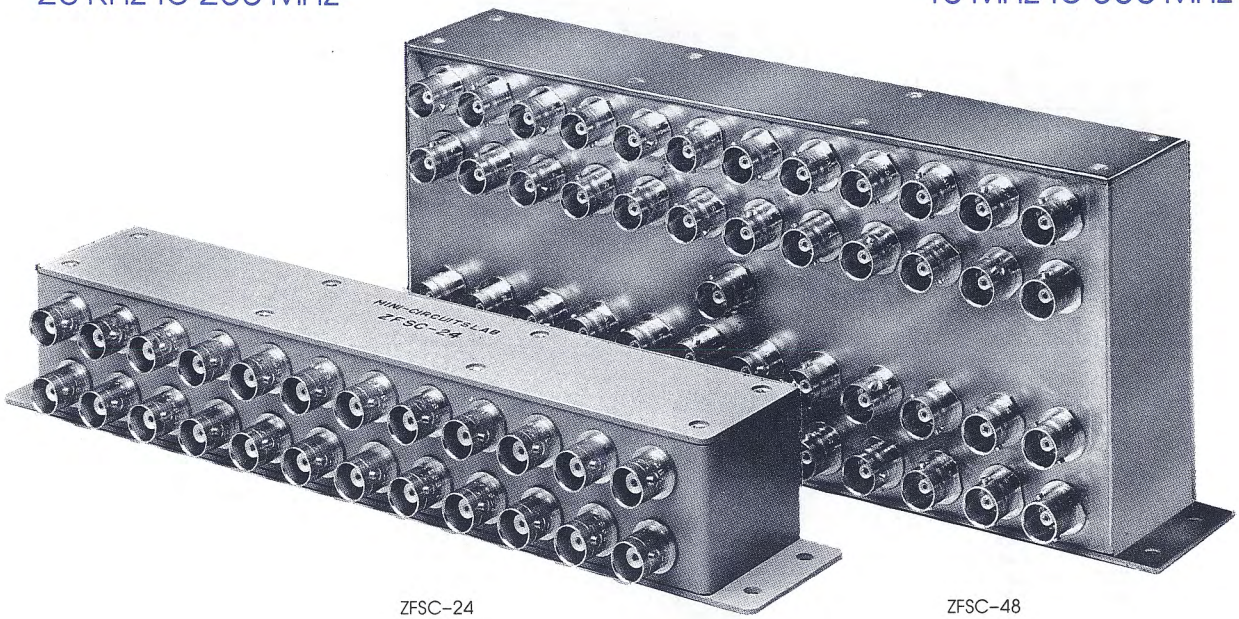
24 WAY–0°
25 KHz to 200 MHz

48 WAY–0°
10 MHz to 300 MHz



ZFSC–24 ZFSC–48

	MODEL NO.	FREQ. RANGE MHz f_L–f_U	ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	INSERTION LOSS, dB 24 WAY (above 13.8dB) 48 WAY (above 16.8dB) L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	AMPLITUDE UNBALANCE dB L Max.	M Max.	U Max.	PRICE $ Qty. (1–9)	DISTRIBUTOR FACTORY	LOCAL
ZFSC–24 case R31	ZFSC–24–1	0.2–100	25	20	25	20	25	20	1.0	2.0	1.0	2.0	1.0	2.0	0.2	0.4	0.5	264.95	●	
	ZFSC–24–11	1–200	33	25	22	20	20	17	0.9	1.7	1.0	1.8	1.3	2.2	0.2	0.8	0.8	274.95	●	
	■ZFSC–24–11–75	1–200	35	25	33	20	27	20	0.6	1.3	0.8	1.5	1.1	2.0	0.2	0.4	0.6	274.95	●	
	◇ZFSC–24–6	0.025–50	30	25	39	28	30	22	0.4	1.0	0.4	1.0	0.6	1.5	0.2	0.3	0.7	274.95	●	
ZFSC–48 case HH68■	ZFSC–48–1	10–300	30	25	28	20	23	20	1.0	1.5	1.8	2.2	2.0	2.5	0.6	0.7	0.9	590.00	●	
	ZFSC–48–1–75	10–300	30	25	28	20	23	20	1.2	2.0	2.1	2.5	2.3	3.0	0.6	0.7	1.0	590.00	●	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)

NOTES:
◇ 1 dB compression derates approximately 13 dB from 10f_L to f_L
■ Denotes 75 ohm models, 75 ohm BNC connectors are standard.
● Opposite ports 28dB
Adjacent ports: odd-even numbers in sequence
Opposite ports: all other ports
* When only specs for M range are given, specification applies to entire frequency range.

1. Matched power rating, 1 watt internal load dissipation, 0.87.
2. Refer to Table of Contents for quality control procedures, environmental specifications, and absolute maximum ratings.
3. For connector types, see case style outline drawing.
4. Prices and specifications subject to change without notice.

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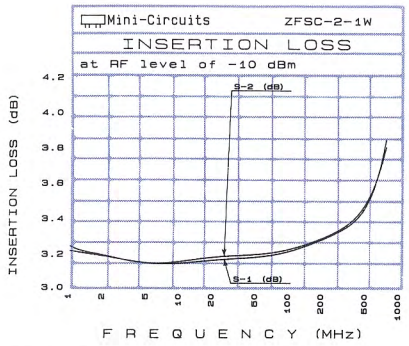
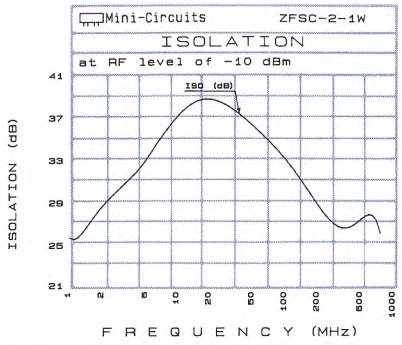
Power Splitter/Combiners

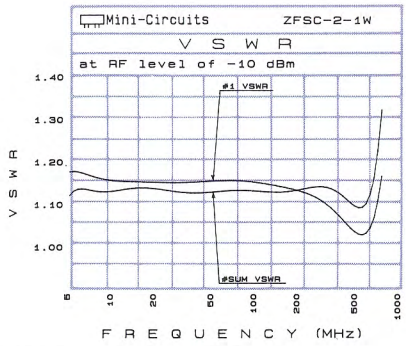
50 ohms

ZFSC-2-1W

1 to 750MHz



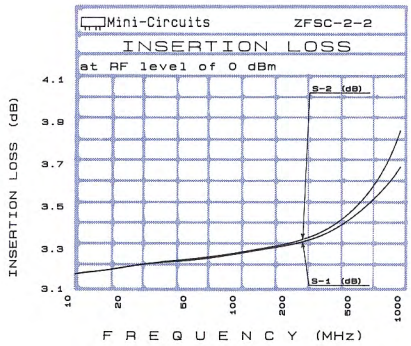


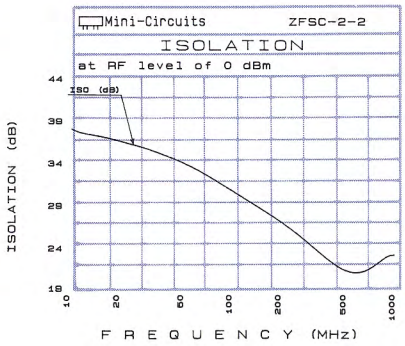


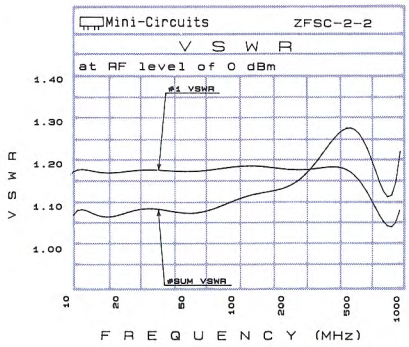
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	3.22	3.24	0.02	25.14	5.0	1.13	1.18	1.18
2.0	3.19	3.19	0.00	28.53	10.0	1.13	1.16	1.16
5.0	3.15	3.15	0.00	33.16	20.0	1.14	1.15	1.15
10.0	3.14	3.15	0.01	37.27	27.6	1.13	1.15	1.15
20.0	3.19	3.20	0.01	38.91	50.0	1.13	1.16	1.16
50.0	3.18	3.19	0.01	36.43	95.3	1.13	1.15	1.16
100.0	3.24	3.25	0.01	32.90	140.5	1.13	1.14	1.15
146.0	3.24	3.24	0.00	30.74	185.6	1.14	1.14	1.14
200.0	3.27	3.28	0.01	29.06	230.8	1.14	1.13	1.13
315.1	3.34	3.34	0.00	26.79	343.6	1.13	1.09	1.10
411.7	3.42	3.44	0.02	26.22	433.9	1.12	1.06	1.07
500.0	3.48	3.50	0.02	26.84	501.7	1.10	1.03	1.04
605.0	3.54	3.56	0.02	29.11	614.6	1.11	1.04	1.03
701.7	3.77	3.75	0.02	26.91	704.9	1.23	1.11	1.10
750.0	3.96	3.90	0.06	23.19	750.0	1.34	1.16	1.15

ZFSC-2-2

10 to 1000MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	3.18	3.18	0.00	38.07	10.0	1.08	1.18	1.18
34.8	3.24	3.24	0.00	35.46	34.8	1.09	1.18	1.18
59.5	3.25	3.26	0.01	33.29	59.5	1.10	1.19	1.19
109.0	3.28	3.29	0.01	30.53	109.0	1.11	1.19	1.19
158.5	3.30	3.30	0.00	28.46	158.5	1.13	1.19	1.19
257.5	3.33	3.35	0.02	25.52	257.5	1.18	1.19	1.19
356.5	3.37	3.39	0.02	23.46	356.5	1.23	1.19	1.18
406.0	3.39	3.40	0.01	22.63	406.0	1.25	1.19	1.18
505.0	3.48	3.52	0.04	21.54	505.0	1.28	1.18	1.17
653.5	3.48	3.54	0.06	20.99	653.5	1.25	1.14	1.13
752.5	3.60	3.69	0.09	21.62	752.5	1.18	1.09	1.10
851.5	3.58	3.69	0.11	23.16	851.5	1.07	1.03	1.05
901.0	3.59	3.71	0.12	23.85	901.0	1.07	1.02	1.02
950.5	3.62	3.77	0.15	23.43	950.5	1.17	1.07	1.04
1000.0	3.79	3.98	0.19	21.38	1000.0	1.34	1.14	1.10

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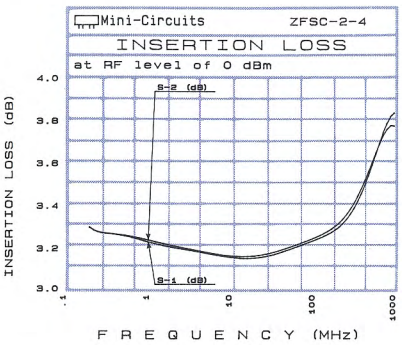
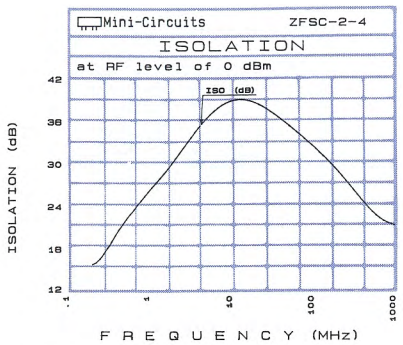
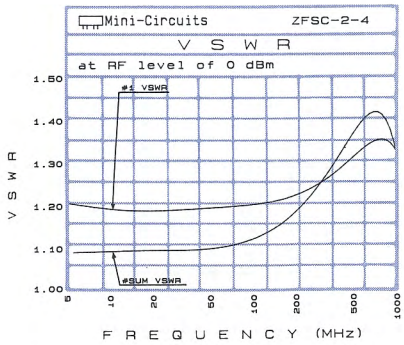
ZFSC-2-4

0.2 to 1000MHz





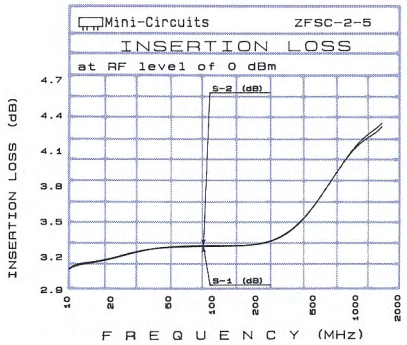


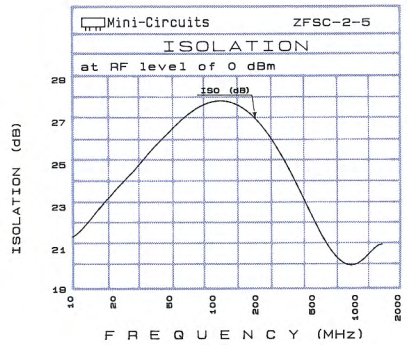
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.2	3.29	3.29	0.00	15.38
1.0	3.23	3.24	0.01	26.35
2.0	3.21	3.22	0.01	30.51
20.0	3.16	3.17	0.01	38.80
50.0	3.19	3.20	0.01	35.47
100.0	3.26	3.26	0.00	32.67
200.0	3.31	3.33	0.02	29.07
345.9	3.43	3.45	0.02	25.75
500.0	3.57	3.58	0.01	23.64
576.4	3.65	3.66	0.01	22.99
653.3	3.69	3.69	0.00	22.48
730.1	3.77	3.77	0.00	22.18
800.0	3.72	3.70	0.02	21.91
845.3	3.82	3.80	0.02	21.82
1000.0	3.81	3.75	0.06	21.07

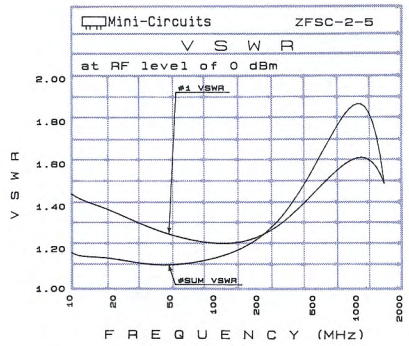
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.09	1.21	1.21
20.0	1.10	1.19	1.19
50.0	1.10	1.20	1.20
100.0	1.12	1.20	1.20
160.5	1.16	1.22	1.22
200.0	1.19	1.23	1.22
347.0	1.29	1.27	1.26
409.2	1.33	1.29	1.28
500.0	1.38	1.32	1.29
564.7	1.40	1.33	1.31
658.0	1.42	1.35	1.31
720.2	1.42	1.35	1.31
800.0	1.41	1.35	1.30
906.7	1.36	1.34	1.28
1000.0	1.3	1.31	1.24

ZFSC-2-5, MSC-2-5

10 to 1500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	3.12	3.11	0.01	21.50
47.3	3.29	3.29	0.00	26.53
84.5	3.28	3.29	0.01	27.88
121.8	3.29	3.29	0.00	28.06
196.3	3.32	3.32	0.00	27.18
270.8	3.33	3.33	0.00	25.83
345.3	3.43	3.43	0.00	24.57
568.8	3.73	3.73	0.00	21.71
755.0	3.93	3.93	0.00	20.51
904.0	4.01	4.02	0.01	20.10
1015.8	4.04	4.05	0.01	20.09
1239.3	4.19	4.22	0.03	20.96
1351.0	4.22	4.26	0.04	21.40
1425.5	4.25	4.28	0.03	21.29
1500.0	4.30	4.34	0.04	20.39

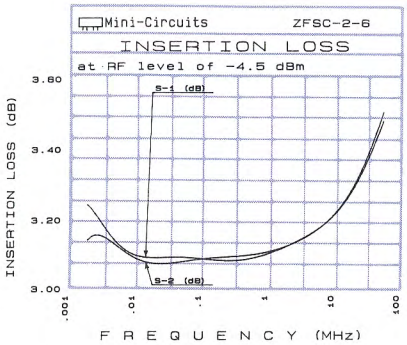
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.18	1.45	1.45
47.3	1.12	1.27	1.27
84.5	1.15	1.23	1.23
121.8	1.18	1.23	1.22
196.3	1.25	1.26	1.25
270.8	1.33	1.31	1.3
345.3	1.42	1.36	1.35
568.8	1.67	1.51	1.49
755.0	1.81	1.59	1.55
904.0	1.88	1.62	1.58
1015.8	1.87	1.62	1.58
1239.3	1.83	1.62	1.57
1351.0	1.72	1.60	1.55
1425.5	1.60	1.55	1.52
1500.0	1.50	1.46	1.45

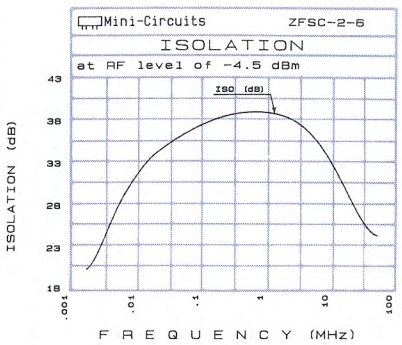
Power Splitter/Combiners

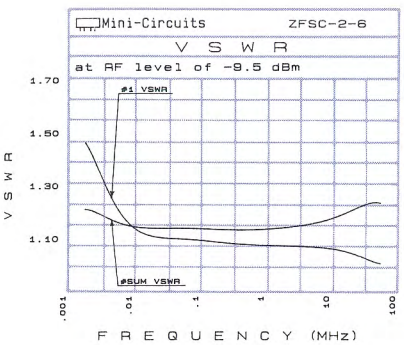
ZFSC-2-6

50 ohms

0.002 to 60MHz







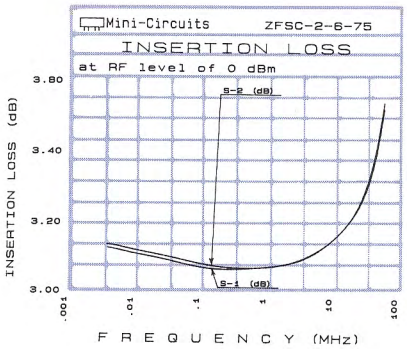
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.002	3.25	3.16	0.09	20.01
0.005	3.14	3.14	0.00	26.55
0.010	3.11	3.10	0.01	31.12
0.015	3.09	3.07	0.02	33.44
0.2	3.10	3.10	0.00	38.17
1.1	3.12	3.12	0.00	38.92
6.0	3.17	3.17	0.00	36.29
10.1	3.22	3.22	0.00	33.75
16.1	3.26	3.26	0.00	30.95
20.0	3.28	3.29	0.01	29.59
30.0	3.33	3.35	0.02	27.20
40.1	3.40	3.42	0.02	25.67
50.0	3.44	3.46	0.02	24.81
54.0	3.46	3.48	0.02	24.62
60.0	3.48	3.51	0.03	24.50

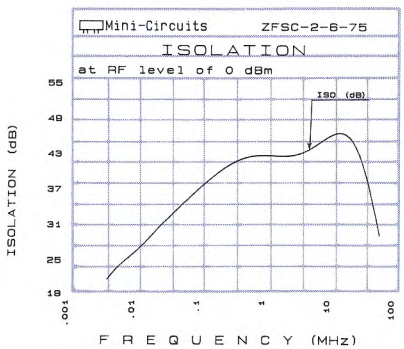
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.002	1.22	1.47	1.48
0.005	1.18	1.25	1.24
0.010	1.14	1.15	1.14
0.015	1.14	1.11	1.11
1.1	1.14	1.08	1.08
5.7	1.16	1.07	1.07
10.1	1.18	1.06	1.06
15.0	1.19	1.06	1.06
20.0	1.20	1.05	1.05
30.0	1.22	1.04	1.04
39.5	1.23	1.02	1.02
45.0	1.24	1.01	1.01
50.0	1.24	1.01	1.00
54.5	1.24	1.01	1.01
60.0	1.23	1.02	1.03

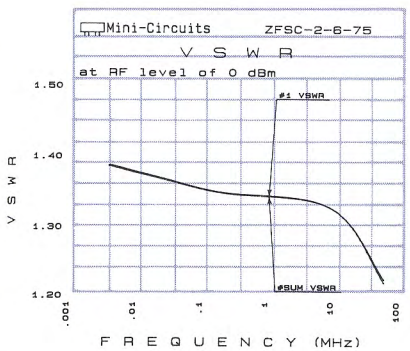
ZFSC-2-6-75

75 ohms

0.004 to 60MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.004	3.13	3.14	0.01	22.13
0.2	3.07	3.08	0.01	39.24
0.5	3.07	3.07	0.00	42.42
2.0	3.08	3.08	0.00	42.78
5.0	3.11	3.12	0.01	43.93
10.1	3.15	3.15	0.00	45.66
15.5	3.19	3.19	0.00	46.74
20.0	3.22	3.23	0.01	46.38
25.2	3.24	3.24	0.00	44.70
30.9	3.28	3.28	0.00	41.92
40.7	3.35	3.37	0.02	37.15
46.5	3.38	3.41	0.03	34.64
50.0	3.42	3.44	0.02	33.30
56.1	3.48	3.50	0.02	31.09
60.0	3.51	3.54	0.03	29.82

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.004	1.37	1.39	1.39
0.2	1.33	1.35	1.35
0.5	1.33	1.35	1.35
2.0	1.33	1.34	1.34
5.0	1.31	1.34	1.34
10.1	1.30	1.33	1.33
15.5	1.28	1.31	1.31
20.0	1.27	1.30	1.30
25.2	1.26	1.29	1.29
30.9	1.25	1.27	1.27
40.7	1.22	1.25	1.25
46.5	1.21	1.24	1.24
50.0	1.21	1.24	1.23
56.1	1.20	1.23	1.23
60.0	1.20	1.23	1.23

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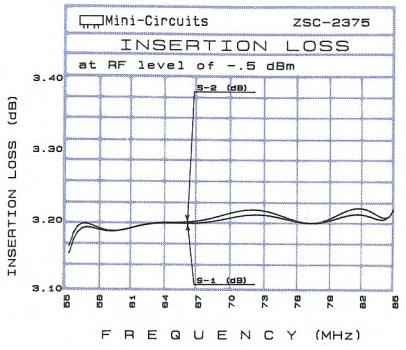
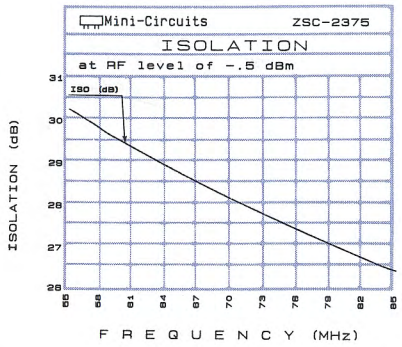
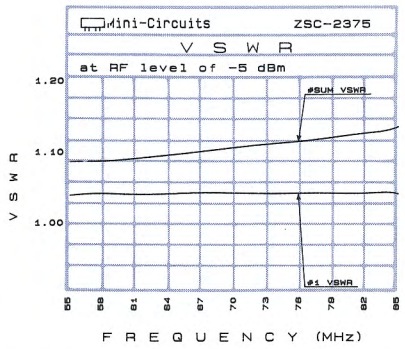
ZSC-2375

75 ohms

55 to 85MHz







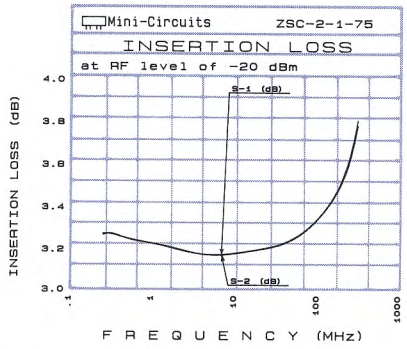
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
55.0	3.17	3.18	0.01	30.27
57.5	3.18	3.19	0.01	29.90
60.0	3.18	3.18	0.00	29.49
62.5	3.19	3.19	0.00	29.16
65.0	3.21	3.21	0.00	28.82
67.5	3.22	3.22	0.00	28.48
70.0	3.20	3.21	0.01	28.17
71.7	3.22	3.22	0.00	27.97
73.3	3.22	3.22	0.00	27.78
75.0	3.19	3.20	0.01	27.58
77.5	3.20	3.20	0.00	27.29
80.0	3.20	3.21	0.01	27.03
82.5	3.21	3.22	0.01	26.74
83.4	3.20	3.20	0.00	26.65
85.0	3.22	3.22	0.00	26.49

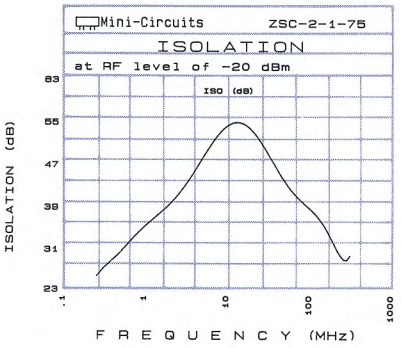
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
55.0	1.08	1.04	1.04
57.3	1.09	1.04	1.04
59.7	1.09	1.04	1.04
61.9	1.09	1.04	1.04
65.0	1.10	1.04	1.04
67.3	1.10	1.04	1.04
68.9	1.10	1.04	1.04
70.4	1.10	1.04	1.04
72.0	1.11	1.04	1.04
73.5	1.12	1.04	1.04
75.0	1.11	1.04	1.04
77.3	1.12	1.04	1.04
79.6	1.12	1.04	1.04
81.9	1.12	1.04	1.04
85.0	1.13	1.04	1.04

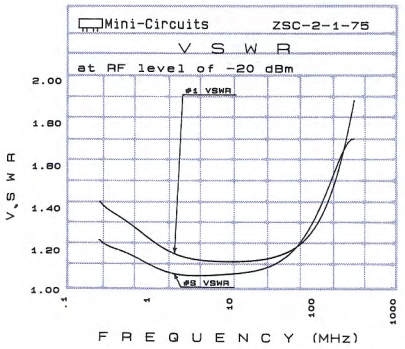
ZSC-2-1-75

75 ohms

0.25 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.3	3.28	3.28	0.00	26.02
5.0	3.17	3.18	0.01	47.23
10.1	3.18	3.18	0.00	55.78
20.0	3.20	3.20	0.00	52.41
45.3	3.25	3.24	0.01	44.45
77.4	3.30	3.29	0.01	40.51
89.9	3.33	3.33	0.00	39.18
102.5	3.36	3.36	0.00	38.01
123.3	3.39	3.39	0.00	36.35
141.0	3.44	3.44	0.00	35.27
161.4	3.46	3.47	0.01	33.80
175.4	3.48	3.48	0.00	33.08
200.0	3.53	3.51	0.02	31.92
250.0	3.66	3.64	0.02	28.99
300.0	3.80	3.78	0.02	28.86

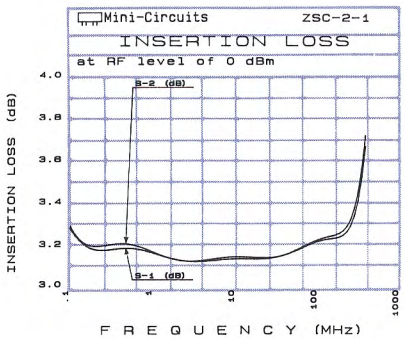
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.3	1.25	1.43	1.43
5.0	1.09	1.15	1.16
10.1	1.10	1.15	1.15
20.0	1.11	1.16	1.16
45.3	1.17	1.21	1.19
77.4	1.27	1.28	1.26
89.9	1.31	1.32	1.29
102.5	1.36	1.36	1.32
123.3	1.42	1.43	1.37
141.0	1.48	1.49	1.42
161.4	1.54	1.56	1.48
175.4	1.58	1.61	1.52
200.0	1.64	1.70	1.60
250.0	1.71	1.78	1.76
300.0	1.74	1.89	1.90

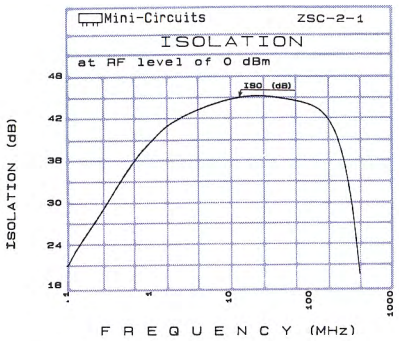
Power Splitter/Combiners

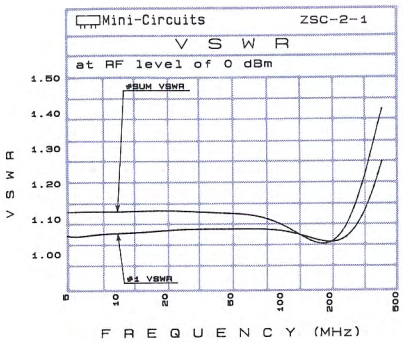
50 ohms

ZMSC-2-1, ZSC-2-1

0.1 to 400MHz





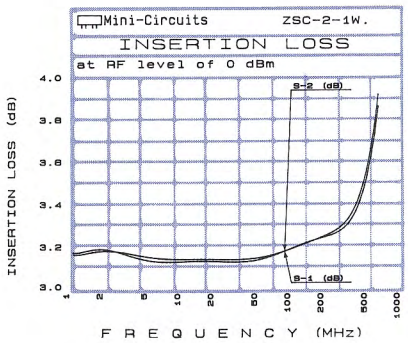


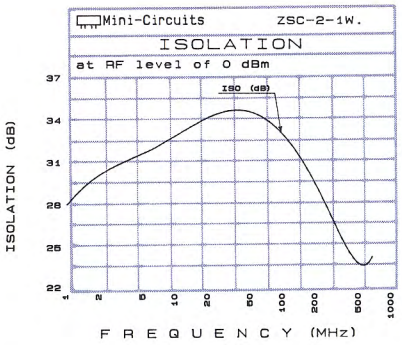
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.1	3.33	3.33	0.00	22.82
0.5	3.24	3.23	0.01	35.06
1.0	3.25	3.24	0.01	39.76
5.0	3.19	3.15	0.04	51.14
10.0	3.17	3.17	0.00	49.55
20.0	3.23	3.20	0.03	44.22
50.0	3.23	3.20	0.03	37.22
100.0	3.27	3.26	0.01	32.39
128.6	3.30	3.29	0.01	30.81
171.5	3.30	3.31	0.01	29.38
200.0	3.31	3.29	0.02	28.96
257.2	3.35	3.33	0.02	29.45
300.0	3.42	3.39	0.03	31.46
328.6	3.46	3.47	0.01	33.72
400.0	3.49	3.45	0.04	34.03

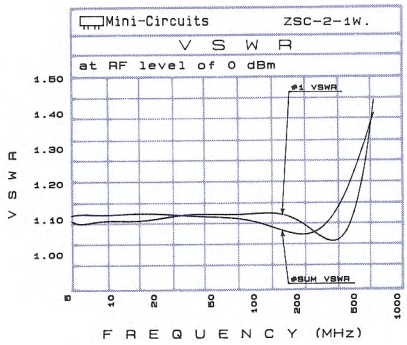
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.1	1.49	1.96	1.97
0.5	1.14	1.20	1.20
1.0	1.14	1.16	1.16
5.0	1.15	1.11	1.11
10.0	1.15	1.11	1.11
20.0	1.16	1.11	1.11
50.0	1.15	1.10	1.10
100.0	1.13	1.08	1.08
128.6	1.12	1.07	1.08
171.5	1.08	1.07	1.07
200.0	1.06	1.07	1.07
257.2	1.05	1.10	1.11
300.0	1.10	1.15	1.16
328.6	1.15	1.18	1.20
400.0	1.25	1.24	1.26

ZMSC-2-1W, ZSC-2-1W

1 to 650MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
1.0	3.31	3.28	0.03	27.72
5.0	3.18	3.21	0.03	37.92
10.0	3.19	3.21	0.02	45.09
20.0	3.22	3.24	0.02	46.45
50.0	3.21	3.24	0.03	37.51
100.0	3.29	3.29	0.00	31.91
152.4	3.35	3.34	0.01	28.72
200.0	3.33	3.35	0.02	26.74
260.6	3.38	3.40	0.02	24.91
300.0	3.40	3.46	0.06	24.02
390.4	3.47	3.49	0.02	22.64
455.3	3.59	3.61	0.02	22.15
500.0	3.62	3.65	0.03	22.04
563.5	3.68	3.71	0.03	22.33
650.0	3.86	3.89	0.03	23.85

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	1.11	1.26	1.26
5.0	1.13	1.16	1.16
10.0	1.13	1.14	1.14
20.0	1.14	1.14	1.14
50.0	1.13	1.13	1.13
100.0	1.13	1.12	1.12
152.4	1.14	1.11	1.11
200.0	1.13	1.10	1.10
260.6	1.14	1.07	1.08
300.0	1.15	1.06	1.06
390.4	1.18	1.03	1.03
455.3	1.21	1.05	1.05
500.0	1.23	1.07	1.07
563.5	1.26	1.12	1.12
650.0	1.30	1.19	1.18

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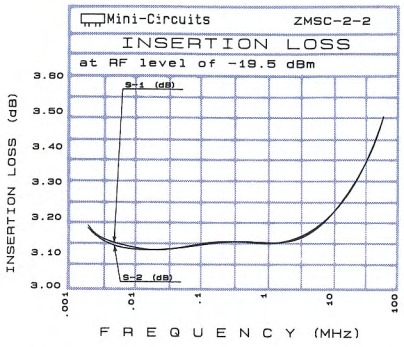
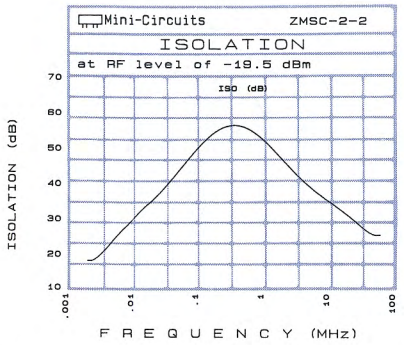
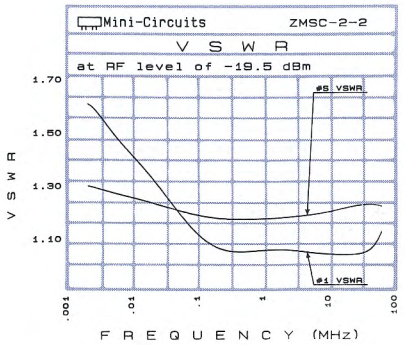
ZMSC-2-2, ZSC-2-2

0.002 to 60MHz





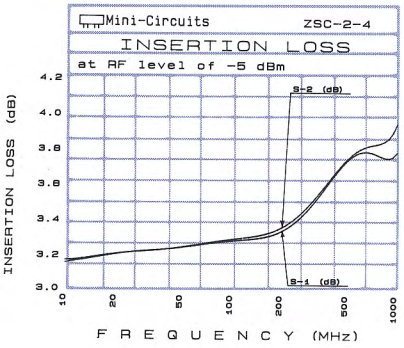


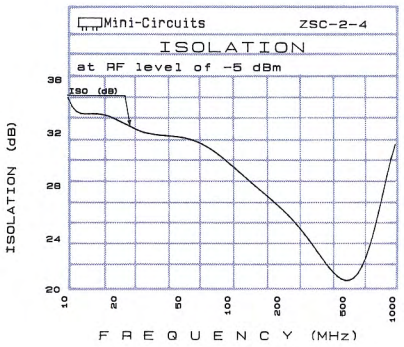
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
002	3.18	3.17	0.01	17.44
005	3.13	3.12	0.01	24.03
010	3.12	3.11	0.01	29.51
020	3.10	3.11	0.01	35.51
101	3.13	3.13	0.00	49.92
1.000	3.13	3.13	0.00	51.68
5.000	3.16	3.16	0.00	39.50
9.900	3.22	3.22	0.00	34.91
14.300	3.24	3.25	0.01	32.76
19.900	3.29	3.29	0.00	30.66
30.900	3.35	3.35	0.00	28.08
41.100	3.41	3.40	0.01	26.55
50.500	3.46	3.45	0.01	25.62
54.500	3.47	3.46	.01	25.23
60.000	3.49	3.50	.01	24.87

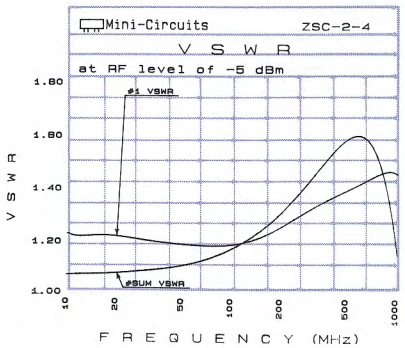
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
.002	1.30	1.62	1.62
.005	1.18	1.06	1.06
.010	1.17	1.06	1.06
.020	1.18	1.06	1.05
.101	1.19	1.05	1.05
1.000	1.20	1.04	1.04
5.000	1.21	1.04	1.03
9.900	1.22	1.04	1.04
14.300	1.23	1.04	1.04
19.900	1.23	1.05	1.05
30.900	1.23	1.07	1.07
41.100	1.22	1.09	1.09
50.500	1.22	1.12	1.12
54.500	1.23	1.10	1.10
60.000	1.22	1.12	1.12

ZSC-2-4

10 to 1000MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	3.16	3.17	0.01	34.05
19.9	3.21	3.21	0.00	32.89
49.6	3.25	3.25	0.00	31.63
99.1	3.28	3.30	0.02	29.86
156.0	3.32	3.34	0.02	27.71
200.6	3.35	3.38	0.03	26.31
302.1	3.50	3.52	0.02	23.78
359.0	3.56	3.58	0.02	22.74
418.4	3.68	3.69	0.01	22.00
500.1	3.77	3.78	0.01	21.43
591.6	3.80	3.81	0.01	21.37
708.0	3.75	3.80	0.05	22.56
797.1	3.81	3.89	0.08	25.32
913.4	3.81	3.93	0.12	33.90
1000.0	3.71	3.85	0.14	24.74

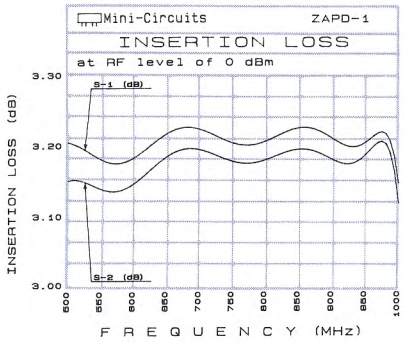
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.08	1.22	1.22
19.9	1.08	1.22	1.22
49.6	1.11	1.19	1.19
99.1	1.17	1.19	1.19
156.0	1.25	1.22	1.22
200.6	1.31	1.25	1.26
302.1	1.44	1.32	1.32
359.0	1.49	1.35	1.35
418.4	1.55	1.38	1.38
500.1	1.59	1.40	1.40
591.6	1.60	1.41	1.42
708.0	1.56	1.44	1.45
797.1	1.48	1.46	1.48
913.4	1.32	1.48	1.50
1000.0	1.15	1.43	1.47

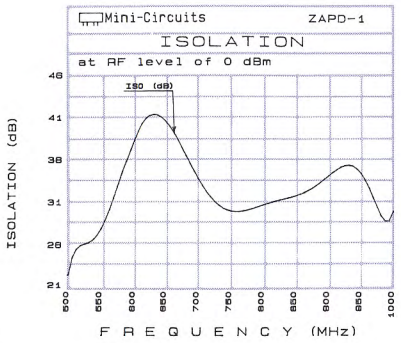
Power Splitter/Combiners

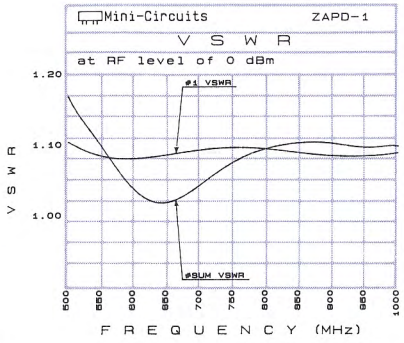
50 ohms

ZAPD-1

0.5 to 1GHz





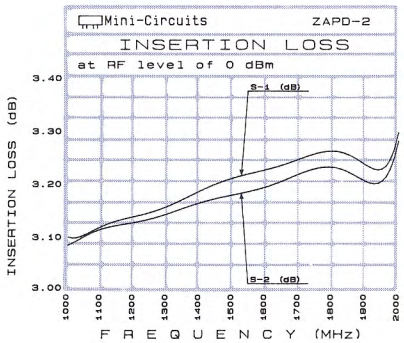


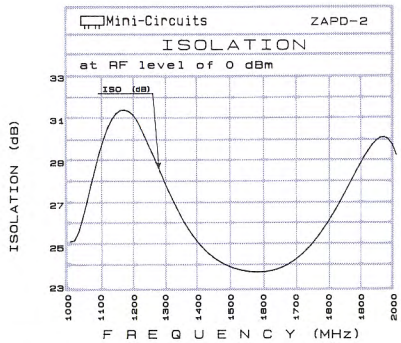
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
500.0	3.21	3.16	0.05	23.83
525.0	3.19	3.14	0.05	25.98
550.0	3.18	3.14	0.04	28.63
600.0	3.17	3.14	0.03	37.12
650.0	3.22	3.18	0.04	40.68
700.0	3.23	3.20	0.03	33.24
750.0	3.20	3.17	0.03	30.69
775.0	3.20	3.17	0.03	30.30
800.0	3.21	3.18	0.03	30.34
850.0	3.25	3.21	0.04	31.69
875.0	3.22	3.19	0.03	33.00
900.0	3.18	3.15	0.03	34.52
950.0	3.22	3.21	0.01	33.85
975.0	3.21	3.19	0.02	31.00
1000.0	3.18	3.16	0.02	28.08

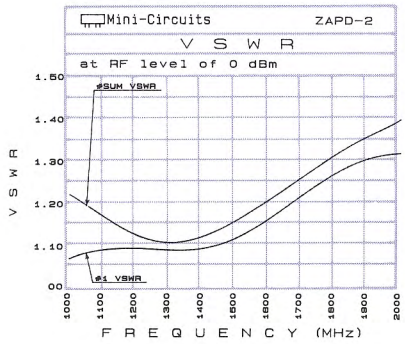
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
500.0	1.16	1.10	1.09
525.0	1.13	1.09	1.08
550.0	1.10	1.08	1.07
600.0	1.03	1.08	1.07
650.0	1.02	1.08	1.07
700.0	1.04	1.09	1.07
750.0	1.08	1.10	1.07
775.0	1.09	1.10	1.07
800.0	1.10	1.09	1.07
850.0	1.10	1.09	1.06
875.0	1.10	1.09	1.06
900.0	1.10	1.08	1.06
950.0	1.10	1.08	1.06
975.0	1.10	1.08	1.06
1000.0	1.10	1.09	1.07

ZAPD-2

1 to 2GHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
1000.0	3.11	3.10	0.01	24.77
1050.0	3.10	3.10	0.00	27.28
1100.0	3.13	3.12	0.01	29.92
1200.0	3.15	3.14	0.01	31.18
1300.0	3.15	3.13	0.02	27.64
1350.0	3.18	3.16	0.02	26.24
1400.0	3.20	3.18	0.02	25.19
1450.0	3.21	3.18	0.03	24.48
1500.0	3.20	3.17	0.03	24.04
1550.0	3.21	3.18	0.03	23.83
1600.0	3.21	3.18	0.03	23.86
1725.0	3.25	3.22	0.03	24.95
1825.0	3.18	3.15	0.03	27.05
1875.0	3.33	3.30	0.03	28.60
2000.0	3.29	3.28	0.01	29.68

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1000.0	1.22	1.07	1.06
1050.0	1.20	1.09	1.08
1100.0	1.17	1.09	1.08
1200.0	1.13	1.10	1.08
1300.0	1.11	1.09	1.07
1350.0	1.11	1.09	1.07
1400.0	1.13	1.10	1.06
1450.0	1.14	1.10	1.07
1500.0	1.16	1.12	1.08
1550.0	1.18	1.14	1.10
1600.0	1.21	1.17	1.12
1725.0	1.27	1.23	1.18
1825.0	1.32	1.28	1.22
1875.0	1.35	1.30	1.24
2000.0	1.40	1.32	1.26

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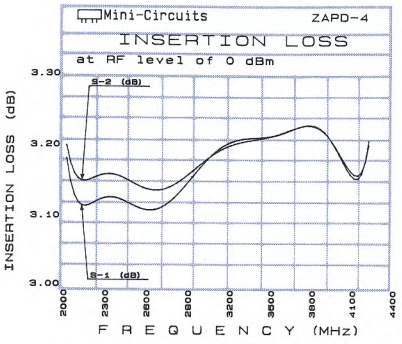
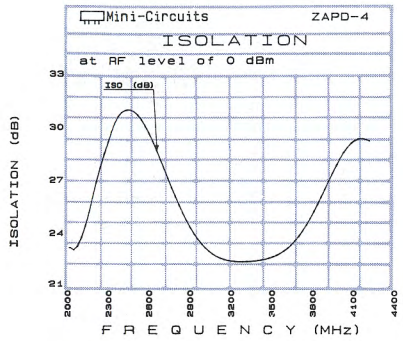
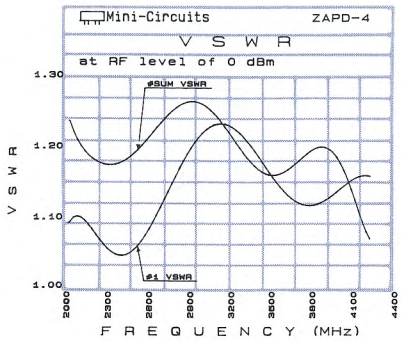
ZAPD-4

2 to 4.2GHz





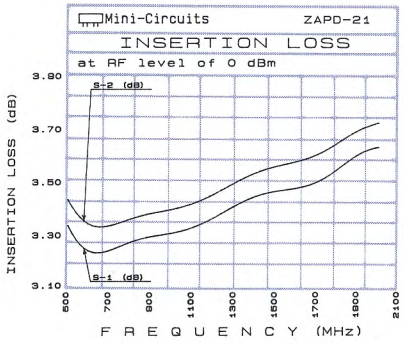


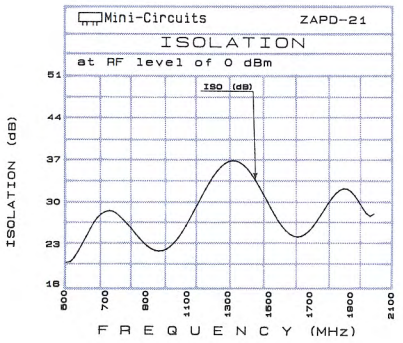
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
2000.0	3.15	3.18	0.03	22.44
2110.0	3.12	3.16	0.04	24.68
2220.0	3.13	3.16	0.03	27.37
2440.0	3.11	3.14	0.03	31.51
2550.0	3.17	3.20	0.03	30.19
2770.0	3.08	3.10	0.02	25.92
2990.0	3.17	3.18	0.01	23.39
3100.0	3.24	3.23	0.01	22.73
3320.0	3.15	3.15	0.00	22.24
3540.0	3.24	3.24	0.00	22.88
3760.0	3.22	3.22	0.00	24.81
3870.0	3.23	3.23	0.00	26.40
3980.0	3.16	3.17	0.01	28.10
4090.0	3.17	3.17	0.00	29.46
4200.0	3.17	3.17	0.00	29.13

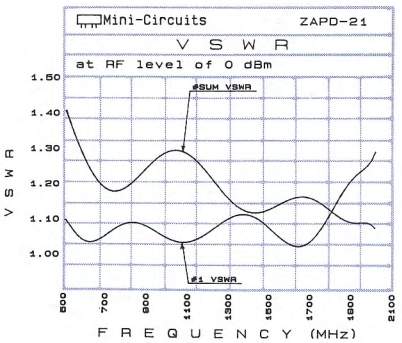
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
2000.0	1.23	1.10	1.12
2110.0	1.20	1.09	1.11
2220.0	1.17	1.07	1.10
2440.0	1.18	1.04	1.09
2550.0	1.21	1.07	1.11
2770.0	1.25	1.16	1.20
2990.0	1.26	1.22	1.27
3100.0	1.24	1.23	1.28
3320.0	1.18	1.20	1.26
3540.0	1.16	1.14	1.20
3760.0	1.20	1.11	1.14
3870.0	1.20	1.13	1.13
3980.0	1.17	1.14	1.14
4090.0	1.13	1.15	1.15
4200.0	1.06	1.16	1.17

ZAPD-21

0.5 to 2.0GHz





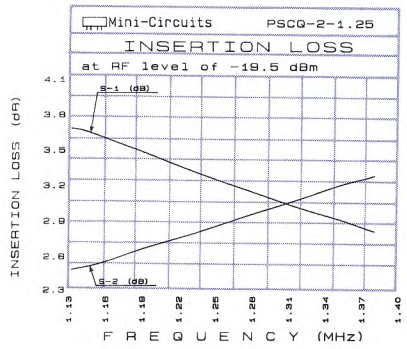


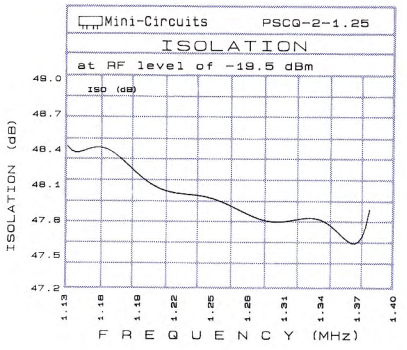
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
500.0	3.34	3.44	0.10	19.29
575.0	3.24	3.35	0.11	23.06
650.0	3.23	3.34	0.11	27.74
725.0	3.25	3.34	0.09	28.50
800.0	3.26	3.34	0.08	25.57
950.0	3.34	3.43	0.09	23.23
1100.0	3.32	3.41	0.09	25.71
1250.0	3.34	3.45	0.11	36.78
1400.0	3.45	3.54	0.09	31.83
1550.0	3.47	3.57	0.10	26.51
1700.0	3.52	3.62	0.10	26.81
1775.0	3.54	3.64	0.10	28.82
1850.0	3.54	3.64	0.10	31.81
1925.0	3.62	3.71	0.09	31.64
2000.0	3.63	3.72	0.09	26.35

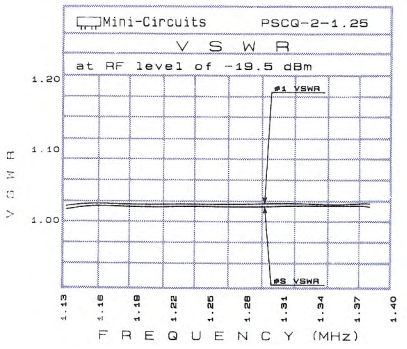
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
500.0	1.40	1.10	1.10
575.0	1.29	1.04	1.04
650.0	1.21	1.04	1.03
725.0	1.17	1.07	1.07
800.0	1.20	1.09	1.09
950.0	1.28	1.07	1.08
1100.0	1.28	1.03	1.04
1250.0	1.19	1.09	1.09
1400.0	1.11	1.11	1.11
1550.0	1.15	1.05	1.07
1700.0	1.16	1.05	1.05
1775.0	1.13	1.11	1.11
1850.0	1.10	1.18	1.17
1925.0	1.09	1.23	1.24
2000.0	1.09	1.28	1.29

Power Splitter/Combiners 50 ohms

PSCQ-2-1.25 1.13 to 1.38MHz

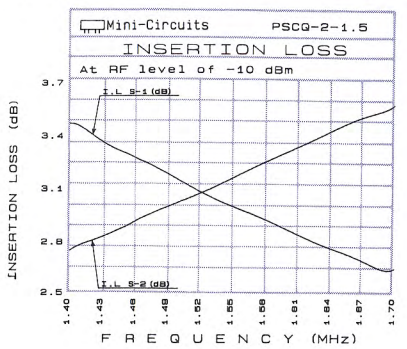


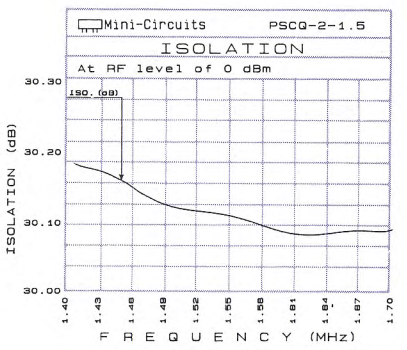


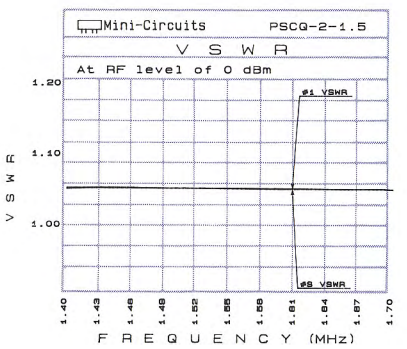


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
1.130	3.69	2.49	1.20	89.8	48
1.145	3.66	2.53	1.13	89.8	49
1.150	3.63	2.53	1.10	89.8	48
1.159	3.59	2.56	1.03	89.8	48
1.174	3.54	2.62	0.92	89.8	48
1.200	3.43	2.70	0.73	89.8	48
1.226	3.33	2.78	0.55	89.8	48
1.240	3.31	2.82	0.49	89.8	48
1.250	3.28	2.83	0.45	89.8	48
1.270	3.25	2.87	0.38	89.8	48
1.300	3.18	2.94	0.24	89.8	48
1.336	3.06	3.03	0.03	89.8	48
1.350	2.95	3.15	0.20	89.8	48
1.365	2.90	3.20	0.30	89.7	47
1.380	2.86	3.25	0.39	89.8	47

PSCQ-2-1.5 1.4 to 1.7MHz

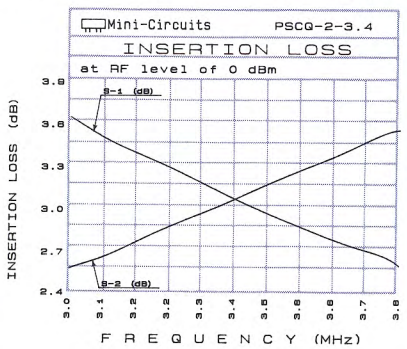


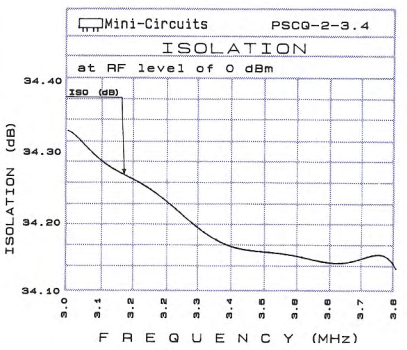


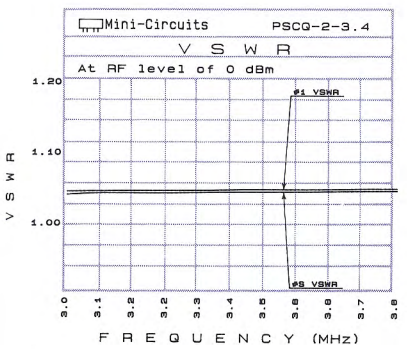


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
1.410	3.48	2.75	0.73	90.00	30.19
1.431	3.41	2.81	0.60	90.00	30.18
1.452	3.33	2.86	0.47	90.00	30.16
1.472	3.26	2.93	0.33	90.00	30.14
1.493	3.21	2.98	0.23	90.00	30.13
1.514	3.14	3.03	0.11	90.00	30.12
1.535	3.07	3.08	0.01	90.00	30.12
1.555	3.01	3.15	0.14	90.00	30.11
1.576	2.97	3.20	0.23	90.00	30.11
1.597	2.92	3.27	0.35	90.00	30.09
1.617	2.85	3.33	0.48	90.10	30.09
1.638	2.79	3.37	0.58	90.10	30.09
1.659	2.75	3.45	0.70	90.10	30.08
1.679	2.70	3.50	0.80	90.10	30.10
1.690	2.63	3.56	0.93	90.10	30.09

PSCQ-2-3.4 3.0 to 3.8MHz







FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
3.028	3.65	2.58	1.07	90.00	34.33
3.083	3.55	2.63	0.92	90.00	34.30
3.138	3.46	2.71	0.75	90.00	34.27
3.193	3.40	2.78	0.62	90.00	34.26
3.248	3.32	2.86	0.46	89.90	34.23
3.303	3.26	2.93	0.33	89.90	34.22
3.359	3.17	3.00	0.17	89.90	34.19
3.414	3.10	3.06	0.04	89.90	34.17
3.469	3.03	3.14	0.11	89.90	34.17
3.524	2.96	3.19	0.23	89.90	34.15
3.579	2.89	3.28	0.39	89.90	34.17
3.635	2.83	3.33	0.50	89.90	34.15
3.690	2.76	3.39	0.63	89.90	34.14
3.745	2.71	3.48	0.77	89.90	34.15
3.772	2.61	3.58	0.97	89.90	34.15

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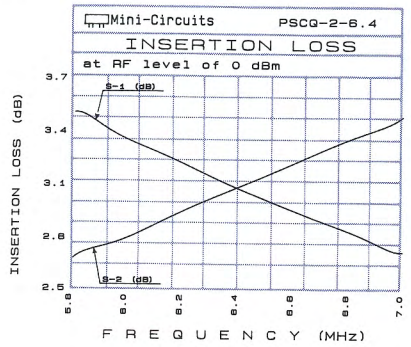
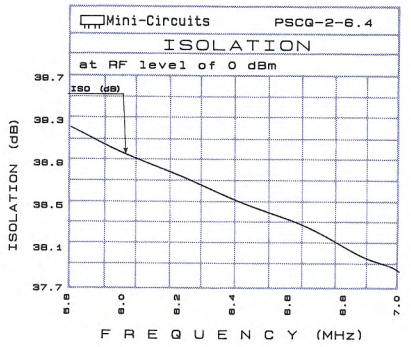
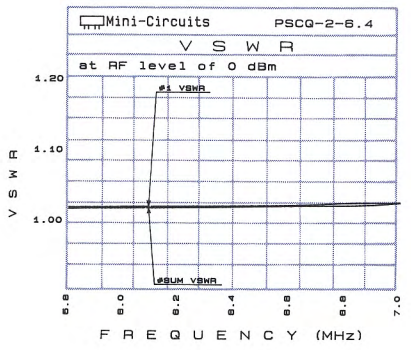
PSCQ-2-6.4 5.8 to 7.0MHz

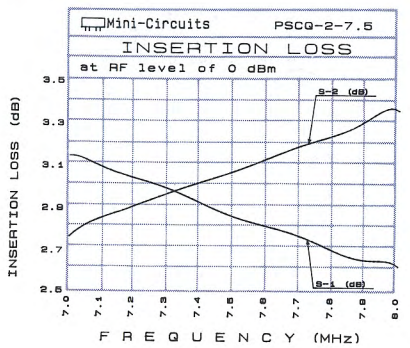


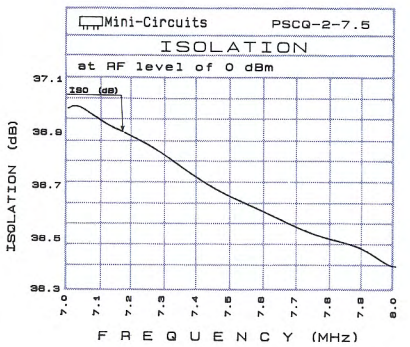


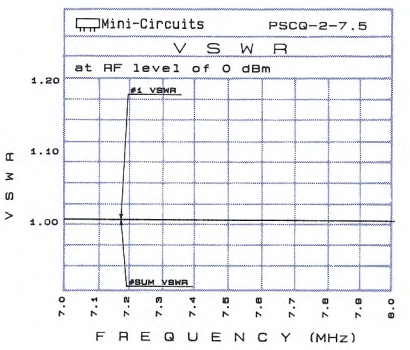


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
5.841	3.51	2.67	0.84	89.70	39.23
5.924	3.46	2.74	0.72	89.70	39.13
6.007	3.38	2.77	0.61	89.70	39.01
6.090	3.31	2.84	0.47	89.70	38.96
6.172	3.28	2.89	0.39	89.70	38.86
6.255	3.21	2.96	0.25	89.70	38.75
6.338	3.15	3.02	0.13	89.70	38.66
6.421	3.09	3.06	0.03	89.70	38.60
6.503	3.05	3.13	0.08	89.70	38.50
6.586	2.98	3.18	0.20	89.70	38.40
6.669	2.93	3.24	0.31	89.70	38.33
6.752	2.89	3.30	0.41	89.70	38.26
6.835	2.84	3.35	0.51	89.70	38.07
6.917	2.79	3.40	0.61	89.70	38.02
6.959	2.72	3.48	0.76	89.70	37.89

PSCQ-2-7.5 7.0 to 8.0MHz

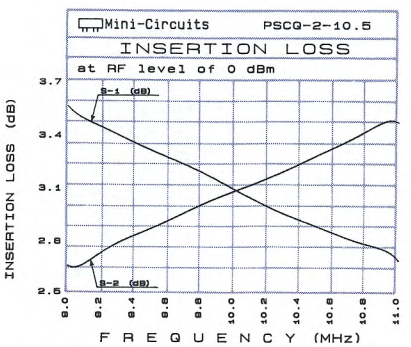


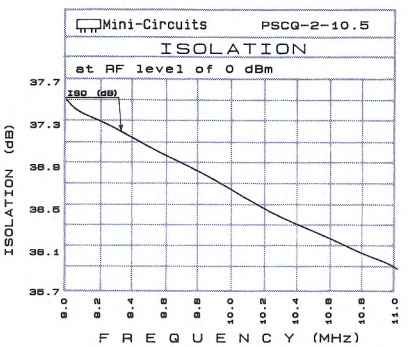


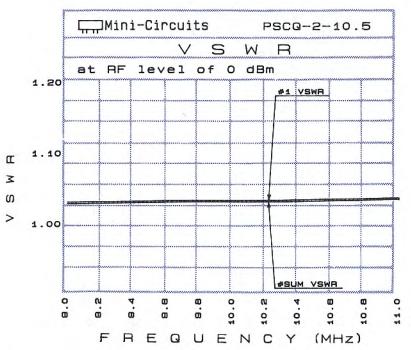


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
7.035	3.14	2.76	0.38	89.60	37.00
7.103	3.11	2.83	0.28	89.60	36.99
7.172	3.06	2.87	0.19	89.60	36.90
7.241	3.04	2.90	0.14	89.60	36.87
7.310	3.03	2.95	0.08	89.60	36.86
7.379	2.95	3.01	0.06	89.60	36.76
7.448	2.90	3.03	0.13	89.60	36.72
7.517	2.88	3.05	0.17	89.60	36.66
7.586	2.85	3.11	0.26	89.60	36.64
7.655	2.80	3.13	0.33	89.60	36.58
7.724	2.78	3.20	0.42	89.60	36.54
7.793	2.74	3.23	0.49	89.60	36.54
7.862	2.69	3.27	0.58	89.60	36.49
7.931	2.65	3.30	0.65	89.60	36.46
7.966	2.63	3.36	0.73	89.60	36.39

PSCQ-2-10.5 9.0 to 11.0MHz



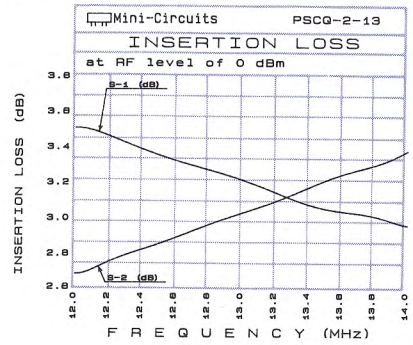


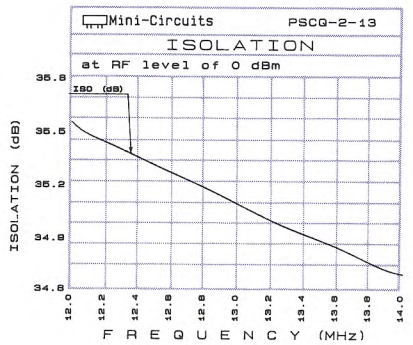


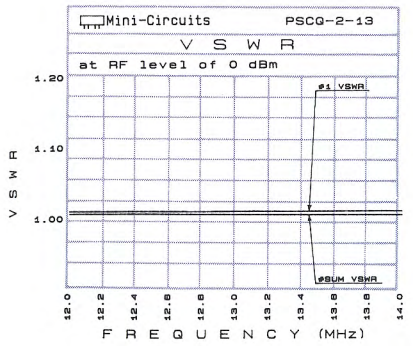
FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
9.00	3.55	2.65	0.90	89.30	37.53
9.14	3.46	2.69	0.77	89.30	37.37
9.28	3.42	2.78	0.64	89.30	37.28
9.41	3.35	2.84	0.51	89.30	37.15
9.55	3.30	2.90	0.40	89.30	37.05
9.69	3.24	2.96	0.28	89.30	36.95
9.83	3.18	3.02	0.16	89.30	36.82
9.97	3.13	3.08	0.05	89.30	36.72
10.10	3.04	3.11	0.07	89.30	36.58
10.24	2.98	3.18	0.20	89.30	36.47
10.38	2.93	3.23	0.30	89.30	36.37
10.52	2.87	3.29	0.42	89.30	36.27
10.66	2.82	3.34	0.52	89.30	36.16
10.79	2.79	3.43	0.64	89.30	36.10
11.00	2.70	3.49	0.79	89.30	35.95

2WAY-90°
Power Splitter/Combiners 50 ohms

PSCQ-2-13 12 to 14MHz

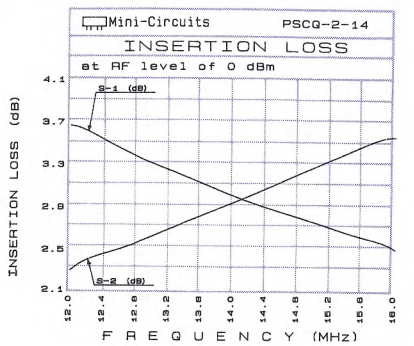


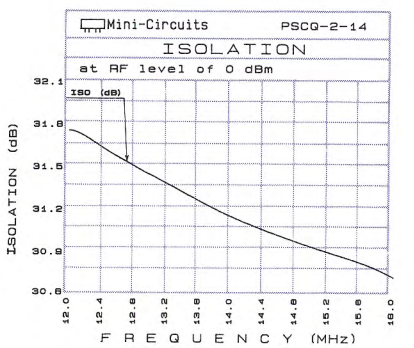


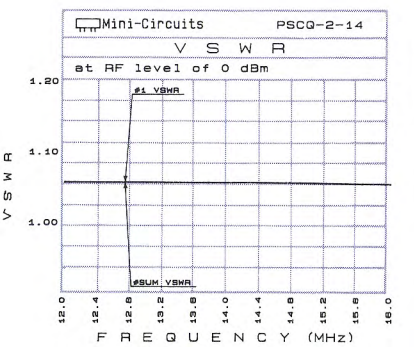


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
12.00	3.52	2.69	0.83	89.40	35.56
12.10	3.49	2.73	0.76	89.40	35.47
12.30	3.43	2.77	0.66	89.40	35.40
12.40	3.38	2.82	0.56	89.40	35.35
12.60	3.33	2.87	0.46	89.40	35.29
12.70	3.32	2.93	0.39	89.40	35.24
12.80	3.26	2.97	0.29	89.40	35.17
13.00	3.21	3.01	0.20	89.40	35.09
13.10	3.18	3.06	0.12	89.40	35.05
13.20	3.12	3.10	0.02	89.40	34.98
13.40	3.07	3.16	0.09	89.40	34.92
13.50	3.04	3.21	0.17	89.40	34.88
13.70	3.04	3.26	0.22	89.40	34.83
13.80	3.01	3.29	0.28	89.40	34.76
14.00	2.95	3.37	0.42	89.40	34.69

PSCQ-2-14 12 to 16MHz

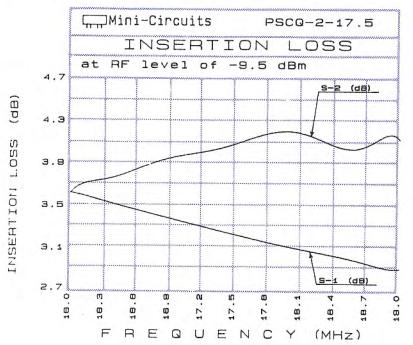


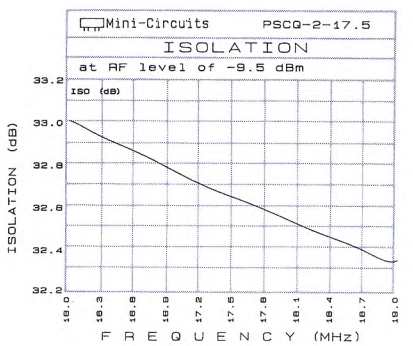


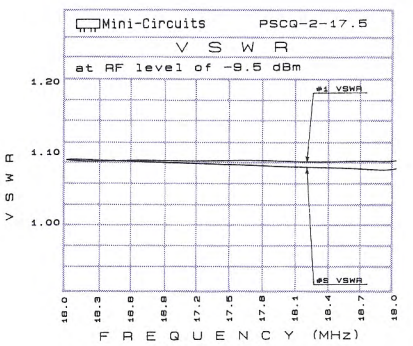


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
12.00	3.69	2.32	1.37	89.50	31.77
12.20	3.62	2.42	1.20	89.50	31.70
12.40	3.52	2.47	1.05	89.50	31.64
12.70	3.41	2.53	0.88	89.50	31.52
13.00	3.31	2.65	0.66	89.60	31.45
13.30	3.22	2.73	0.49	89.60	31.35
13.50	3.15	2.81	0.34	89.60	31.27
13.70	3.08	2.87	0.21	89.60	31.22
14.10	2.99	2.95	0.04	89.60	31.12
14.40	2.90	3.05	0.15	89.50	31.07
14.70	2.86	3.19	0.33	89.40	31.00
15.10	2.75	3.31	0.56	89.30	30.93
15.50	2.66	3.45	0.79	89.20	30.86
15.80	2.58	3.54	0.96	89.10	30.78
16.00	2.53	3.58	1.05	89.00	30.74

PSCQ-2-17.5 16 to 19MHz







FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
16.00	3.62	3.65	0.03	88.98	33.01
16.20	3.56	3.74	0.18	88.99	32.94
16.40	3.51	3.77	0.26	89.00	32.90
16.60	3.46	3.83	0.37	88.96	32.87
16.80	3.40	3.88	0.48	88.94	32.81
17.10	3.33	3.99	0.66	88.92	32.73
17.20	3.30	4.00	0.70	88.92	32.71
17.40	3.25	4.05	0.80	88.93	32.67
17.50	3.21	4.08	0.87	88.93	32.65
17.80	3.15	4.16	1.01	88.92	32.59
18.00	3.10	4.20	1.10	88.87	32.53
18.30	3.05	4.00	0.95	88.89	32.48
18.40	3.03	4.04	1.01	88.90	32.44
18.70	2.95	4.07	1.12	88.87	32.40
19.00	2.89	4.18	1.29	88.86	32.33

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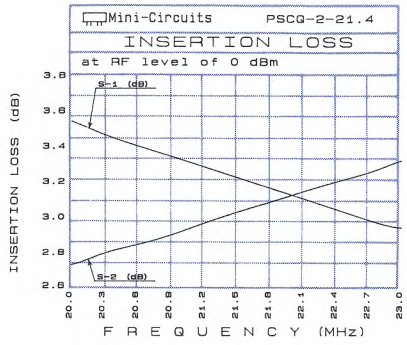
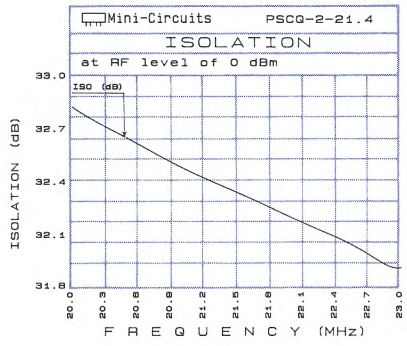
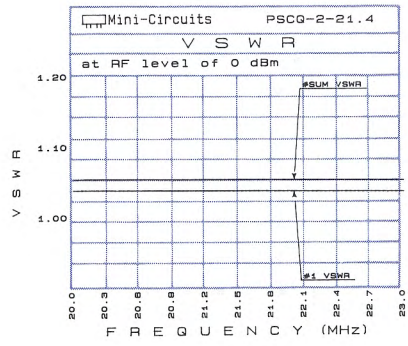
ZMSCQ-2-21.4
PSCQ-2-21.4 20 to 23MHz

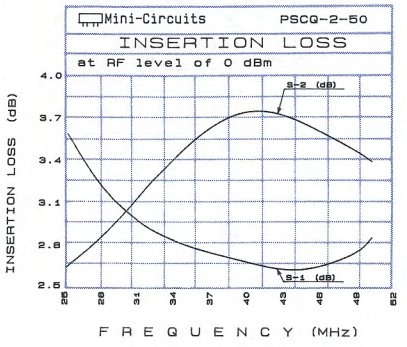


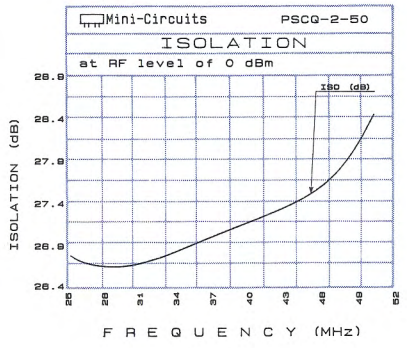


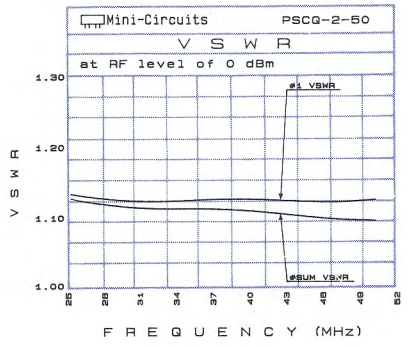


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
20.00	3.54	2.73	0.81	89.40	32.89
20.20	3.48	2.77	0.71	89.34	32.84
20.40	3.45	2.82	0.63	89.34	32.73
20.50	3.40	2.83	0.57	89.33	32.70
20.80	3.38	2.88	0.50	89.36	32.58
21.00	3.31	2.91	0.40	89.38	32.55
21.20	3.28	2.98	0.30	89.34	32.44
21.50	3.20	3.02	0.18	89.36	32.35
21.80	3.18	3.09	0.09	89.34	32.25
22.00	3.12	3.11	0.01	89.34	32.14
22.20	3.07	3.16	0.09	89.35	32.10
22.40	3.05	3.20	0.15	89.33	32.02
22.50	3.01	3.21	0.20	89.30	31.98
22.80	2.97	3.27	0.30	89.30	31.93
23.00	2.94	3.32	0.38	89.34	31.86

PSCQ-2-50,
ZMSCQ-2-50,
ZSCQ-2-50 25 to 50MHz

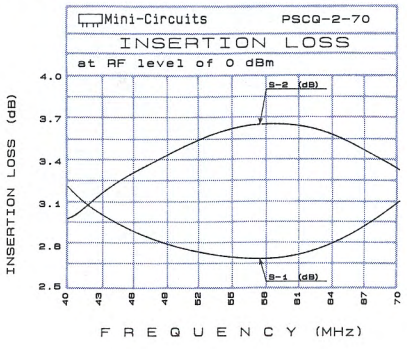


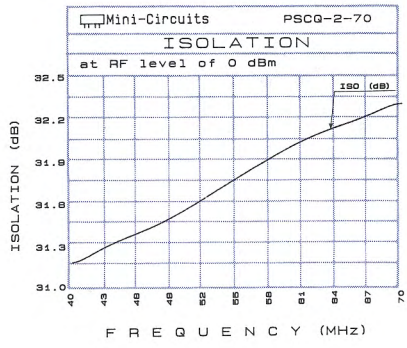


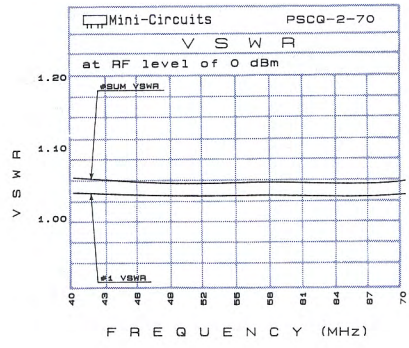


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
25.00	3.62	2.64	0.98	90.26	26.78
27.00	3.39	2.83	0.56	90.29	26.68
29.10	3.20	3.03	0.17	90.36	26.67
30.00	3.13	3.12	0.01	90.48	26.66
31.80	3.00	3.24	0.24	90.54	26.73
34.40	2.88	3.39	0.51	90.70	26.87
36.50	2.82	3.47	0.65	90.80	26.98
38.50	2.79	3.51	0.72	90.90	27.10
40.00	2.79	3.53	0.74	91.02	27.20
42.60	2.84	3.50	0.66	91.36	27.35
44.60	2.92	3.42	0.50	91.61	27.48
46.60	2.68	3.56	0.88	91.83	27.72
48.00	2.70	3.50	0.78	92.09	27.95
49.30	2.80	3.40	0.63	92.38	28.26
50.00	2.84	3.41	0.57	92.53	28.43

PSCQ-2-70 40 to 70MHz



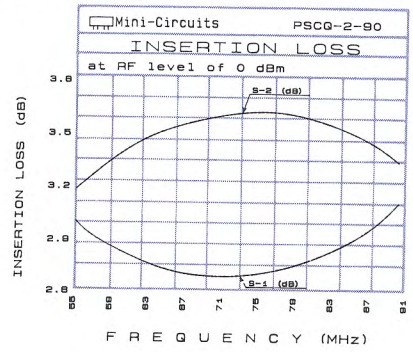


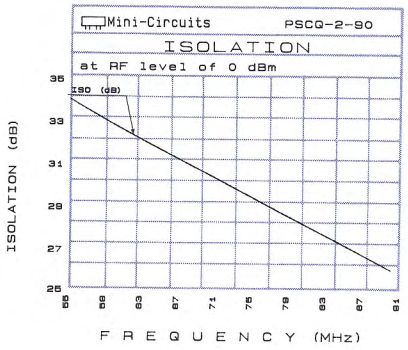


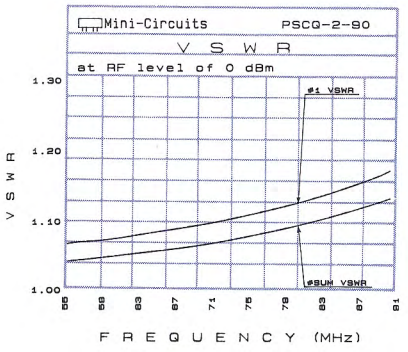
FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
40.00	3.21	2.99	0.22	89.70	31.18
41.60	3.11	3.08	0.03	89.70	31.25
42.40	3.05	3.13	0.08	89.70	31.27
44.70	2.96	3.26	0.30	89.70	31.36
47.10	2.88	3.38	0.50	89.70	31.45
49.50	2.80	3.46	0.66	89.70	31.51
51.10	2.76	3.51	0.75	89.70	31.58
53.40	2.73	3.60	0.87	89.70	31.71
55.80	2.71	3.63	0.92	89.70	31.81
58.20	2.71	3.67	0.96	89.80	31.92
60.50	2.73	3.65	0.92	89.90	32.02
62.90	2.79	3.62	0.83	89.90	32.10
65.30	2.87	3.54	0.67	90.00	32.17
67.60	2.99	3.45	0.46	90.10	32.24
70.00	3.12	3.34	0.22	90.20	32.29

Power Splitter/Combiners 50 ohms

PSCQ-2-90, ZMSCQ-2-90, ZSCQ-2-90 — 55 to 90MHz

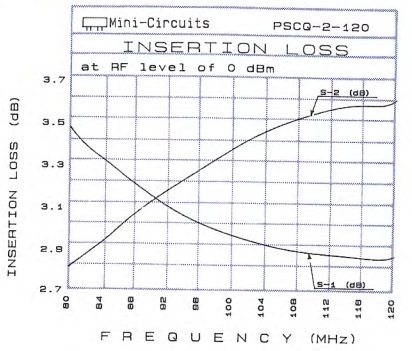


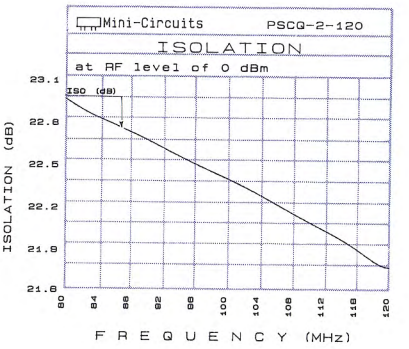


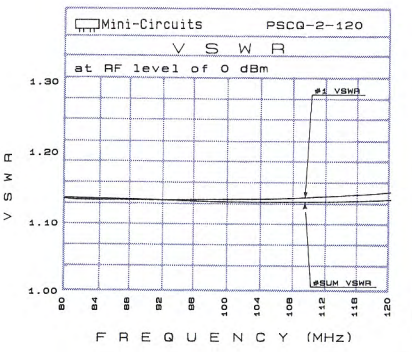


FREQ. (MHz)	INSERT. LOSS (db) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
55.00	2.86	3.42	0.56	90.11	33.90
57.90	2.97	3.30	0.33	90.13	32.96
59.90	3.04	3.24	0.20	90.13	32.26
61.80	3.10	3.18	0.08	90.16	31.53
64.70	3.17	3.12	0.05	90.20	30.45
67.60	3.24	3.09	0.15	90.30	29.48
70.60	3.29	3.06	0.23	90.33	28.38
73.50	3.32	3.08	0.24	90.51	27.37
75.40	3.32	3.09	0.23	90.48	26.74
80.00	3.30	3.18	0.12	90.89	25.15
82.20	3.27	3.25	0.02	91.05	24.38
85.10	3.20	3.33	0.13	91.34	23.41
87.10	3.15	3.44	0.29	91.59	22.73
89.00	3.10	3.53	0.43	91.85	22.11
90.00	3.07	3.61	0.54	91.99	21.79

PSCQ-2-120 — 80 to 120MHz

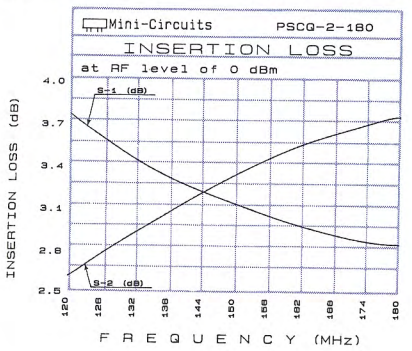


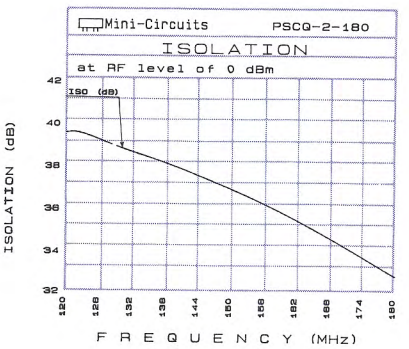


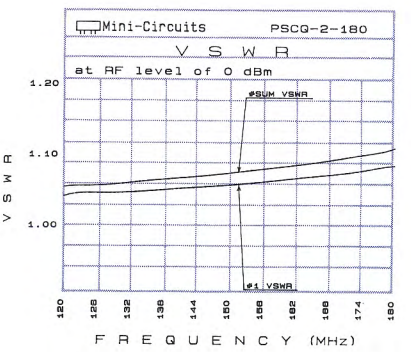


FREQ. (MHz)	INSERT. LOSS (db) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
80.00	3.47	2.82	0.65	89.22	22.97
82.10	3.39	2.89	0.50	89.23	22.90
85.30	3.29	2.99	0.30	89.28	22.81
87.40	3.23	3.05	0.18	89.25	22.76
90.50	3.15	3.14	0.01	89.35	22.68
92.60	3.09	3.19	0.10	89.34	22.61
95.80	3.04	3.28	0.24	89.35	22.53
100.00	2.98	3.39	0.41	89.42	22.42
102.10	2.95	3.42	0.47	89.42	22.34
105.30	2.93	3.50	0.57	89.49	22.27
107.40	2.90	3.52	0.62	89.49	22.19
110.50	2.90	3.56	0.66	89.58	22.09
113.70	2.88	3.59	0.71	89.66	22.00
115.80	2.88	3.60	0.72	89.66	21.93
120.00	2.87	3.61	0.74	89.79	21.78

PSCQ-2-180, ZMSCQ-2-180, ZSCQ-2-180 — 120 to 180MHz







FREQ. (MHz)	INSERT. LOSS (db) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
120.00	3.80	2.69	1.11	88.74	39.74
123.20	3.72	2.76	0.96	88.72	39.63
126.30	3.63	2.84	0.79	88.65	39.34
129.50	3.55	2.92	0.63	88.65	38.93
132.60	3.48	2.99	0.49	88.61	38.56
135.80	3.41	3.07	0.34	88.61	38.39
138.90	3.34	3.13	0.21	88.58	38.29
140.60	3.31	3.17	0.14	88.53	37.84
145.20	3.23	3.26	0.03	88.53	37.52
150.00	3.16	3.35	0.19	88.55	36.99
153.20	3.11	3.43	0.32	88.45	36.59
159.50	3.03	3.53	0.50	88.48	35.87
164.30	2.99	3.62	0.63	88.37	35.13
170.60	2.94	3.70	0.76	88.31	34.25
180.00	2.92	3.76	0.84	88.27	32.89

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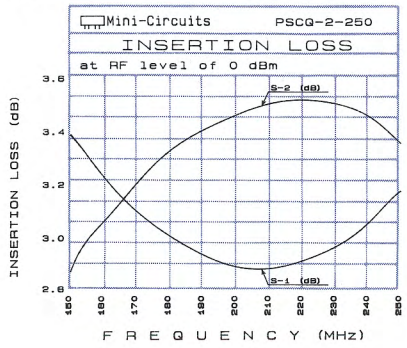
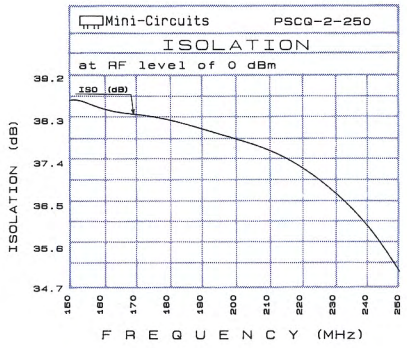
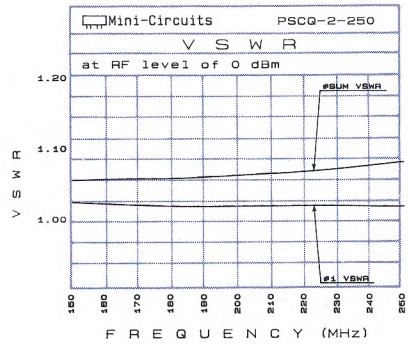
PSCQ-2-250 150 to 250MHz

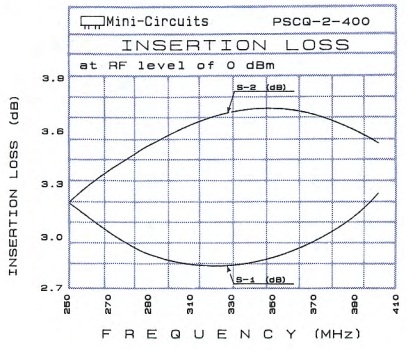


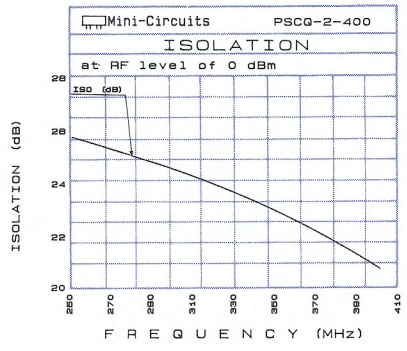


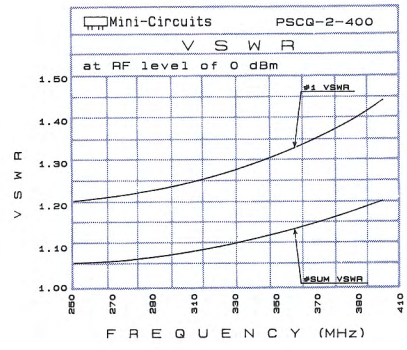


FREQ. (MHz)	INSERT. LOSS (db) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
150.00	3.39	2.89	0.50	90.00	38.75
155.00	3.31	2.99	0.32	89.80	38.63
160.00	3.23	3.07	0.16	89.70	38.53
165.00	3.16	3.13	0.03	89.50	38.50
170.00	3.10	3.20	0.10	89.40	38.40
175.00	3.05	3.27	0.22	89.20	38.46
180.00	3.01	3.33	0.32	89.30	38.36
185.00	2.96	3.37	0.41	89.40	38.25
190.00	2.93	3.41	0.48	89.40	38.17
200.00	2.89	3.46	0.57	89.60	37.84
210.00	2.89	3.51	0.62	89.50	37.63
220.00	2.92	3.53	0.61	89.40	37.32
230.00	2.96	3.50	0.54	89.60	36.85
240.00	3.05	3.46	0.41	89.90	36.11
250.00	3.18	3.36	0.18	90.30	35.14

PSCQ-2-400 250 to 400MHz

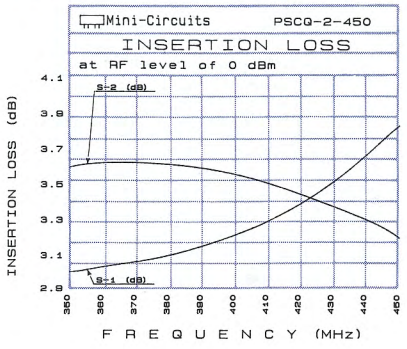


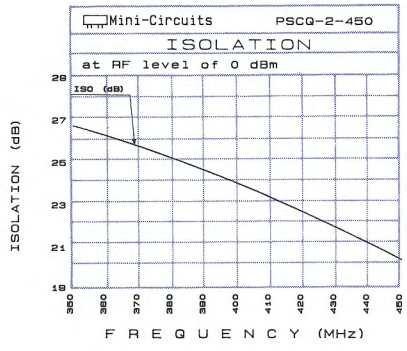


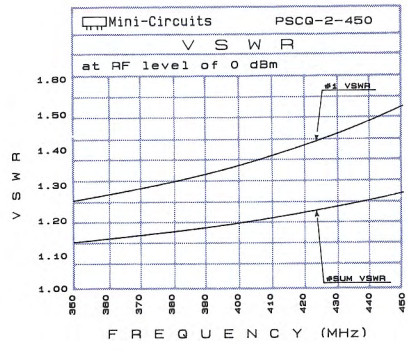


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
250.00	3.18	3.20	0.02	89.58	25.76
261.60	3.09	3.32	0.23	89.53	25.50
273.30	3.00	3.41	0.41	89.48	25.24
280.80	2.95	3.46	0.51	89.43	25.05
292.40	2.89	3.53	0.64	89.40	24.76
304.00	2.86	3.61	0.75	89.53	24.47
311.50	2.85	3.65	0.80	89.59	24.25
323.10	2.84	3.69	0.85	89.75	23.90
342.30	2.87	3.73	0.86	89.86	23.27
350.10	2.89	3.73	0.84	89.70	22.99
361.40	2.93	3.71	0.78	89.58	22.56
373.00	3.00	3.69	0.69	89.34	22.09
380.90	3.06	3.65	0.59	89.15	21.75
392.10	3.15	3.59	0.44	89.05	21.23
400.00	3.24	3.54	0.30	89.06	20.85

PSCQ-2-450 350 to 450MHz



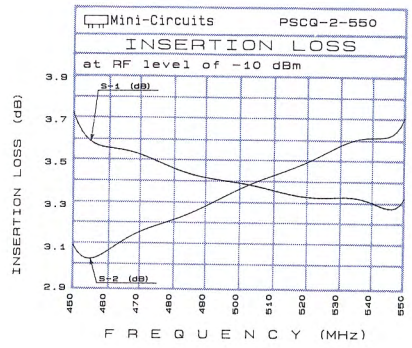


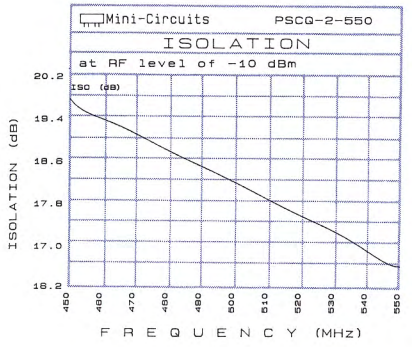


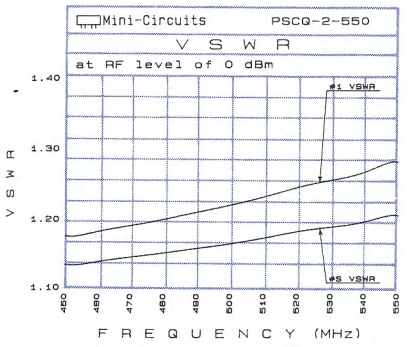
FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
350.00	3.01	3.61	0.60	90.33	26.76
355.30	3.02	3.62	0.60	90.33	26.51
360.50	3.04	3.63	0.59	90.37	26.26
365.80	3.05	3.62	0.57	90.39	26.00
371.00	3.07	3.62	0.55	90.39	25.72
381.50	3.10	3.61	0.51	90.42	25.14
392.00	3.17	3.58	0.41	90.42	24.53
400.00	3.22	3.56	0.34	90.46	24.03
410.50	3.30	3.50	0.20	90.49	23.35
415.80	3.34	3.47	0.13	90.52	23.00
421.00	3.40	3.44	0.04	90.50	22.63
426.30	3.46	3.39	0.07	90.57	22.25
431.50	3.53	3.36	0.17	90.47	21.87
442.00	3.70	3.29	0.41	90.57	21.09
450.00	3.84	3.21	0.63	90.54	20.46

Power Splitter/Combiners 50 ohms

PSCQ-2-550 450 to 550MHz

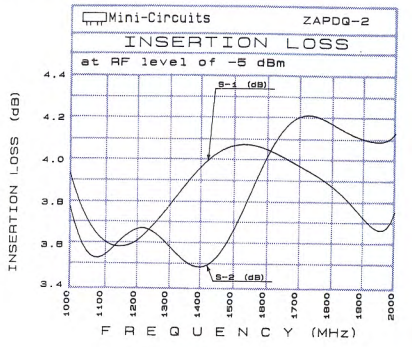


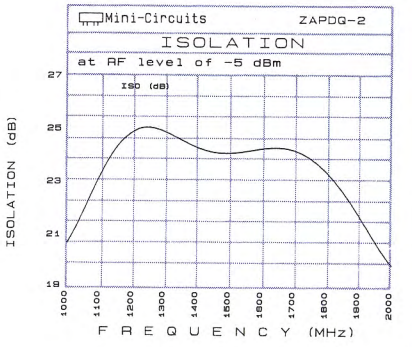


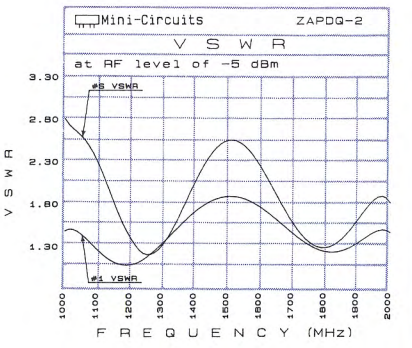


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
450.00	3.70	3.07	0.63	91.0	20
455.30	3.62	3.06	0.56	90.9	20
460.50	3.55	3.07	0.48	90.7	19
471.10	3.56	3.20	0.36	90.4	19
481.60	3.48	3.25	0.23	90.5	19
492.10	3.42	3.32	0.10	90.8	18
500.00	3.42	3.40	0.02	91.0	18
510.50	3.32	3.40	0.08	91.0	18
515.80	3.36	3.49	0.13	91.0	18
521.10	3.36	3.53	0.17	91.0	18
529.00	3.33	3.56	0.23	91.0	17
534.20	3.33	3.61	0.28	91.0	17
539.50	3.31	3.61	0.30	91.0	17
544.70	3.29	3.61	0.32	91.0	17
550.00	3.32	3.69	0.37	91.0	17

ZAPDQ-2 1 to 2.0GHz

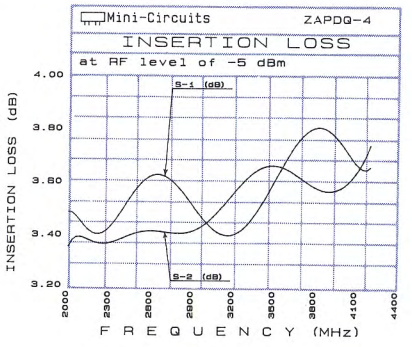


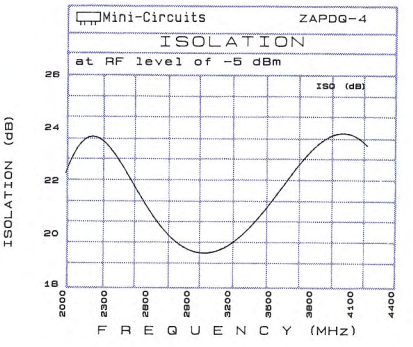


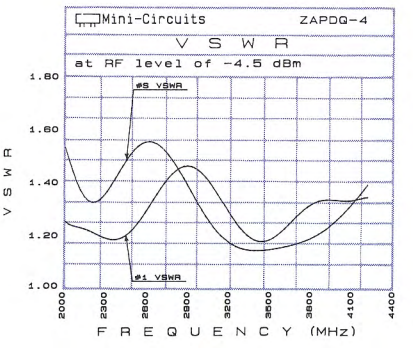


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
1000.00	3.94	3.83	0.11	93.29	20.26
1052.50	3.75	3.66	0.09	90.27	21.65
1132.50	3.61	3.61	0.00	87.98	23.62
1210.00	3.64	3.63	0.01	87.46	24.62
1290.00	3.77	3.64	0.13	87.25	24.57
1367.50	3.89	3.62	0.27	86.76	24.13
1447.50	3.96	3.63	0.33	86.05	23.75
1500.00	3.97	3.67	0.30	85.59	23.64
1580.00	3.99	3.83	0.16	85.32	23.70
1657.50	3.95	3.99	0.04	85.68	23.70
1737.50	3.91	4.14	0.23	86.70	23.38
1815.00	3.87	4.22	0.35	87.93	22.55
1895.00	3.80	4.24	0.44	88.99	21.25
1947.50	3.75	4.22	0.47	89.50	20.30
2000.00	3.73	4.18	0.45	89.89	19.31

ZAPDQ-4 2 to 4.2GHz







FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
2000.00	3.52	3.37	0.15	94.9	22.35
2126.50	3.43	3.39	0.04	94.7	23.52
2253.00	3.40	3.33	0.07	94.5	23.60
2500.50	3.62	3.53	0.09	94.3	21.85
2753.50	3.64	3.39	0.25	94.0	19.93
2880.00	3.49	3.44	0.05	93.8	19.42
3001.00	3.43	3.41	0.02	93.6	19.26
3193.50	3.41	3.56	0.15	93.4	19.58
3320.00	3.45	3.56	0.11	93.2	20.11
3501.50	3.57	3.68	0.11	93.0	21.21
3699.50	3.78	3.61	0.17	92.8	22.55
3886.50	3.82	3.58	0.24	92.6	23.58
4002.00	3.73	3.62	0.11	92.6	23.77
4139.50	3.64	3.64	0.00	92.2	23.58
4200.00	3.65	3.77	0.12	91.9	23.37

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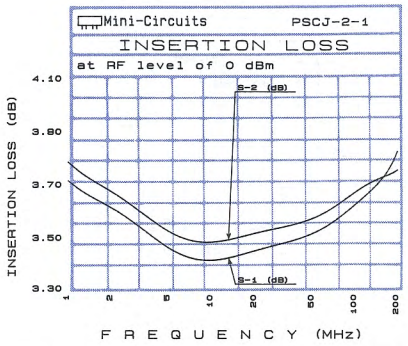
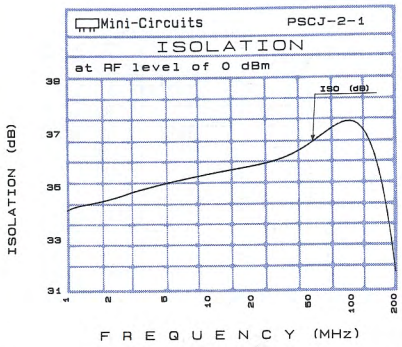
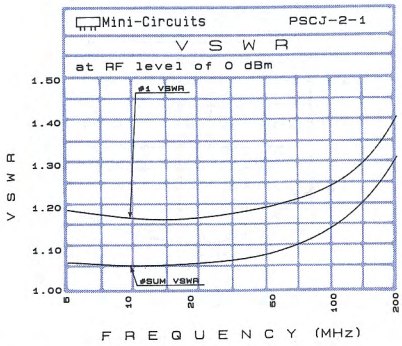
PSCJ-2-1

50 ohms

1 to 200MHz



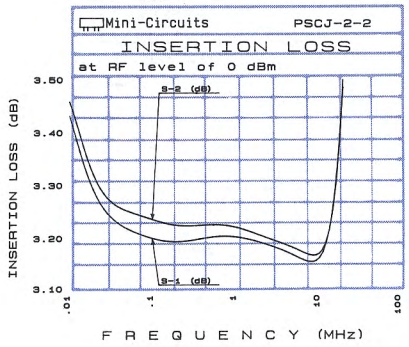


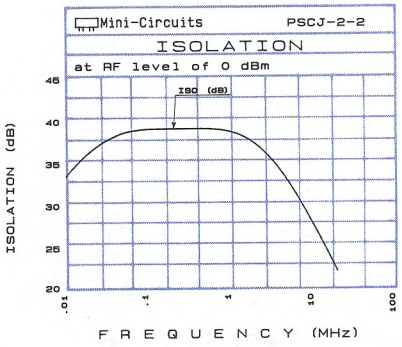


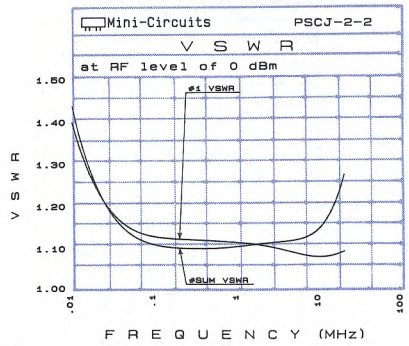
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	PHASE (DEGREES) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	3.71	3.78	0.07	34.14	180.30	5.0	1.07	1.19	1.15
5.0	3.47	3.53	0.06	35.09	180.20	10.6	1.06	1.17	1.13
10.0	3.41	3.47	0.06	35.47	180.00	20.0	1.07	1.17	1.13
19.1	3.48	3.54	0.06	35.64	179.60	27.3	1.07	1.18	1.14
31.2	3.46	3.52	0.06	36.05	179.60	44.0	1.08	1.20	1.15
43.2	3.48	3.55	0.07	36.32	179.50	50.0	1.09	1.20	1.15
50.0	3.50	3.56	0.06	36.59	179.50	60.7	1.10	1.21	1.16
67.3	3.53	3.57	0.04	37.03	179.70	77.4	1.12	1.23	1.17
85.4	3.57	3.61	0.04	37.37	179.90	94.1	1.15	1.25	1.19
100.0	3.56	3.65	0.09	37.32	180.00	105.3	1.16	1.26	1.20
121.6	3.59	3.63	0.04	37.04	180.20	127.6	1.19	1.29	1.22
151.8	3.80	3.82	0.02	35.72	180.50	155.4	1.24	1.33	1.25
175.9	3.73	3.71	0.02	33.76	180.80	177.7	1.27	1.37	1.28
187.9	3.89	3.85	0.04	33.02	180.90	188.9	1.29	1.39	1.29
200.0	3.72	3.66	0.06	31.84	181.00	200.0	1.31	1.41	1.30

PSCJ-2-2, ZMSCJ-2-2, ZSCJ-2-2, ZFSCJ-2-2

0.01 to 20MHz







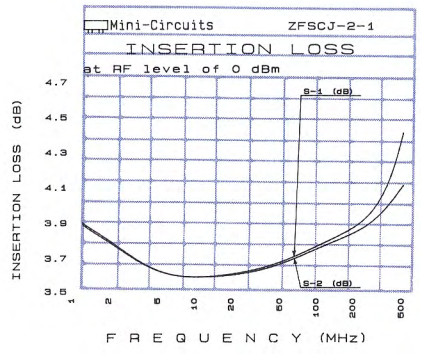
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	PHASE (DEGREES) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.01	3.43	3.46	0.03	33.63	180.3	0.01	1.43	1.39	1.42
0.1	3.21	3.25	0.04	39.14	180.3	0.1	1.11	1.13	1.13
0.5	3.22	3.24	0.02	39.23	180.2	0.5	1.10	1.12	1.12
1.0	3.20	3.22	0.02	38.87	180.2	1.0	1.11	1.11	1.11
2.0	3.18	3.20	0.02	37.49	180.2	2.0	1.11	1.11	1.10
4.0	3.16	3.18	0.02	34.41	180.1	4.0	1.12	1.09	1.09
6.0	3.16	3.20	0.04	31.89	180.0	6.0	1.12	1.09	1.08
8.0	3.17	3.19	0.02	29.81	180.0	8.0	1.13	1.08	1.08
10.0	3.14	3.15	0.01	28.07	180.0	10.0	1.14	1.08	1.07
11.3	3.16	3.18	0.02	27.08	179.9	11.3	1.16	1.08	1.07
12.7	3.20	3.21	0.01	26.18	179.9	12.7	1.17	1.08	1.07
14.0	3.22	3.22	0.00	25.35	179.8	14.0	1.19	1.09	1.07
16.0	3.30	3.30	0.00	24.24	179.7	16.0	1.22	1.09	1.07
18.0	3.39	3.37	0.02	23.24	179.6	18.0	1.25	1.09	1.07
20.0	3.46	3.44	0.02	22.36	179.5	20.0	1.26	1.09	1.07

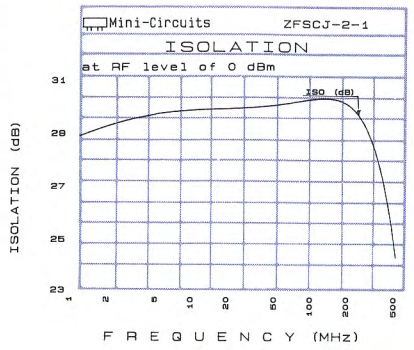
Power Splitter/Combiners

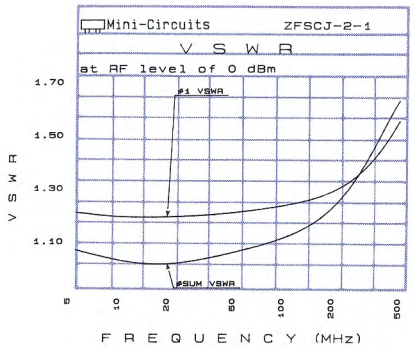
50 ohms

ZFSCJ-2-1

1 to 500MHz



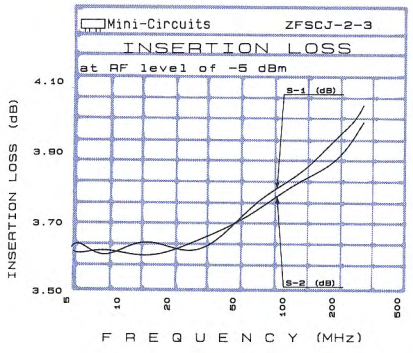


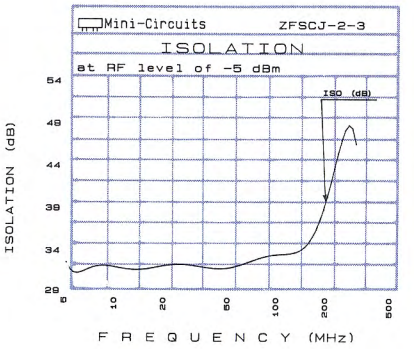


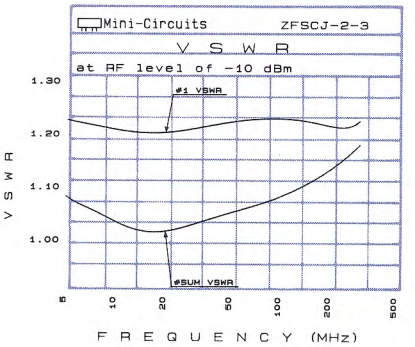
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	PHASE (Degrees) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	3.93	3.94	0.01	28.80	179.45	5.0	1.07	1.21	1.21
10.0	3.59	3.59	0.00	29.88	179.75	20.0	1.01	1.19	1.19
20.0	3.62	3.61	0.01	29.94	179.86	48.7	1.06	1.21	1.20
50.0	3.69	3.69	0.00	30.07	179.82	77.8	1.09	1.22	1.22
79.0	3.74	3.73	0.01	30.22	179.73	100.0	1.11	1.24	1.22
100.0	3.76	3.75	0.01	30.28	179.69	121.5	1.14	1.25	1.23
125.8	3.79	3.78	0.01	30.33	179.72	150.6	1.17	1.26	1.24
156.9	3.84	3.81	0.03	30.29	179.59	179.7	1.21	1.28	1.25
200.0	3.88	3.86	0.02	30.06	179.52	208.8	1.24	1.30	1.25
250.5	3.94	3.89	0.05	29.60	179.60	267.1	1.33	1.34	1.28
312.9	4.03	3.95	0.08	28.79	179.67	325.3	1.41	1.39	1.30
359.7	4.11	3.99	0.12	27.86	179.70	369.0	1.48	1.43	1.32
406.4	4.22	4.04	0.18	26.85	179.93	412.7	1.54	1.47	1.34
468.8	4.33	4.09	0.24	25.25	179.20	470.9	1.60	1.53	1.37
500.0	4.42	4.14	0.28	24.40	178.88	500.0	1.63	1.55	1.38

ZFSCJ-2-3

5 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)	PHASE (Degrees) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	3.64	3.62	0.02	31.73	179.50	5.0	1.08	1.23	1.22
10.0	3.61	3.62	0.01	32.06	179.50	10.0	1.03	1.21	1.21
13.4	3.65	3.61	0.04	32.11	179.40	13.4	1.02	1.20	1.20
20.0	3.64	3.61	0.03	32.09	179.40	20.0	1.01	1.20	1.20
30.3	3.59	3.65	0.06	32.20	179.30	30.3	1.03	1.21	1.21
50.0	3.70	3.68	0.02	32.34	179.10	50.0	1.05	1.22	1.22
64.0	3.73	3.71	0.02	32.48	179.00	64.0	1.06	1.23	1.23
89.3	3.80	3.72	0.08	33.03	178.80	89.3	1.08	1.23	1.23
100.0	3.80	3.78	0.02	33.32	178.70	100.0	1.08	1.23	1.23
123.0	3.85	3.81	0.04	34.12	178.60	123.0	1.09	1.23	1.23
148.3	3.85	3.80	0.05	35.26	178.40	148.3	1.11	1.22	1.23
198.9	3.95	3.88	0.07	39.32	178.10	198.9	1.13	1.22	1.22
249.4	3.99	3.92	0.07	48.08	177.80	249.4	1.16	1.21	1.21
274.7	3.99	3.93	0.06	51.04	177.70	274.7	1.17	1.22	1.20
300.0	4.03	4.01	0.02	43.94	177.50	300.0	1.18	1.23	1.20

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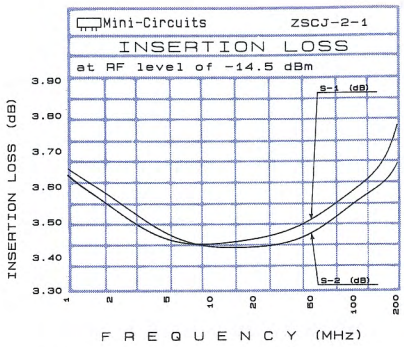
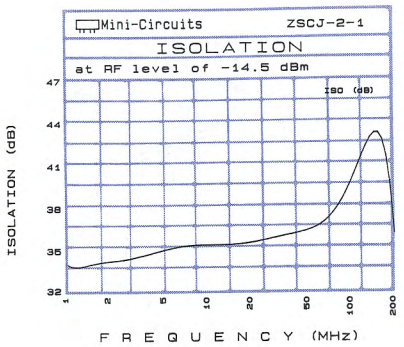
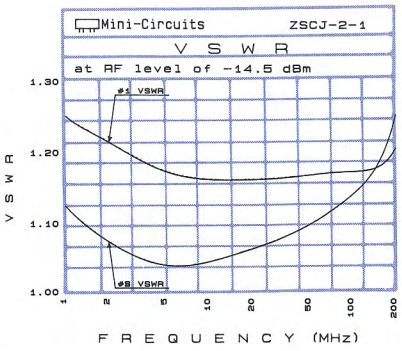
ZMSCJ-2-1, ZSCJ-2-1 — 50 ohms — 1 to 200 MHz

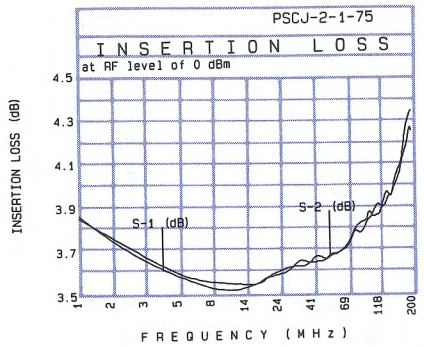


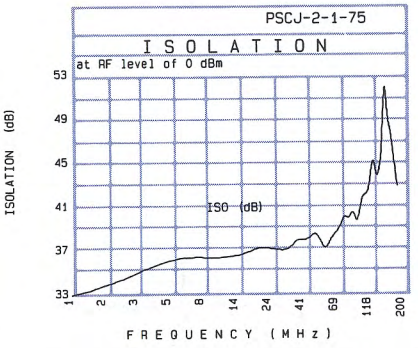


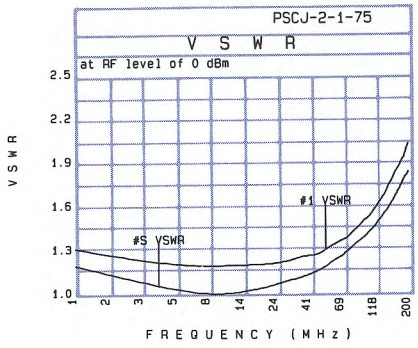


FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2	PHASE (Degrees) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	3.63	3.65	0.02	33.85	180.02	1.0	1.12	1.25	1.25
5.0	3.44	3.46	0.02	35.05	179.83	5.0	1.04	1.17	1.17
10.0	3.44	3.43	0.01	35.43	179.69	10.0	1.05	1.16	1.16
19.9	3.45	3.42	0.03	35.68	179.67	19.9	1.06	1.17	1.17
37.3	3.48	3.45	0.03	36.08	179.59	37.3	1.09	1.17	1.17
49.8	3.51	3.47	0.04	36.57	179.54	49.8	1.10	1.17	1.17
67.2	3.54	3.50	0.04	37.37	179.39	67.2	1.12	1.17	1.17
79.6	3.55	3.51	0.04	38.19	179.30	79.6	1.12	1.18	1.17
100.0	3.60	3.56	0.04	39.72	179.12	100.0	1.14	1.18	1.17
115.4	3.61	3.58	0.03	41.35	179.03	115.4	1.15	1.18	1.17
133.8	3.63	3.59	0.04	43.30	178.83	133.8	1.17	1.18	1.18
145.8	3.65	3.60	0.05	43.82	178.77	145.8	1.18	1.19	1.18
163.7	3.66	3.60	0.06	42.71	178.59	163.7	1.20	1.19	1.18
182.1	3.72	3.63	0.09	40.00	178.48	182.1	1.22	1.20	1.19
200.0	3.78	3.68	0.10	37.32	178.41	200.0	1.25	1.21	1.20

PSCJ-2-1-75 — 75 ohms — 1 to 200 MHz







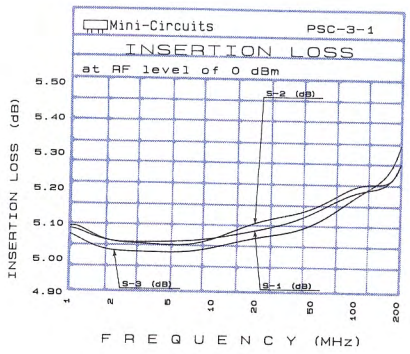
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2	PHASE (Degrees) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.000	3.87	3.88	0.01	33.14	179.95	1.000	1.21	1.33	1.33
2.000	3.73	3.70	0.03	34.46	179.93	2.000	1.12	1.26	1.26
5.000	3.58	3.58	0.00	36.84	179.68	5.000	1.03	1.21	1.21
10.000	3.57	3.52	0.05	36.42	179.85	10.000	1.01	1.21	1.20
20.000	3.60	3.60	0.00	37.62	179.89	20.000	1.06	1.22	1.22
43.000	3.66	3.70	0.04	37.97	179.54	43.000	1.16	1.28	1.28
50.000	3.66	3.66	0.00	39.06	180.00	50.000	1.19	1.30	1.30
75.000	3.77	3.76	0.01	39.53	179.66	75.000	1.31	1.40	1.41
100.000	3.90	3.85	0.05	40.57	179.62	100.000	1.41	1.53	1.51
106.000	3.85	3.87	0.02	42.33	179.87	106.000	1.44	1.54	1.54
132.000	3.93	3.98	0.05	43.58	179.86	132.000	1.55	1.68	1.68
159.000	4.04	4.06	0.02	48.85	179.67	159.000	1.67	1.83	1.83
185.000	4.18	4.28	0.10	42.52	179.46	185.000	1.80	1.94	1.96
195.000	4.28	4.33	0.05	41.63	179.69	195.000	1.83	2.02	2.03
200.000	4.25	4.34	0.09	41.48	179.50	200.000	1.85	2.04	2.05

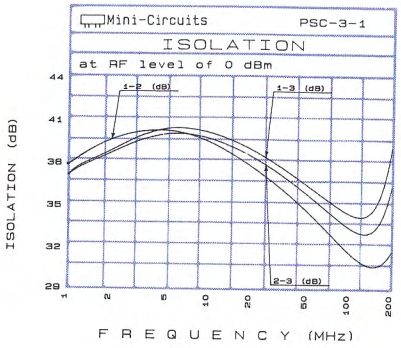
Power Splitter/Combiners

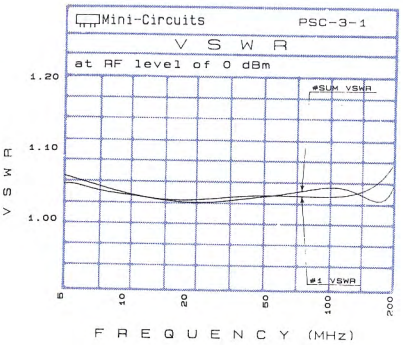
50 ohms

PSC-3-1

1 to 200 MHz



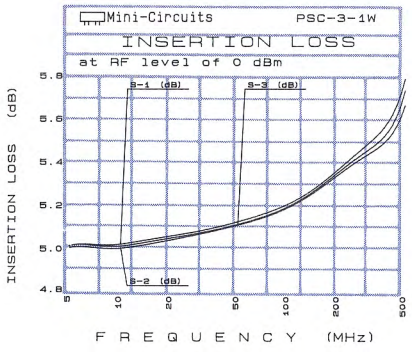


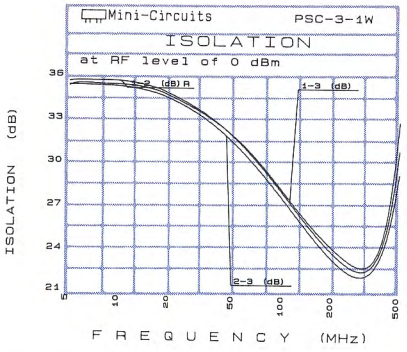


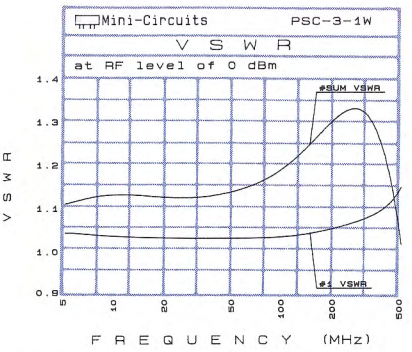
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.0	5.09	5.10	5.07	0.03	37.94	37.24	5.0	1.05	1.06	1.06	1.06
5.0	5.05	5.04	5.03	0.02	40.45	40.21	10.0	1.03	1.04	1.04	1.04
10.0	5.04	5.04	5.06	0.02	39.48	39.69	20.0	1.02	1.03	1.03	1.03
20.0	5.12	5.14	5.07	0.07	37.79	38.54	38.4	1.03	1.03	1.03	1.03
37.2	5.13	5.15	5.11	0.04	35.78	36.81	50.0	1.03	1.03	1.03	1.03
50.0	5.12	5.13	5.08	0.05	34.61	35.80	60.7	1.04	1.03	1.03	1.04
61.3	5.20	5.21	5.16	0.05	33.76	35.12	71.9	1.04	1.03	1.03	1.04
73.4	5.15	5.17	5.14	0.03	32.98	34.48	83.0	1.04	1.03	1.03	1.04
85.4	5.18	5.20	5.16	0.04	32.30	33.91	100.0	1.05	1.03	1.03	1.04
100.0	5.23	5.26	5.23	0.03	31.72	33.48	122.0	1.04	1.04	1.03	1.04
121.6	5.21	5.24	5.23	0.03	31.07	33.14	138.7	1.04	1.04	1.03	1.05
139.7	5.26	5.27	5.28	0.02	30.80	33.17	155.4	1.03	1.05	1.04	1.05
157.8	5.25	5.24	5.27	0.03	30.76	33.53	177.7	1.03	1.06	1.05	1.07
175.9	5.28	5.30	5.33	0.05	31.08	34.42	188.9	1.03	1.07	1.06	1.08
200.0	5.28	5.29	5.37	0.09	31.94	36.61	200.0	1.05	1.08	1.07	1.09

PSC-3-1W

5 to 500 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
5.000	5.02	5.01	5.02	0.01	35.07	34.76	5.000	1.11	1.04	1.06	1.05
10.000	5.02	5.00	5.01	0.02	35.10	34.70	10.000	1.14	1.04	1.04	1.04
20.000	5.06	5.04	6.05	0.02	34.31	33.99	20.000	1.12	1.03	1.04	1.03
50.000	5.12	5.10	5.11	0.02	31.21	30.83	50.000	1.14	1.03	1.04	1.03
100.000	5.19	5.17	5.18	0.02	27.21	26.78	100.000	1.19	1.04	1.04	1.04
108.980	5.20	5.18	5.19	0.02	26.67	26.24	108.980	1.21	1.04	1.04	1.04
118.860	5.22	5.21	5.21	0.01	26.13	26.70	118.860	1.22	1.04	1.04	1.04
133.700	5.28	5.26	5.27	0.02	26.41	24.98	133.700	1.25	1.04	1.05	1.05
143.600	5.31	5.30	5.30	0.01	24.97	24.58	143.600	1.26	1.04	1.05	1.06
158.450	5.34	5.31	5.32	0.03	24.36	23.97	158.450	1.27	1.05	1.06	1.06
168.360	5.33	5.31	5.32	0.02	24.04	23.61	168.360	1.27	1.06	1.06	1.06
183.200	5.33	5.31	5.32	0.02	23.67	23.46	183.200	1.28	1.08	1.06	1.06
200.000	5.32	5.30	5.31	0.02	23.13	22.72	200.000	1.28	1.06	1.06	1.06
250.000	5.50	5.46	5.43	0.04	22.29	21.88	250.000	1.36	1.07	1.07	1.07
500.000	5.78	5.66	5.73	0.12	29.75	27.81	500.000	1.07	1.15	1.12	1.12

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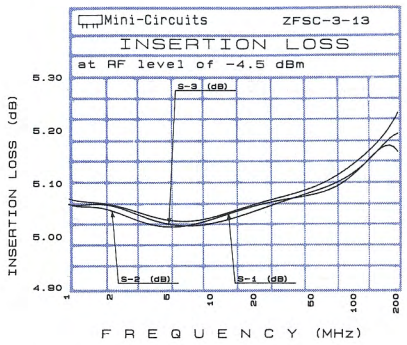
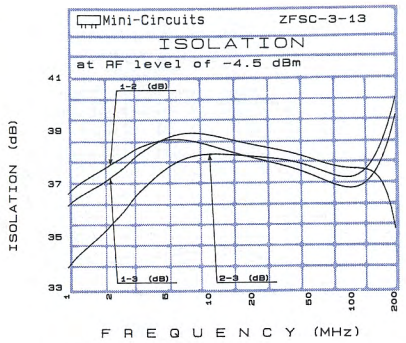
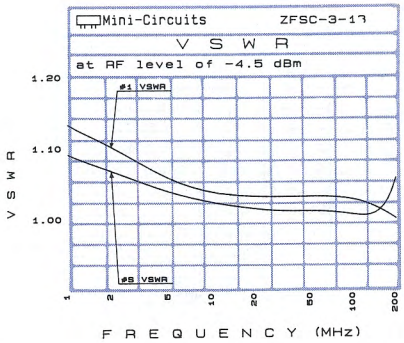
PSC-3-13, ZFSC-3-13

1 to 200MHz



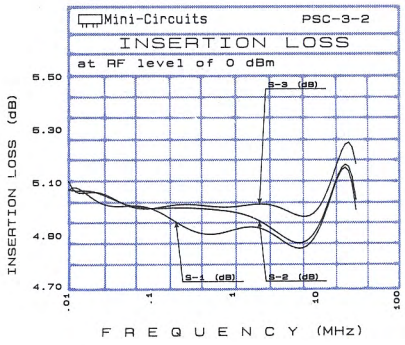


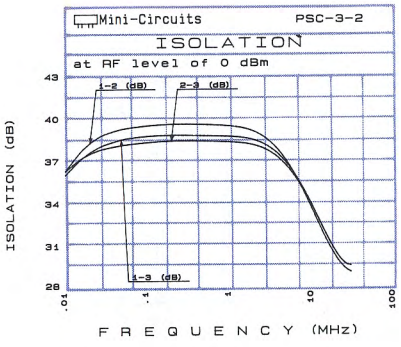


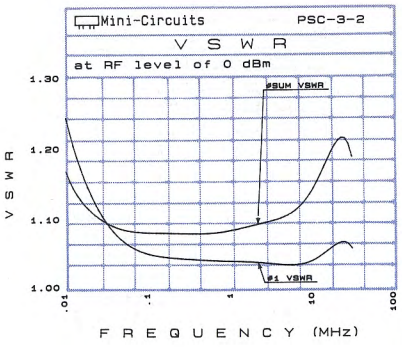
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.0	5.07	5.06	5.06	0.01	36.68	33.90	1.0	1.09	1.13	1.15	1.15
10.0	5.03	5.03	5.03	0.00	38.37	38.06	10.0	1.02	1.04	1.04	1.04
18.9	5.06	5.06	5.04	0.02	38.01	38.04	18.9	1.02	1.03	1.03	1.03
31.3	5.07	5.06	5.06	0.01	37.65	37.87	31.3	1.01	1.03	1.03	1.03
43.3	5.09	5.09	5.08	0.01	37.44	37.70	43.3	1.01	1.03	1.03	1.03
55.2	5.09	5.07	5.08	0.02	37.20	37.51	55.2	1.01	1.03	1.03	1.03
67.2	5.11	5.08	5.10	0.03	37.04	37.36	67.2	1.01	1.03	1.03	1.03
79.6	5.13	5.11	5.10	0.03	36.90	37.28	79.6	1.01	1.03	1.03	1.03
100.0	5.13	5.12	5.13	0.01	36.82	37.25	100.0	1.01	1.03	1.03	1.03
115.4	5.15	5.14	5.14	0.01	36.90	37.36	115.4	1.00	1.02	1.03	1.02
133.8	5.18	5.15	5.16	0.03	37.16	37.67	133.8	1.00	1.02	1.02	1.02
163.7	5.20	5.17	5.17	0.03	38.02	38.68	163.7	1.02	1.01	1.02	1.01
176.1	5.21	5.17	5.18	0.04	38.51	39.23	176.1	1.03	1.01	1.01	1.01
188.1	5.21	5.16	5.18	0.05	39.01	39.68	188.1	1.04	1.00	1.01	1.01
200.0	5.24	5.18	5.21	0.06	39.33	39.92	200.0	1.05	1.00	1.01	1.01

PSC-3-2, ZMSC-3-2, ZSC-3-2

0.01 to 30MHz







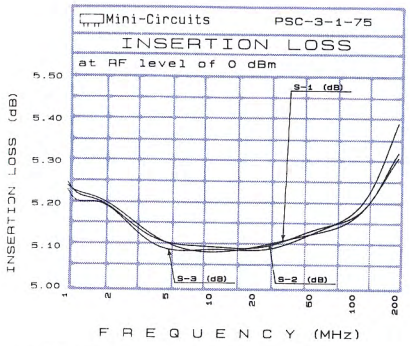
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
0.01	4.98	5.00	5.00	0.02	36.10	36.00	0.01	1.17	1.28	1.29	1.29
0.1	4.85	4.85	4.85	0.00	39.00	38.00	0.1	1.07	1.06	1.05	1.05
0.5	4.82	4.82	4.82	0.00	40.00	39.00	0.5	1.02	1.02	1.01	1.02
1.1	4.84	4.85	4.84	0.01	40.10	39.00	1.1	1.03	1.02	1.02	1.03
3.1	4.88	4.89	4.89	0.01	38.00	37.00	3.1	1.07	1.05	1.05	1.05
5.0	4.90	4.90	4.90	0.00	38.93	38.72	5.0	1.08	1.05	1.05	1.05
7.3	4.94	4.94	4.94	0.00	36.19	35.97	7.3	1.10	1.07	1.07	1.07
10.0	4.99	4.97	4.98	0.02	33.99	33.78	10.0	1.11	1.08	1.07	1.08
12.5	5.01	5.00	5.01	0.01	32.52	32.23	12.5	1.11	1.08	1.08	1.08
15.5	5.06	5.05	5.05	0.01	31.03	30.79	15.5	1.11	1.09	1.09	1.09
18.6	5.10	5.08	5.09	0.02	29.90	29.68	18.6	1.11	1.09	1.09	1.10
20.7	5.12	5.11	5.11	0.01	29.33	29.12	20.7	1.11	1.10	1.10	1.10
23.8	5.16	5.14	5.14	0.02	28.66	28.47	23.8	1.11	1.11	1.11	1.11
26.9	5.22	5.20	5.20	0.02	28.18	28.01	26.9	1.12	1.12	1.12	1.12
30.0	5.25	5.23	5.24	0.02	27.85	27.00	30.0	1.13	1.13	1.13	1.13

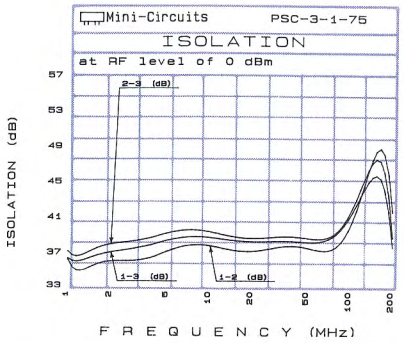
Power Splitter/Combiners

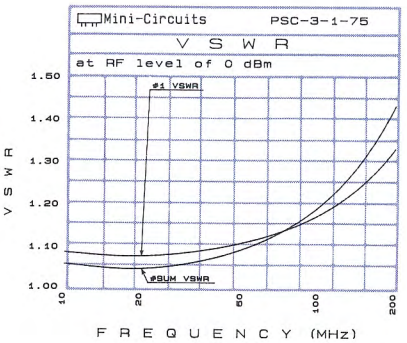
75 ohms

PSC-3-1-75 ,ZSC-3-1-75

1 to 200MHz



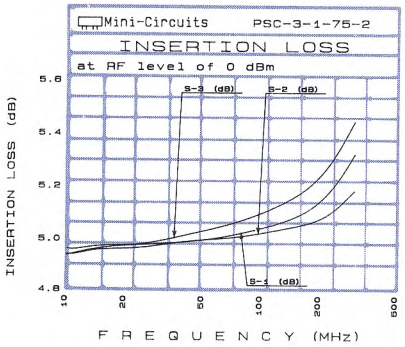


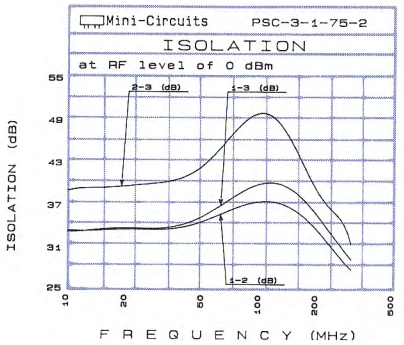


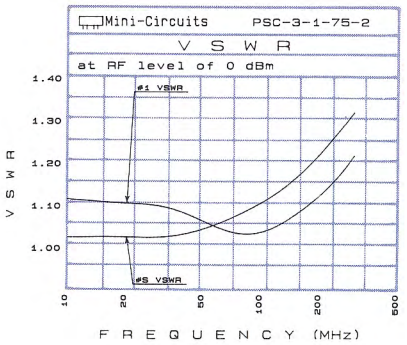
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.0	5.24	5.24	5.22	0.02	35.20	36.51	10.0	1.06	1.09	1.09	1.08
5.0	5.10	5.10	5.08	0.02	37.18	39.25	20.0	1.05	1.08	1.08	1.08
10.0	5.09	5.08	5.09	0.01	37.61	39.22	25.8	1.05	1.08	1.08	1.08
19.1	5.10	5.09	5.09	0.01	37.46	38.78	36.4	1.07	1.09	1.09	1.09
31.2	5.12	5.12	5.10	0.02	37.21	38.48	50.0	1.09	1.11	1.11	1.11
43.2	5.14	5.13	5.13	0.01	37.26	38.48	57.5	1.11	1.12	1.12	1.12
50.0	5.15	5.12	5.13	0.03	37.32	38.55	68.1	1.13	1.13	1.13	1.13
67.3	5.15	5.15	5.15	0.00	37.79	39.06	83.9	1.16	1.15	1.15	1.16
85.4	5.15	5.14	5.16	0.02	38.78	40.02	99.7	1.19	1.17	1.18	1.18
100.0	5.17	5.17	5.18	0.01	39.87	41.15	110.3	1.22	1.19	1.19	1.19
121.6	5.18	5.18	5.21	0.03	42.31	43.70	131.4	1.26	1.22	1.22	1.23
151.8	5.25	5.25	5.29	0.04	49.53	49.09	157.8	1.33	1.26	1.26	1.27
175.9	5.27	5.27	5.34	0.07	48.76	45.34	178.9	1.38	1.30	1.30	1.31
187.9	5.30	5.30	5.37	0.07	44.21	42.22	189.5	1.41	1.31	1.32	1.33
200.0	5.34	5.32	5.40	0.08	41.15	39.78	200.0	1.43	1.33	1.33	1.34

PSC-3-1-75-2

10 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
10.0	4.94	4.94	4.96	0.02	33.48	39.30	10.0	1.03	1.12	1.12	1.12
20.1	4.97	4.96	4.98	0.02	33.85	39.84	20.1	1.03	1.11	1.11	1.11
44.0	4.99	4.99	5.02	0.03	34.30	42.00	44.0	1.04	1.08	1.07	1.07
69.4	5.02	5.01	5.07	0.06	36.57	46.49	69.4	1.07	1.04	1.04	1.05
99.9	5.04	5.02	5.10	0.08	37.76	51.00	99.9	1.11	1.04	1.05	1.06
120.9	5.06	5.04	5.13	0.09	37.54	48.66	120.9	1.13	1.05	1.07	1.08
155.0	5.09	5.05	5.17	0.12	36.45	44.24	155.0	1.17	1.08	1.11	1.12
172.4	5.10	5.05	5.20	0.15	35.04	42.46	172.4	1.19	1.10	1.12	1.13
197.7	5.13	5.07	5.23	0.16	33.55	39.67	197.7	1.22	1.12	1.15	1.16
214.4	5.18	5.09	5.27	0.18	32.63	38.17	214.4	1.24	1.14	1.17	1.18
231.8	5.19	5.10	5.29	0.19	31.48	36.90	231.8	1.26	1.16	1.19	1.20
248.5	5.21	5.12	5.33	0.21	30.58	35.62	248.5	1.27	1.17	1.20	1.22
265.9	5.26	5.15	5.38	0.23	29.64	34.60	265.9	1.29	1.19	1.22	1.24
282.6	5.29	5.17	5.41	0.24	28.80	33.58	282.6	1.30	1.20	1.24	1.25
300.0	5.32	5.18	5.45	0.27	27.89	32.62	300.0	1.32	1.22	1.26	1.27

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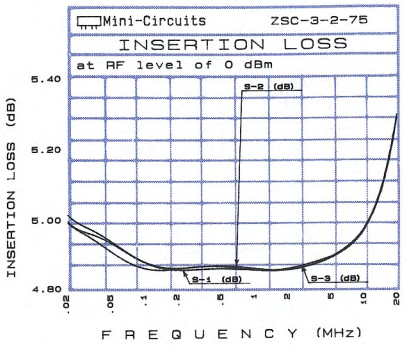
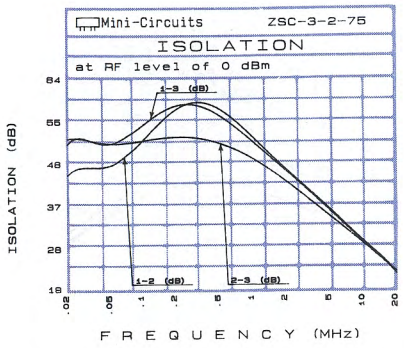
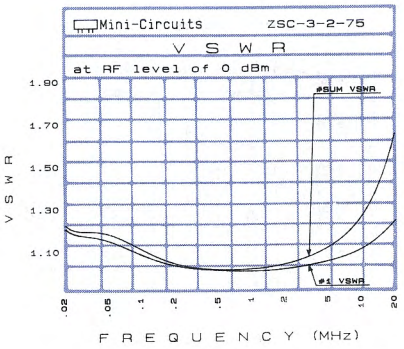
ZSC-3-2-75

0.02 to 20MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
0.02	4.99	5.01	4.99	0.02	44.31	51.62	0.02	1.21	1.20	1.20	1.21
0.1	4.91	4.91	4.88	0.03	46.77	50.07	0.1	1.16	1.13	1.13	1.14
0.2	4.86	4.87	4.87	0.01	58.93	51.89	0.2	1.04	1.03	1.03	1.03
1.0	4.87	4.87	4.87	0.00	51.53	47.09	1.0	1.02	1.00	1.01	1.01
2.0	4.86	4.86	4.86	0.00	44.91	42.25	2.0	1.04	1.02	1.02	1.01
3.3	4.88	4.88	4.88	0.00	40.35	38.45	3.3	1.07	1.03	1.03	1.03
5.0	4.89	4.90	4.89	0.01	36.29	34.93	5.0	1.12	1.05	1.05	1.05
7.1	4.92	4.94	4.92	0.02	33.00	32.02	7.1	1.18	1.07	1.08	1.08
9.1	4.96	4.97	4.95	0.02	30.71	29.97	9.1	1.24	1.10	1.10	1.10
10.0	4.99	4.98	4.99	0.01	29.77	29.14	10.0	1.27	1.11	1.11	1.11
11.0	4.99	4.98	4.99	0.01	28.89	28.33	11.0	1.29	1.12	1.12	1.12
12.9	5.05	5.04	5.06	0.02	27.35	26.98	12.9	1.36	1.15	1.15	1.15
15.5	5.12	5.11	5.12	0.01	25.56	25.37	15.5	1.46	1.18	1.18	1.18
18.1	5.24	5.22	5.23	0.02	24.08	24.05	18.1	1.57	1.21	1.22	1.22
20.0	5.28	5.29	5.29	0.01	23.06	23.12	20.0	1.65	1.24	1.24	1.24

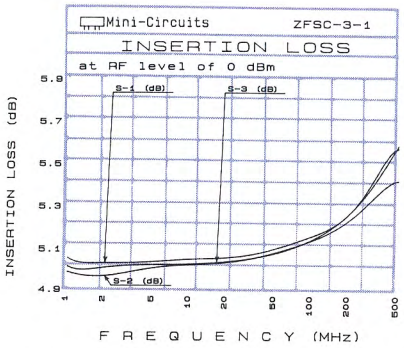
3WAY-0°

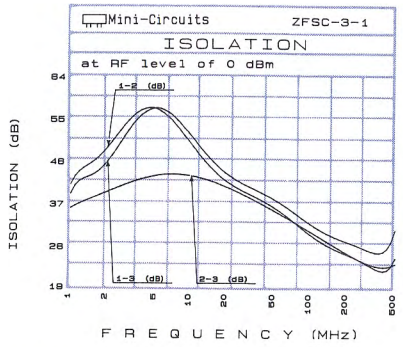
Power Splitter/Combiners

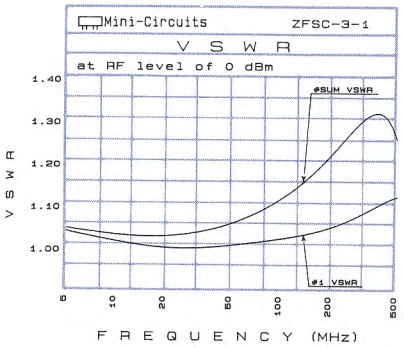
50 ohms

ZFSC-3-1

1 to 500MHz



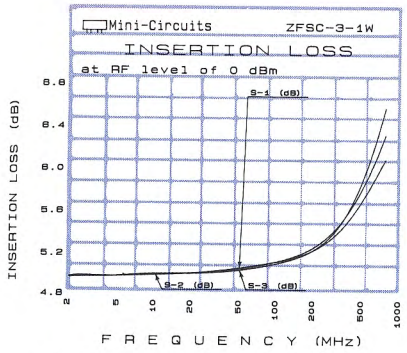


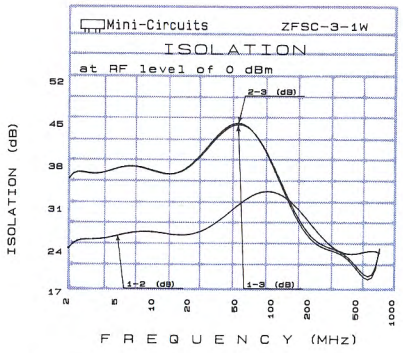


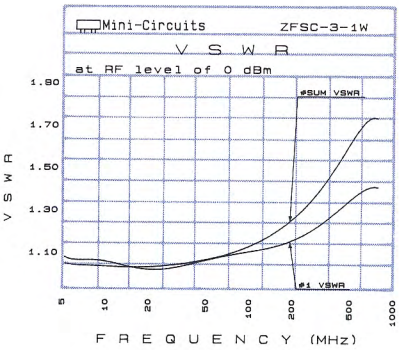
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.0	5.05	4.99	5.01	0.06	41.99	36.39	5.0	1.05	1.04	1.05	1.05
10.0	5.04	5.02	5.01	0.03	48.39	43.21	10.0	1.04	1.02	1.02	1.03
20.0	5.09	5.06	5.06	0.03	42.54	40.71	20.0	1.03	1.00	1.01	1.01
50.0	5.08	5.07	5.05	0.03	35.84	35.70	50.0	1.06	1.01	1.02	1.02
79.0	5.16	5.13	5.13	0.03	32.63	32.85	77.8	1.09	1.02	1.02	1.04
100.0	5.20	5.21	5.21	0.01	30.98	31.29	100.0	1.12	1.03	1.03	1.04
125.8	5.19	5.16	5.18	0.03	29.40	29.72	121.5	1.14	1.03	1.03	1.05
156.9	5.24	5.20	5.24	0.04	27.83	28.28	165.2	1.19	1.04	1.04	1.07
200.0	5.38	5.33	5.34	0.05	26.26	26.70	200.0	1.22	1.05	1.04	1.08
250.5	5.29	5.23	5.30	0.07	24.93	25.38	252.5	1.27	1.07	1.05	1.09
312.9	5.49	5.42	5.48	0.07	23.99	24.40	310.7	1.30	1.09	1.06	1.10
359.7	5.46	5.34	5.43	0.12	23.55	23.92	354.4	1.32	1.10	1.07	1.11
406.4	5.47	5.34	5.44	0.13	23.54	23.85	412.7	1.32	1.11	1.07	1.11
468.8	5.65	5.51	5.65	0.14	24.09	24.25	470.9	1.29	1.12	1.08	1.10
500.0	5.54	5.36	5.53	0.18	24.52	24.53	500.0	1.26	1.12	1.08	1.09

ZFSC-3-1W

2 to 750MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
2.0	4.99	4.98	4.98	0.01	25.40	36.77	5.0	1.05	1.07	1.58	1.69
5.0	4.99	4.99	4.99	0.00	26.98	37.66	50.0	1.07	1.06	1.05	1.06
50.0	5.06	5.06	5.05	0.01	31.27	46.00	100.0	1.13	1.11	1.07	1.05
100.0	5.12	5.12	5.12	0.00	34.64	35.87	163.0	1.22	1.14	1.13	1.09
142.3	5.20	5.17	5.16	0.04	31.77	31.10	200.0	1.27	1.16	1.16	1.13
200.0	5.28	5.25	5.26	0.03	28.56	27.58	253.3	1.34	1.20	1.20	1.19
259.1	5.35	5.31	5.32	0.04	26.40	25.22	298.5	1.40	1.23	1.23	1.25
305.9	5.44	5.39	5.44	0.05	25.29	23.90	366.2	1.48	1.28	1.28	1.36
399.4	5.63	5.53	5.64	0.11	24.02	22.08	411.4	1.53	1.31	1.31	1.45
446.1	5.71	5.63	5.76	0.13	23.75	21.50	500.0	1.63	1.36	1.36	1.64
500.0	5.85	5.73	5.94	0.21	23.70	21.05	569.4	1.68	1.39	1.40	1.83
563.0	5.95	5.82	6.07	0.25	23.90	20.78	614.6	1.72	1.40	1.41	1.97
609.8	6.04	5.88	6.20	0.32	24.18	20.78	659.7	1.73	1.41	1.42	2.10
656.5	6.06	5.68	5.83	0.38	24.42	20.93	704.9	1.74	1.41	1.42	2.25
750.0	6.16	5.59	5.79	0.57	24.02	21.85	750.0	1.73	1.40	1.41	2.38

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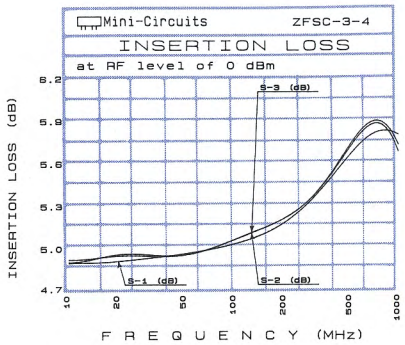
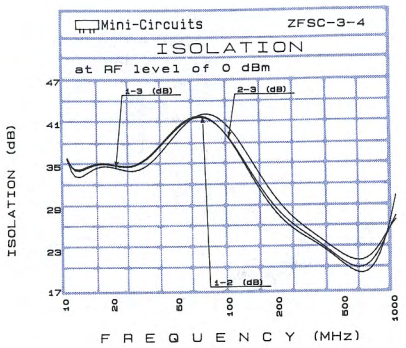
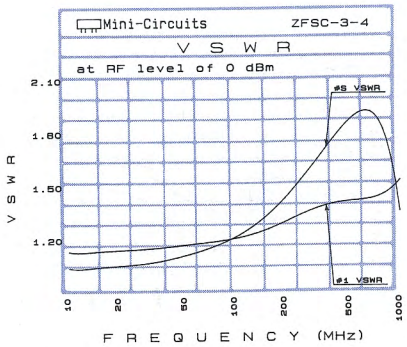
ZFSC-3-4

1 to 1000MHz



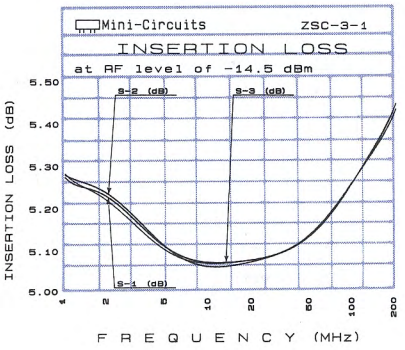


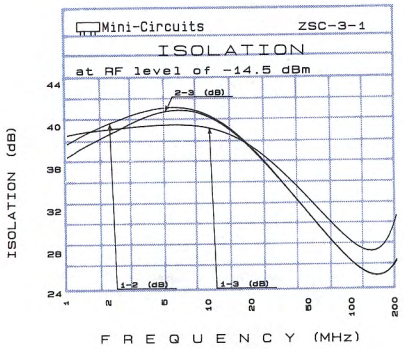


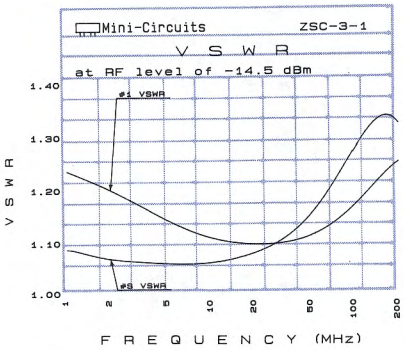
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
10.0	4.90	4.92	4.90	0.02	35.01	35.09	10.0	1.04	1.13	1.13	1.13
20.0	4.91	4.95	4.96	0.05	34.89	35.05	20.0	1.05	1.14	1.14	1.14
50.0	4.97	4.96	4.95	0.02	40.12	40.41	50.0	1.11	1.17	1.18	1.18
68.2	4.99	4.98	4.98	0.01	43.64	44.12	68.2	1.15	1.18	1.19	1.19
100.0	5.01	5.07	5.06	0.06	38.20	37.75	100.0	1.22	1.21	1.22	1.22
200.0	5.19	5.22	5.20	0.03	28.75	28.28	200.0	1.43	1.30	1.32	1.31
300.9	5.42	5.40	5.42	0.02	24.93	24.48	300.9	1.63	1.37	1.41	1.38
417.2	5.58	5.58	5.62	0.04	22.43	21.96	417.2	1.81	1.42	1.46	1.43
500.0	5.69	5.74	5.74	0.05	21.41	20.93	500.0	1.88	1.42	1.47	1.44
591.8	5.78	5.82	5.86	0.08	20.87	20.34	591.8	1.92	1.42	1.47	1.44
649.9	5.82	5.90	5.90	0.08	20.90	20.33	649.9	1.92	1.42	1.47	1.44
766.3	5.80	5.84	5.85	0.05	21.93	21.23	766.3	1.87	1.45	1.49	1.48
824.5	5.82	5.89	5.91	0.09	23.37	22.63	824.5	1.80	1.47	1.50	1.50
940.8	5.79	5.74	5.79	0.05	28.05	29.33	940.8	1.54	1.52	1.52	1.56
1000.0	5.81	5.73	5.76	0.08	25.03	28.13	1000.0	1.36	1.49	1.48	1.55

ZSC-3-1, ZMSC-3-1

1 to 200MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.0	5.27	5.28	5.28	0.01	38.39	37.14	1.0	1.09	1.24	1.25	1.24
5.0	5.11	5.11	5.10	0.01	41.87	41.54	5.0	1.06	1.14	1.14	1.14
10.0	5.07	5.06	5.07	0.01	41.02	40.81	10.0	1.06	1.11	1.11	1.11
19.9	5.08	5.09	5.08	0.01	37.88	37.72	19.9	1.08	1.10	1.10	1.10
37.3	5.11	5.10	5.11	0.01	33.57	33.56	37.3	1.12	1.11	1.11	1.11
49.8	5.14	5.14	5.14	0.00	31.51	31.54	49.8	1.15	1.11	1.12	1.11
67.2	5.19	5.19	5.19	0.00	29.41	29.44	67.2	1.20	1.13	1.14	1.13
79.6	5.23	5.23	5.23	0.00	28.29	28.32	79.6	1.23	1.15	1.16	1.15
100.0	5.26	5.26	5.26	0.00	26.97	26.97	100.0	1.28	1.17	1.18	1.17
115.4	5.29	5.29	5.30	0.01	26.31	26.31	115.4	1.31	1.19	1.20	1.18
133.8	5.34	5.33	5.33	0.01	25.84	25.89	133.8	1.33	1.21	1.22	1.20
145.8	5.34	5.36	5.35	0.02	25.76	25.79	145.8	1.34	1.22	1.24	1.21
163.7	5.39	5.40	5.39	0.01	25.93	25.95	163.7	1.34	1.23	1.25	1.22
182.1	5.40	5.41	5.42	0.02	26.46	26.44	182.1	1.33	1.25	1.27	1.24
200.0	5.42	5.44	5.44	0.02	27.17	27.04	200.0	1.33	1.25	1.28	1.25

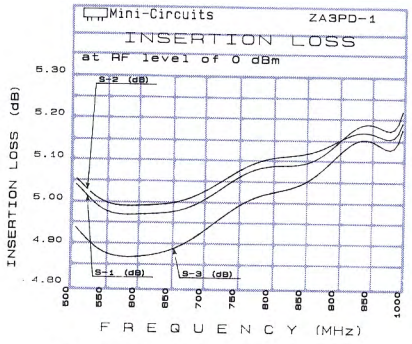
3WAY-0°

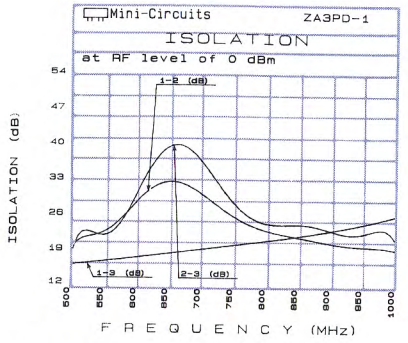
Power Splitter/Combiners

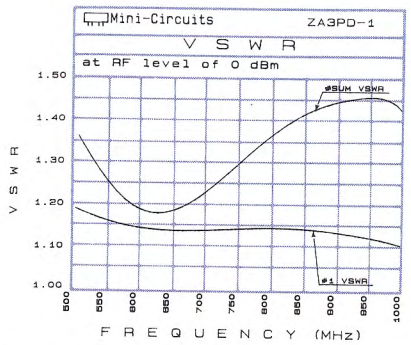
50 ohms

ZA3PD-1

0.5 to 1.0GHz



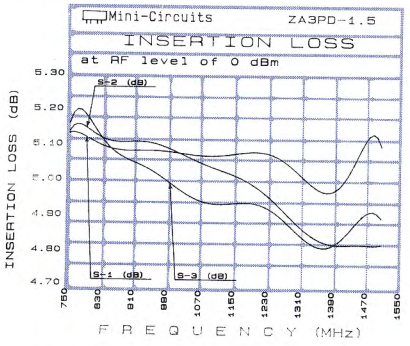


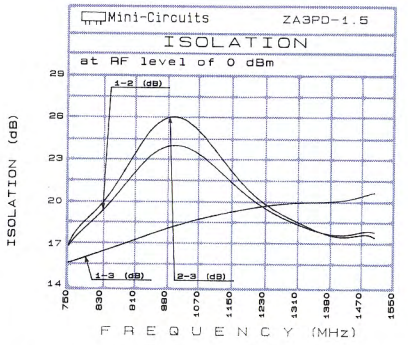


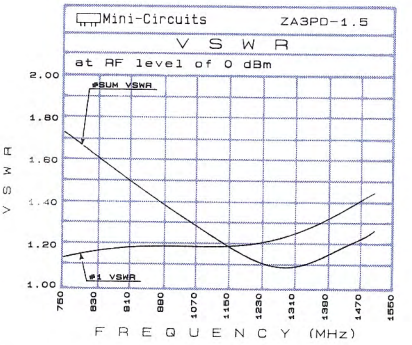
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
500.0	5.04	5.06	4.94	0.12	19.41	19.57	500.0	1.39	1.19	1.18	1.15
540.0	4.98	5.00	4.88	0.12	21.98	22.14	540.0	1.29	1.17	1.18	1.13
578.8	4.96	4.99	4.87	0.12	25.27	25.61	578.8	1.22	1.15	1.18	1.12
605.0	4.96	4.98	4.86	0.12	28.11	28.93	605.0	1.19	1.14	1.18	1.12
657.5	4.97	4.99	4.89	0.10	33.18	38.40	657.5	1.19	1.14	1.17	1.13
710.0	5.02	5.04	4.95	0.09	28.68	32.65	710.0	1.24	1.14	1.15	1.14
750.0	5.04	5.06	4.98	0.08	25.48	27.94	750.0	1.29	1.14	1.14	1.15
776.3	5.07	5.08	5.01	0.07	23.99	26.18	776.3	1.33	1.14	1.13	1.15
802.5	5.10	5.11	5.03	0.08	22.83	24.91	802.5	1.36	1.15	1.13	1.15
855.0	5.08	5.11	5.04	0.07	21.16	23.33	855.0	1.42	1.14	1.13	1.15
907.5	5.17	5.16	5.13	0.04	20.16	22.62	907.5	1.44	1.14	1.13	1.14
933.8	5.17	5.16	5.14	0.03	19.79	22.45	933.8	1.46	1.13	1.15	1.13
960.0	5.17	5.15	5.13	0.04	19.52	22.41	960.0	1.46	1.12	1.16	1.12
986.3	5.18	5.16	5.13	0.05	19.28	22.44	986.3	1.44	1.11	1.17	1.12
1000.0	5.19	5.17	5.15	0.04	19.16	22.43	1000.0	1.43	1.11	1.18	1.11

ZA3PD-1.5

0.75 to 1.5GHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
750.0	5.13	5.15	5.19	0.06	17.00	17.28	750.0	1.74	1.14	1.72	1.17
810.0	5.10	5.13	5.16	0.06	18.74	19.25	810.0	1.65	1.17	1.75	1.19
871.9	5.08	5.10	5.05	0.05	20.79	21.70	871.9	1.56	1.19	1.74	1.21
931.9	5.08	5.10	5.05	0.05	22.80	24.35	931.9	1.48	1.20	1.74	1.22
993.8	5.09	5.09	4.98	0.11	24.02	26.15	993.8	1.39	1.20	1.69	1.22
1033.1	5.07	5.07	4.96	0.11	23.94	25.91	1033.1	1.34	1.20	1.67	1.22
1095.0	5.06	5.04	4.93	0.13	22.71	23.97	1095.0	1.26	1.20	1.62	1.21
1155.0	5.08	5.01	4.93	0.15	21.22	21.93	1155.0	1.19	1.20	1.57	1.22
1200.0	5.07	4.98	4.95	0.12	20.20	20.65	1200.0	1.15	1.21	1.52	1.22
1256.3	5.04	4.92	4.88	0.16	19.16	19.42	1256.3	1.11	1.23	1.48	1.25
1318.1	5.02	4.86	4.84	0.18	18.37	18.46	1318.1	1.11	1.27	1.44	1.28
1378.1	4.95	4.82	4.80	0.15	17.83	17.82	1378.1	1.15	1.32	1.42	1.33
1440.0	5.07	4.82	4.89	0.25	17.81	17.63	1440.0	1.21	1.39	1.42	1.41
1479.4	5.13	4.82	4.91	0.31	17.95	17.70	1479.4	1.25	1.43	1.44	1.45
1500.0	5.12	4.82	4.91	0.30	18.07	17.78	1500.0	1.27	1.46	1.45	1.47

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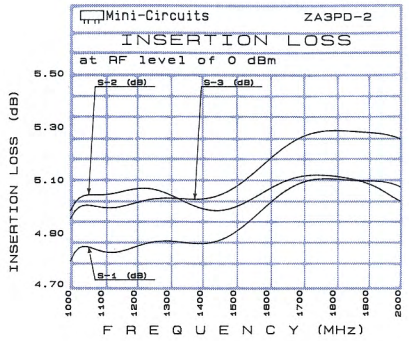
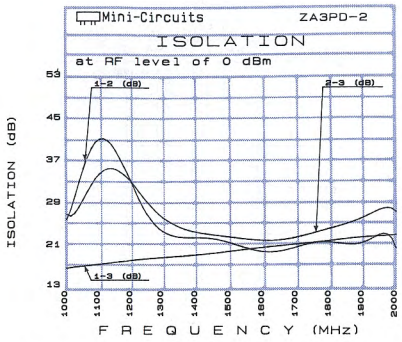
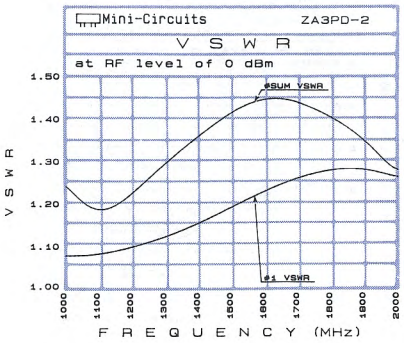
ZA3PD-2

1 to 2.0GHz



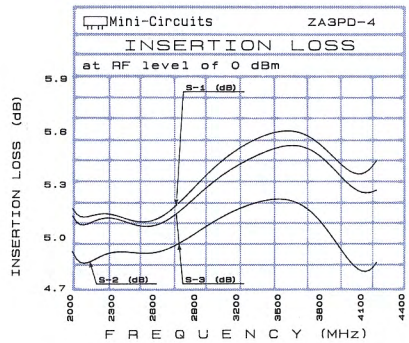


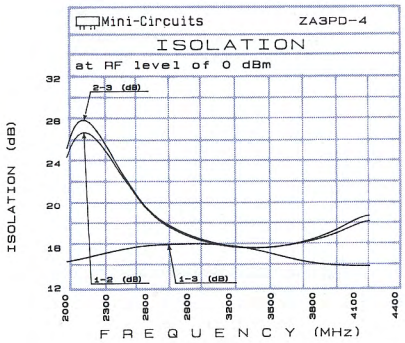


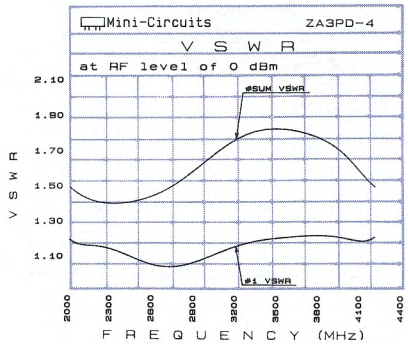
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1000.0	4.83	5.01	4.98	0.18	27.50	25.72	1000.0	1.25	1.08	1.24	1.12
1080.0	4.84	5.04	5.00	0.20	38.28	32.03	1080.0	1.19	1.08	1.20	1.12
1135.0	4.84	5.06	5.01	0.22	40.87	36.47	1135.0	1.19	1.09	1.17	1.13
1190.0	4.84	5.06	5.00	0.22	31.38	33.06	1190.0	1.22	1.10	1.13	1.13
1270.0	4.86	5.05	5.02	0.19	25.97	27.59	1270.0	1.27	1.11	1.07	1.15
1352.5	4.89	5.03	5.05	0.16	23.05	24.48	1352.5	1.33	1.14	1.02	1.16
1460.0	4.87	4.99	5.04	0.17	21.08	22.49	1460.0	1.40	1.18	1.09	1.20
1500.0	4.89	4.99	5.06	0.17	20.72	22.16	1500.0	1.42	1.19	1.12	1.21
1540.0	4.94	5.02	5.11	0.17	20.47	21.95	1540.0	1.44	1.21	1.16	1.22
1647.5	5.09	5.12	5.25	0.16	20.27	22.01	1647.5	1.44	1.25	1.27	1.25
1757.5	5.11	5.13	5.29	0.18	20.72	23.12	1757.5	1.42	1.27	1.37	1.27
1810.0	5.10	5.11	5.28	0.18	21.14	24.08	1810.0	1.41	1.29	1.44	1.28
1865.0	5.12	5.12	5.31	0.19	21.61	25.34	1865.0	1.36	1.28	1.47	1.27
1920.0	5.08	5.06	5.26	0.20	22.02	26.72	1920.0	1.34	1.28	1.53	1.27
2000.0	5.07	5.01	5.25	0.24	22.24	27.72	2000.0	1.28	1.27	1.59	1.25

ZA3PD-4

2 to 4.2GHz





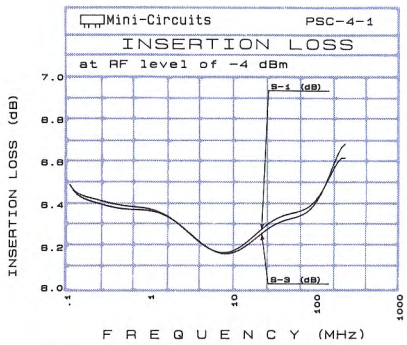


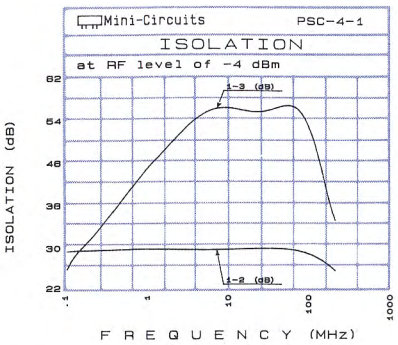
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
2000.0	5.14	4.88	5.09	0.26	24.98	25.94	2000.0	1.49	1.18	1.64	1.18
2253.0	5.13	4.90	5.11	0.23	25.78	26.45	2253.0	1.40	1.14	1.54	1.15
2440.0	5.11	4.93	5.09	0.18	22.14	22.35	2440.0	1.41	1.10	1.46	1.11
2627.0	5.09	4.89	5.06	0.20	19.31	19.40	2627.0	1.45	1.04	1.32	1.06
2753.5	5.20	4.97	5.14	0.23	18.03	18.18	2753.5	1.51	1.03	1.24	1.03
2880.0	5.25	5.01	5.20	0.24	17.14	17.28	2880.0	1.58	1.06	1.16	1.05
3001.0	5.34	5.05	5.26	0.29	16.54	16.64	3001.0	1.65	1.10	1.10	1.09
3067.0	5.42	5.09	5.33	0.33	16.34	16.43	3067.0	1.69	1.12	1.07	1.11
3320.0	5.56	5.21	5.47	0.35	15.91	15.97	3320.0	1.80	1.18	1.03	1.19
3446.5	5.52	5.14	5.43	0.38	15.92	15.94	3446.5	1.82	1.20	1.06	1.22
3507.0	5.56	5.17	5.47	0.39	16.02	16.04	3507.0	1.82	1.20	1.07	1.23
3760.0	5.55	5.13	5.49	0.42	16.62	16.53	3760.0	1.79	1.22	1.14	1.30
4002.0	5.37	4.85	5.30	0.52	17.93	17.54	4002.0	1.66	1.20	1.16	1.30
4073.5	5.37	4.82	5.27	0.55	18.38	17.91	4073.5	1.60	1.19	1.15	1.29
4200.0	5.39	4.80	5.23	0.59	19.03	18.50	4200.0	1.49	1.20	1.13	1.28

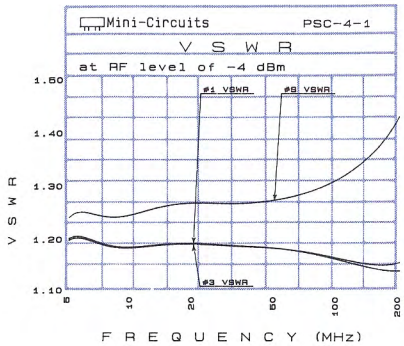
4 WAY-0°
Power Splitter/Combiners 50 ohms

PSC-4-1

0.1 to 200MHz



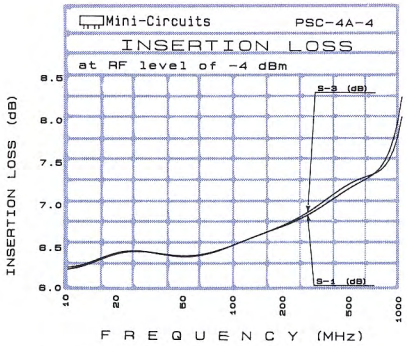


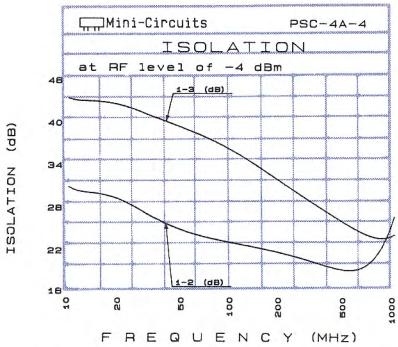


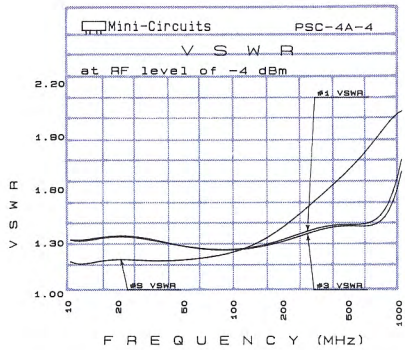
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.1	6.48	6.47	6.48	6.50	0.03	29.44	26.57	28.60	5.0	1.25	1.21	1.21	1.20	1.21
0.5	6.40	6.38	6.39	6.39	0.02	29.80	39.84	29.37	10.6	1.25	1.18	1.18	1.18	1.19
1.0	6.38	6.36	6.36	6.36	0.02	29.90	45.33	29.56	16.1	1.27	1.19	1.20	1.19	1.20
10.0	6.11	6.12	6.11	6.11	0.01	29.87	56.00	30.03	32.9	1.26	1.19	1.19	1.19	1.19
20.0	6.42	6.42	6.38	6.42	0.04	29.92	56.00	30.12	44.0	1.27	1.19	1.19	1.19	1.19
40.1	6.43	6.44	6.41	6.44	0.03	29.95	56.00	30.25	60.7	1.29	1.19	1.19	1.19	1.19
50.0	6.26	6.28	6.25	6.28	0.03	29.91	56.00	30.27	71.9	1.28	1.17	1.17	1.17	1.18
60.1	6.45	6.45	6.42	6.45	0.03	29.70	56.00	30.13	83.0	1.30	1.17	1.17	1.17	1.18
80.1	6.46	6.46	6.43	6.48	0.05	29.29	56.00	29.83	99.7	1.32	1.17	1.17	1.17	1.18
100.0	6.46	6.47	6.47	6.51	0.05	28.80	51.54	29.43	110.9	1.32	1.16	1.16	1.16	1.17
120.0	6.45	6.47	6.45	6.52	0.07	28.21	46.60	28.93	133.1	1.35	1.15	1.15	1.16	1.17
140.0	6.45	6.48	6.47	6.52	0.07	27.65	42.96	28.35	149.9	1.35	1.14	1.14	1.15	1.16
160.0	6.50	6.52	6.52	6.58	0.08	27.02	39.86	27.71	166.6	1.37	1.14	1.13	1.15	1.15
180.0	6.52	6.54	6.56	6.64	0.12	26.40	37.39	26.98	183.3	1.40	1.14	1.13	1.15	1.16
200.0	6.56	6.58	6.63	6.68	0.12	25.84	35.09	26.22	200.0	1.43	1.14	1.14	1.16	1.17

PSC-4A-4

10 to 1000MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.26	6.27	6.24	6.41	0.17	30.75	43.51	31.15	10.0	1.18	1.31	1.31	1.31	1.32
50.0	6.35	6.39	6.38	6.53	0.18	24.85	39.19	24.53	50.0	1.20	1.27	1.27	1.27	1.27
100.0	6.64	6.63	6.61	6.73	0.12	23.09	35.89	22.72	100.0	1.26	1.28	1.27	1.27	1.27
155.4	6.75	6.76	6.75	6.87	0.12	22.21	33.08	21.81	155.4	1.35	1.31	1.29	1.30	1.30
200.0	6.82	6.81	6.83	6.92	0.11	21.78	31.54	21.28	200.0	1.40	1.32	1.31	1.31	1.31
300.9	6.83	6.80	6.86	6.88	0.08	20.59	28.81	19.98	300.9	1.52	1.37	1.34	1.36	1.35
359.1	6.94	6.93	7.00	7.01	0.08	20.04	27.69	19.32	359.1	1.59	1.39	1.36	1.38	1.37
446.3	7.27	7.28	7.32	7.31	0.05	19.49	26.29	18.49	446.3	1.71	1.43	1.39	1.42	1.41
500.0	7.02	7.00	7.07	7.06	0.07	19.21	25.57	18.08	446.3	1.71	1.40	1.37	1.39	1.39
591.8	7.29	7.26	7.33	7.30	0.07	19.41	24.82	17.85	500.0	1.78	1.39	1.37	1.39	1.38
708.1	7.33	7.30	7.33	7.34	0.04	20.17	23.99	17.68	591.8	1.85	1.42	1.39	1.40	1.39
795.4	7.61	7.54	7.53	7.57	0.08	21.53	23.77	17.68	708.1	2.00	1.51	1.48	1.46	1.45
882.6	7.72	7.65	7.60	7.69	0.12	23.58	23.78	18.23	882.6	2.00	1.58	1.54	1.53	1.51
940.8	8.05	7.99	7.87	8.00	0.18	25.31	24.19	18.52	940.8	2.03	1.67	1.62	1.61	1.58
1000.0	8.13	8.10	7.91	8.10	0.22	26.08	24.56	18.79	1000.0	1.96	1.71	1.65	1.67	1.64

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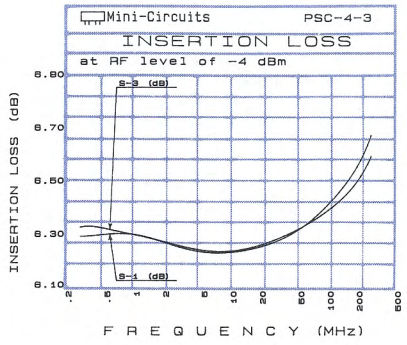
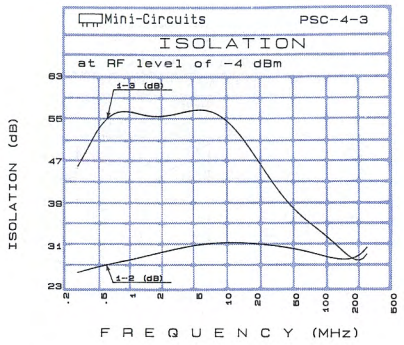
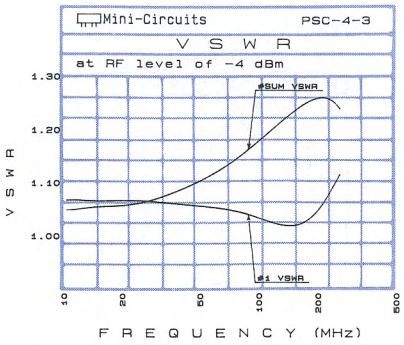
Mini-Circuits

PSC-4-3

0.25 to 250MHz



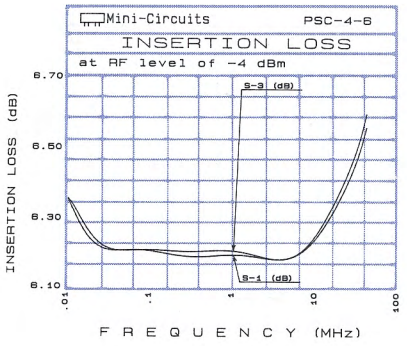


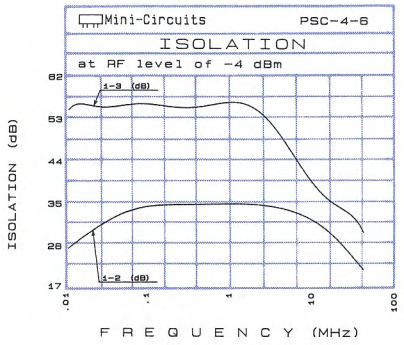


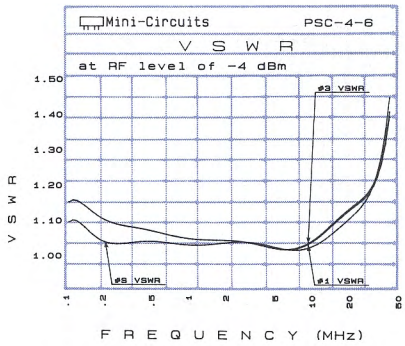
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.25	6.29	6.33	6.33	6.33	0.04	26.10	45.98	26.52	10.0	1.05	1.07	1.07	1.07	1.07
0.5	6.30	6.32	6.32	6.32	0.02	27.59	56.00	28.23	16.6	1.06	1.07	1.07	1.06	1.06
1.0	6.30	6.30	6.29	6.31	0.02	28.65	56.00	29.49	20.2	1.06	1.07	1.06	1.06	1.06
5.0	6.23	6.23	6.23	6.24	0.01	31.51	56.00	32.39	30.4	1.07	1.06	1.06	1.06	1.06
10.0	6.23	6.23	6.23	6.22	0.01	31.79	56.00	32.52	44.2	1.10	1.06	1.06	1.05	1.06
25.2	6.27	6.26	6.27	6.26	0.01	31.35	43.48	31.61	58.0	1.12	1.06	1.06	1.05	1.05
50.0	6.30	6.30	6.30	6.29	0.01	30.51	37.79	30.06	78.4	1.15	1.05	1.05	1.04	1.05
75.2	6.38	6.35	6.34	6.35	0.04	29.76	34.60	28.77	100.0	1.18	1.03	1.03	1.03	1.03
100.0	6.51	6.45	6.46	6.46	0.06	29.16	32.41	27.76	119.8	1.21	1.02	1.03	1.02	1.02
125.1	6.47	6.43	6.44	6.44	0.04	28.77	30.94	27.03	147.4	1.24	1.02	1.02	1.02	1.02
150.1	6.44	6.40	6.40	6.40	0.04	28.77	29.92	26.66	167.8	1.25	1.03	1.02	1.03	1.02
175.1	6.56	6.50	6.49	6.50	0.07	28.93	29.20	26.67	188.2	1.26	1.04	1.04	1.05	1.03
200.0	6.63	6.57	6.56	6.58	0.07	29.28	28.76	27.04	202.0	1.26	1.06	1.04	1.06	1.05
225.0	6.64	6.56	6.57	6.61	0.08	30.09	28.66	28.00	229.6	1.26	1.09	1.08	1.09	1.08
250.0	6.63	6.58	6.56	6.63	0.07	30.88	28.94	29.77	250.0	1.24	1.12	1.10	1.12	1.10

PSC-4-6

0.01 to 40MHz





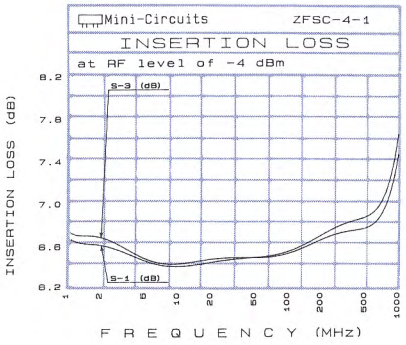


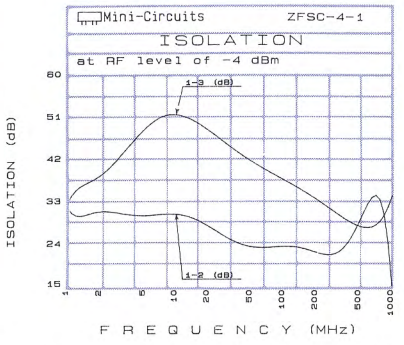
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.01	6.35	6.40	6.36	6.36	0.05	25.59	56.00	26.01	0.1	1.11	1.17	1.17	1.17	1.16
0.1	6.20	6.20	6.21	6.19	0.02	34.62	56.00	34.42	1.0	1.04	1.06	1.05	1.05	1.05
1.0	6.18	6.18	6.21	6.19	0.03	35.15	56.00	34.80	2.6	1.03	1.03	1.03	1.03	1.03
2.0	6.19	6.19	6.19	6.17	0.02	34.95	56.00	34.64	5.0	1.03	1.03	1.03	1.03	1.03
5.0	6.20	6.18	6.20	6.19	0.02	33.78	45.61	33.47	7.6	1.03	1.03	1.03	1.03	1.03
8.3	6.20	6.20	6.21	6.20	0.01	32.32	41.23	32.04	10.1	1.02	1.04	1.04	1.04	1.04
10.0	6.20	6.22	6.22	6.21	0.02	31.58	39.66	31.30	12.6	1.03	1.06	1.06	1.06	1.06
13.8	6.33	6.32	6.35	6.32	0.03	29.88	37.45	29.65	16.3	1.09	1.11	1.11	1.11	1.12
17.9	6.35	6.36	6.38	6.37	0.03	28.13	35.54	27.94	20.0	1.13	1.16	1.16	1.16	1.16
20.0	6.35	6.33	6.36	6.36	0.03	27.27	34.74	27.08	21.3	1.15	1.16	1.16	1.17	1.17
24.8	6.35	6.33	6.38	6.36	0.05	25.43	33.08	25.28	26.3	1.15	1.16	1.16	1.17	1.17
29.0	6.45	6.43	6.47	6.49	0.06	24.13	32.14	23.97	30.0	1.18	1.18	1.18	1.18	1.18
31.7	6.52	6.51	6.54	6.53	0.03	23.38	31.67	23.22	32.5	1.23	1.22	1.22	1.23	1.23
35.9	6.54	6.51	6.57	6.56	0.06	22.21	30.99	22.05	36.3	1.35	1.31	1.32	1.32	1.33
40.0	6.48	6.50	6.52	6.51	0.04	21.02	30.30	20.86	40.0	1.43	1.38	1.38	1.39	1.39

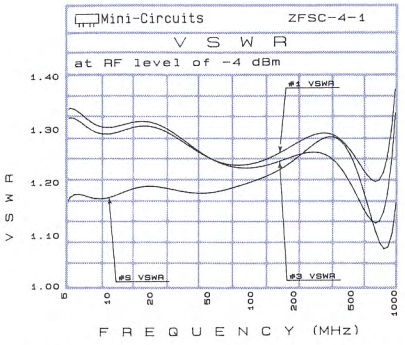
4WAY-0°
Power Splitter/Combiners
50 ohms

ZFSC-4-1

1 to 1000MHz



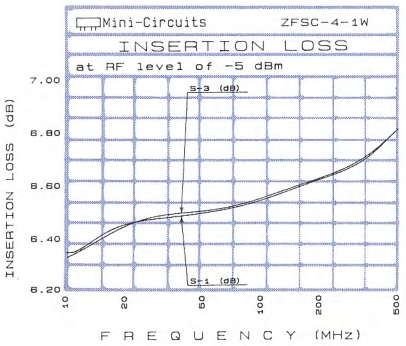


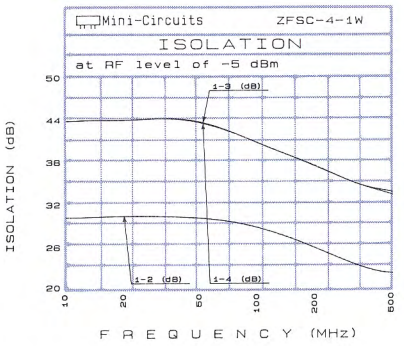


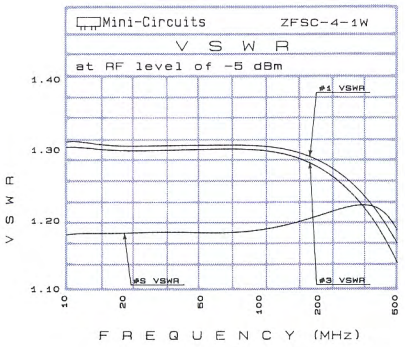
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1.0	6.67	6.64	6.73	6.70	0.09	30.34	33.51	29.96	5.0	1.17	1.33	1.33	1.34	1.34
5.0	6.49	6.44	6.50	6.49	0.06	30.25	47.61	30.43	20.0	1.19	1.31	1.31	1.32	1.32
50.0	6.44	6.42	6.43	6.43	0.02	23.55	41.88	23.52	95.4	1.20	1.25	1.24	1.24	1.24
100.0	6.63	6.59	6.59	6.60	0.04	22.76	37.89	22.74	155.6	1.23	1.26	1.25	1.25	1.25
162.0	6.63	6.64	6.62	6.63	0.02	22.64	34.87	22.74	200.0	1.24	1.26	1.25	1.24	1.25
200.0	6.74	6.68	6.66	6.69	0.08	22.63	33.42	22.82	246.0	1.26	1.28	1.26	1.25	1.26
290.8	6.83	6.83	6.75	6.80	0.08	22.85	30.89	23.12	336.4	1.28	1.29	1.27	1.25	1.26
387.3	6.90	6.98	6.84	6.92	0.14	23.69	29.08	24.02	426.7	1.28	1.28	1.26	1.23	1.25
451.7	6.90	6.92	6.80	6.91	0.12	24.87	28.25	25.14	486.9	1.26	1.27	1.24	1.20	1.22
500.0	6.81	6.85	6.72	6.82	0.13	26.01	27.73	26.36	517.1	1.23	1.24	1.21	1.18	1.20
612.7	6.92	6.99	6.80	6.94	0.19	32.05	27.02	31.37	637.5	1.16	1.20	1.16	1.12	1.15
709.3	7.02	7.07	6.87	7.07	0.20	44.83	27.07	32.16	727.9	1.10	1.19	1.15	1.11	1.15
805.9	7.09	7.20	7.02	7.19	0.18	28.42	27.88	25.57	818.3	1.07	1.23	1.19	1.16	1.20
902.4	7.41	7.36	7.25	7.41	0.16	22.72	29.95	21.13	908.6	1.07	1.28	1.23	1.22	1.25
1000.0	7.71	7.58	7.52	7.64	0.19	19.13	34.90	18.09	1000.0	1.18	1.33	1.28	1.28	1.31

ZFSC-4-1W

10 to 500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.34	6.33	6.33	6.33	0.01	30.21	44.00	30.08	10.0	1.18	1.31	1.31	1.30	1.31
50.4	6.50	6.50	6.50	6.50	0.00	30.05	42.88	29.81	50.4	1.18	1.31	1.31	1.30	1.30
99.4	6.55	6.55	6.56	6.56	0.01	28.76	40.64	28.37	99.4	1.19	1.31	1.31	1.30	1.30
121.5	6.55	6.55	6.55	6.55	0.00	28.06	39.15	27.65	121.5	1.19	1.30	1.30	1.30	1.30
149.7	6.60	6.59	6.60	6.60	0.01	27.24	38.35	26.71	149.7	1.20	1.30	1.30	1.29	1.29
199.9	6.63	6.62	6.63	6.63	0.01	25.86	37.08	25.34	199.9	1.21	1.28	1.29	1.27	1.27
219.5	6.63	6.62	6.64	6.64	0.02	25.40	36.54	24.85	219.5	1.21	1.28	1.28	1.27	1.27
247.7	6.63	6.62	6.63	6.63	0.01	24.75	35.95	24.21	247.7	1.22	1.27	1.27	1.26	1.26
275.8	6.67	6.64	6.67	6.66	0.03	24.22	35.51	23.71	275.8	1.22	1.26	1.27	1.25	1.25
317.5	6.69	6.66	6.70	6.70	0.04	23.58	34.91	23.10	317.5	1.22	1.24	1.25	1.23	1.23
360.4	6.69	6.67	6.71	6.70	0.04	23.06	34.48	22.59	360.4	1.22	1.23	1.24	1.21	1.21
402.0	6.74	6.70	6.75	6.75	0.05	22.68	34.13	22.25	402.0	1.22	1.21	1.23	1.19	1.19
443.7	6.77	6.73	6.78	6.78	0.05	22.41	34.09	22.07	443.7	1.21	1.19	1.21	1.17	1.17
471.8	6.79	6.76	6.80	6.80	0.04	22.33	34.13	22.01	471.8	1.20	1.18	1.20	1.15	1.16
500.0	6.80	6.75	6.80	6.81	0.06	22.27	34.39	22.02	500.0	1.19	1.17	1.19	1.14	1.15

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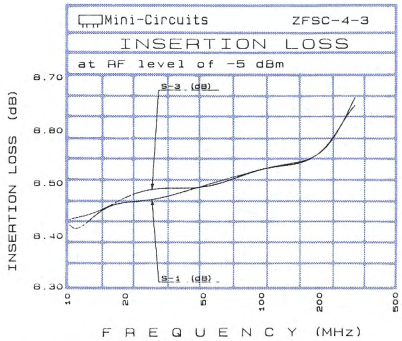
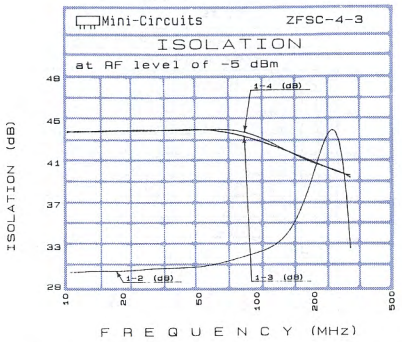
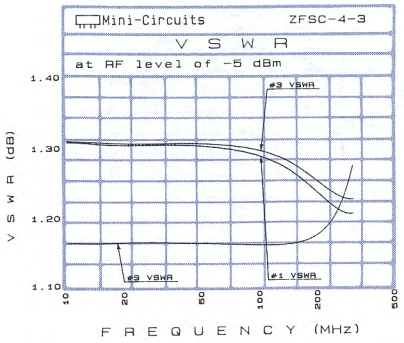
ZFSC-4-3

10 to 300MHz



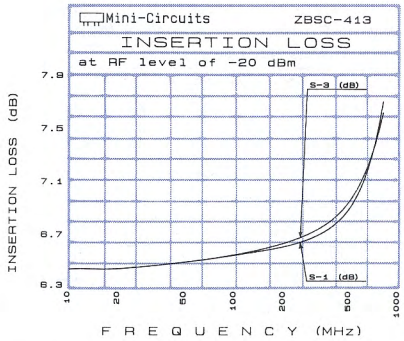


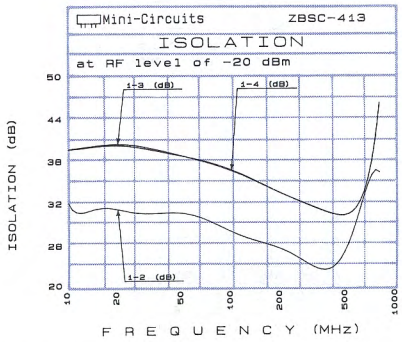


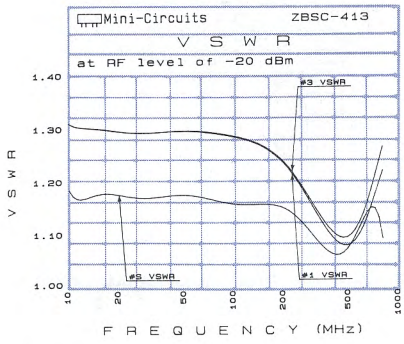
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.41	6.40	6.43	6.43	0.03	30.60	44.00	30.26	10.0	1.16	1.31	1.31	1.31	1.31
18.0	6.46	6.45	6.46	6.47	0.02	30.72	44.00	30.54	18.0	1.16	1.30	1.30	1.31	1.31
20.2	6.47	6.47	6.48	6.47	0.01	30.70	44.00	30.60	20.2	1.17	1.30	1.30	1.31	1.30
34.7	6.47	6.48	6.49	6.49	0.02	30.93	44.00	30.89	34.7	1.17	1.30	1.30	1.31	1.30
49.9	6.50	6.50	6.50	6.51	0.01	31.18	44.00	31.31	49.9	1.16	1.30	1.30	1.31	1.31
60.0	6.51	6.51	6.51	6.50	0.01	31.31	44.00	31.46	60.0	1.16	1.30	1.30	1.30	1.30
76.0	6.50	6.50	6.50	6.50	0.00	31.64	42.84	31.89	76.0	1.16	1.29	1.29	1.30	1.30
99.9	6.52	6.52	6.53	6.52	0.01	32.51	43.46	32.52	99.9	1.16	1.29	1.28	1.29	1.29
126.0	6.54	6.53	6.54	6.54	0.01	33.55	42.41	33.48	126.0	1.16	1.27	1.27	1.28	1.28
150.7	6.54	6.53	6.54	6.53	0.01	35.01	41.68	34.70	150.7	1.16	1.26	1.26	1.27	1.27
200.7	6.55	6.54	6.56	6.55	0.02	40.32	41.07	38.77	200.7	1.18	1.23	1.22	1.25	1.25
225.3	6.58	6.57	6.59	6.58	0.02	44.00	41.35	43.31	225.3	1.19	1.22	1.21	1.24	1.24
250.0	6.62	6.60	6.62	6.60	0.02	44.00	40.96	44.00	250.0	1.21	1.21	1.19	1.23	1.23
275.4	6.63	6.60	6.61	6.61	0.03	39.86	40.91	44.00	275.4	1.24	1.20	1.18	1.23	1.22
300.0	6.67	6.64	6.66	6.65	0.03	35.01	40.69	39.63	300.0	1.27	1.20	1.18	1.22	1.22

ZBSC-413

10 to 800MHz







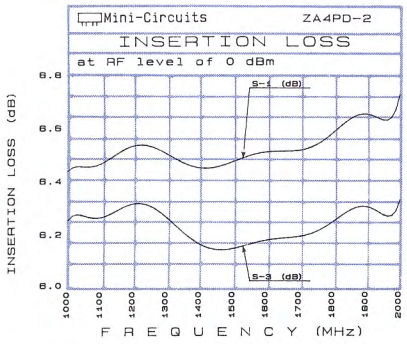
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.44	6.44	6.44	6.43	0.01	31.12	39.73	32.08	10.0	1.17	1.31	1.31	1.31	1.32
20.0	6.44	6.45	6.44	6.44	0.01	31.02	40.33	31.99	20.0	1.17	1.29	1.29	1.30	1.30
50.0	6.49	6.49	6.49	6.48	0.01	30.29	38.61	30.95	50.0	1.17	1.29	1.29	1.30	1.30
100.0	6.54	6.55	6.54	6.54	0.01	28.26	36.44	28.41	100.0	1.16	1.28	1.29	1.30	1.30
154.0	6.58	6.58	6.59	6.58	0.01	26.23	34.67	26.07	154.0	1.15	1.26	1.26	1.27	1.27
200.0	6.62	6.63	6.65	6.64	0.03	24.95	33.45	24.68	200.0	1.14	1.23	1.23	1.24	1.25
249.0	6.64	6.66	6.68	6.66	0.04	23.96	32.59	23.58	249.0	1.13	1.19	1.20	1.21	1.21
345.0	6.71	6.74	6.76	6.74	0.05	23.13	31.03	22.50	345.0	1.09	1.12	1.13	1.14	1.15
400.0	6.77	6.80	6.82	6.80	0.05	23.26	30.45	22.48	400.0	1.06	1.09	1.10	1.11	1.11
465.0	6.87	6.91	6.92	6.88	0.05	24.12	30.41	22.89	465.0	1.05	1.07	1.09	1.09	1.09
500.0	6.90	6.95	6.95	6.92	0.05	24.87	30.44	23.29	500.0	1.06	1.07	1.09	1.09	1.08
608.0	7.12	7.20	7.15	7.09	0.11	29.16	31.93	25.57	608.0	1.13	1.12	1.14	1.12	1.11
680.0	7.28	7.39	7.30	7.22	0.17	35.65	34.77	27.98	680.0	1.16	1.15	1.18	1.15	1.12
752.0	7.52	7.66	7.49	7.38	0.28	38.03	41.71	32.39	752.0	1.12	1.19	1.23	1.17	1.15
800.0	7.73	7.90	7.64	7.51	0.39	29.23	43.38	41.15	800.0	1.10	1.23	1.28	1.21	1.18

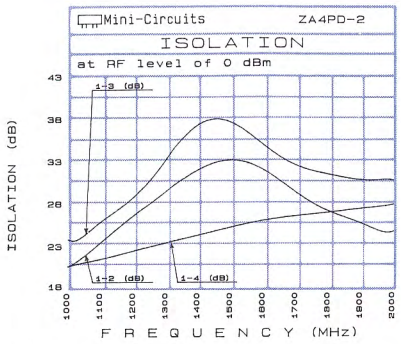
Power Splitter/Combiners

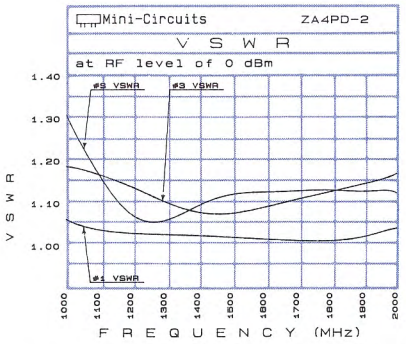
50 ohms

ZA4PD-2

1 to 2.0GHz



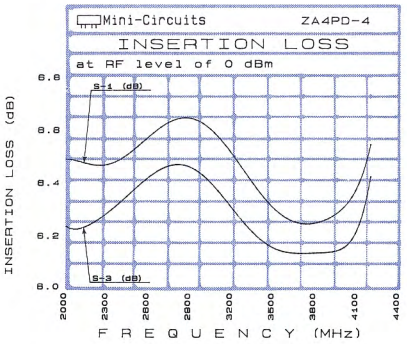


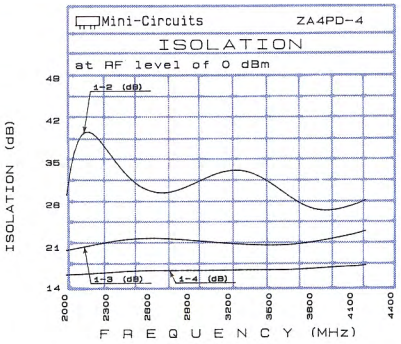


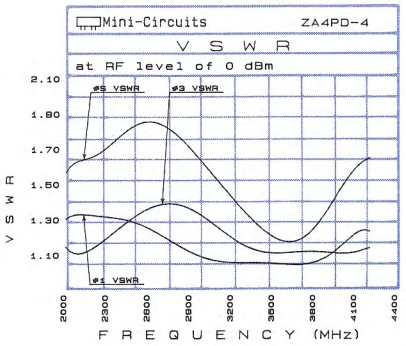
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1000.0	6.45	6.23	6.27	6.47	0.24	20.58	25.91	20.83	1000.0	1.31	1.06	1.20	1.19	1.03
1080.0	6.46	6.23	6.26	6.47	0.24	22.92	27.93	23.42	1080.0	1.19	1.04	1.18	1.18	1.05
1157.5	6.49	6.25	6.28	6.52	0.27	25.33	27.77	26.07	1157.5	1.11	1.03	1.16	1.15	1.06
1210.0	6.54	6.29	6.32	6.55	0.26	26.99	26.89	27.82	1210.0	1.07	1.03	1.14	1.14	1.06
1262.5	6.52	6.27	6.30	6.52	0.25	28.58	25.96	29.34	1262.5	1.05	1.03	1.11	1.12	1.06
1315.0	6.52	6.25	6.26	6.50	0.27	30.11	25.23	30.82	1315.0	1.07	1.03	1.10	1.10	1.06
1395.0	6.43	6.13	6.15	6.39	0.30	31.51	24.37	32.00	1395.0	1.10	1.02	1.07	1.08	1.05
1472.5	6.46	6.13	6.13	6.40	0.33	33.30	24.29	33.79	1472.5	1.12	1.02	1.05	1.08	1.05
1552.5	6.52	6.17	6.18	6.45	0.35	32.87	24.59	33.21	1552.5	1.13	1.02	1.05	1.09	1.04
1605.0	6.51	6.18	6.19	6.44	0.33	31.69	24.96	31.91	1605.0	1.13	1.02	1.06	1.09	1.04
1685.0	6.49	6.17	6.18	6.40	0.32	29.68	25.84	29.84	1685.0	1.13	1.02	1.08	1.11	1.03
1762.5	6.57	6.21	6.21	6.48	0.36	27.92	27.14	28.00	1762.5	1.13	1.01	1.09	1.12	1.03
1842.5	6.61	6.27	6.29	6.52	0.34	26.43	28.98	26.45	1842.5	1.13	1.02	1.11	1.14	1.04
1920.0	6.64	6.27	6.27	6.53	0.37	25.34	31.35	25.32	1920.0	1.13	1.03	1.12	1.15	1.06
2000.0	6.67	6.27	6.27	6.55	0.40	24.43	34.33	24.32	2000.0	1.13	1.04	1.14	1.17	1.08

ZA4PD-4

2 to 4.2GHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
2000.0	6.47	6.23	6.21	6.49	0.28	32.33	28.25	31.73	2000.0	1.60	1.32	1.12	1.14	1.30
2126.5	6.47	6.26	6.23	6.49	0.26	40.00	25.01	40.35	2126.5	1.64	1.33	1.12	1.11	1.31
2313.5	6.46	6.31	6.28	6.47	0.19	35.88	22.55	37.66	2313.5	1.74	1.32	1.24	1.21	1.32
2500.5	6.60	6.45	6.44	6.64	0.20	31.57	21.55	32.35	2500.5	1.81	1.28	1.35	1.32	1.29
2627.0	6.60	6.44	6.44	6.66	0.22	30.42	21.38	31.05	2627.0	1.85	1.24	1.40	1.38	1.25
2819.5	6.62	6.46	6.48	6.71	0.25	30.47	21.90	31.18	2819.5	1.79	1.16	1.40	1.38	1.17
3001.0	6.61	6.36	6.40	6.72	0.36	31.88	23.30	32.90	3001.0	1.62	1.08	1.32	1.31	1.10
3067.0	6.62	6.36	6.40	6.74	0.38	32.67	23.97	33.86	3067.0	1.54	1.07	1.28	1.28	1.09
3259.5	6.41	6.17	6.22	6.53	0.36	34.14	25.54	36.42	3259.5	1.34	1.05	1.16	1.17	1.09
3446.5	6.35	6.11	6.17	6.45	0.34	32.20	25.02	34.50	3446.5	1.24	1.07	1.10	1.11	1.09
3573.0	6.28	6.09	6.15	6.39	0.30	30.06	23.39	32.08	3573.0	1.14	1.06	1.11	1.12	1.08
3820.5	6.25	6.05	6.13	6.35	0.30	27.41	20.49	29.01	3820.5	1.29	1.07	1.11	1.12	1.08
4002.0	6.33	6.05	6.15	6.42	0.37	27.20	19.17	28.74	4002.0	1.49	1.17	1.07	1.11	1.17
4073.5	6.34	6.09	6.19	6.43	0.34	27.54	18.81	29.21	4073.5	1.57	1.21	1.07	1.12	1.20
4200.0	6.52	6.27	6.38	6.58	0.31	28.74	18.49	30.86	4200.0	1.67	1.26	1.09	1.14	1.25

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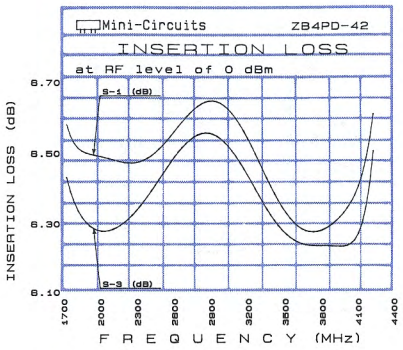
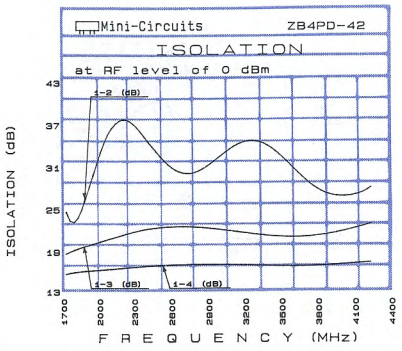
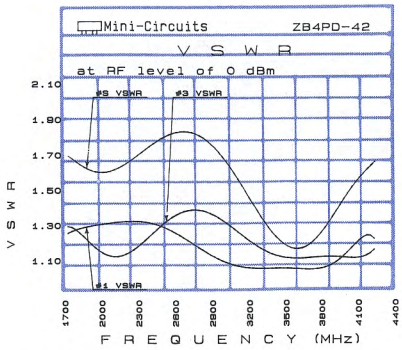
ZB4PD-42

1.7 to 4.2GHz



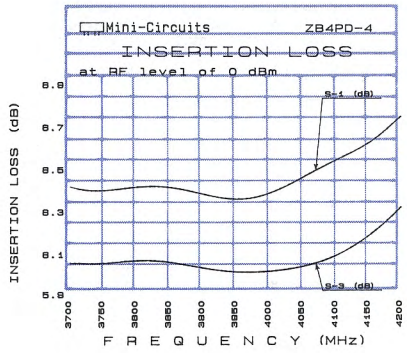


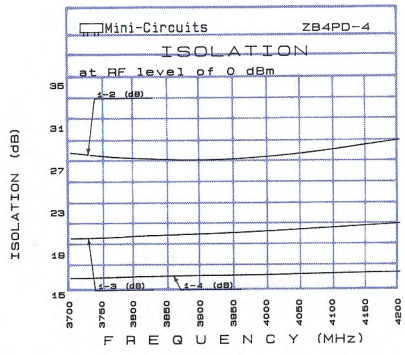


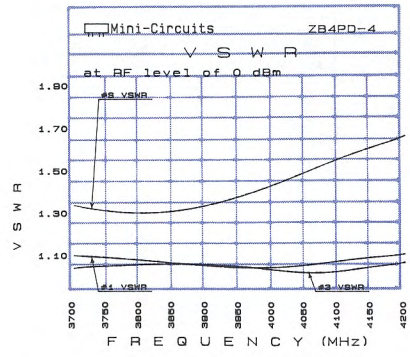
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1700.0	6.57	6.39	6.43	6.62	0.23	22.52	35.47	22.22	1700.0	1.69	1.26	1.27	1.30	1.22
1850.0	6.53	6.30	6.34	6.55	0.25	26.61	36.73	26.15	1850.0	1.61	1.29	1.19	1.22	1.24
2000.0	6.48	6.24	6.28	6.50	0.26	32.60	28.24	32.06	2000.0	1.61	1.32	1.12	1.14	1.26
2212.5	6.50	6.32	6.34	6.53	0.21	39.41	23.64	42.62	2212.5	1.66	1.32	1.17	1.15	1.27
2500.0	6.59	6.44	6.50	6.62	0.18	31.84	21.70	32.74	2500.0	1.80	1.28	1.35	1.32	1.23
2656.3	6.61	6.44	6.52	6.69	0.25	30.86	21.64	31.57	2656.3	1.83	1.23	1.40	1.38	1.19
2950.0	6.63	6.40	6.53	6.75	0.35	32.16	23.20	32.98	2950.0	1.68	1.10	1.34	1.33	1.11
3100.0	6.64	6.37	6.53	6.77	0.40	33.99	24.71	35.28	3100.0	1.54	1.06	1.25	1.26	1.11
3318.8	6.37	6.11	6.30	6.48	0.37	35.02	26.05	37.78	3318.8	1.31	1.06	1.13	1.15	1.13
3500.0	6.35	6.11	6.29	6.46	0.35	32.24	24.70	34.77	3500.0	1.17	1.06	1.10	1.11	1.12
3687.5	6.29	6.07	6.24	6.40	0.33	29.02	22.11	30.97	3687.5	1.20	1.04	1.12	1.12	1.08
3906.3	6.28	6.07	6.24	6.38	0.31	27.06	19.86	28.64	3906.3	1.40	1.11	1.09	1.12	1.09
4000.0	6.37	6.06	6.22	6.46	0.40	27.07	19.19	28.66	4000.0	1.50	1.16	1.07	1.11	1.13
4125.0	6.46	6.18	6.35	6.54	0.36	27.51	18.62	29.31	4125.0	1.61	1.23	1.08	1.13	1.19
4200.0	6.58	6.30	6.44	6.62	0.32	28.13	18.42	30.10	4200.0	1.66	1.26	1.10	1.15	1.21

ZB4PD-4

3.7 to 4.2GHz







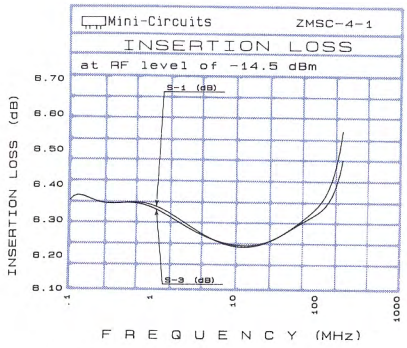
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
3700.0	6.41	6.16	6.06	6.43	0.37	28.68	22.06	28.90	3700.0	1.34	1.10	1.07	1.04	1.11
3740.0	6.39	6.16	6.05	6.42	0.37	28.40	21.57	28.54	3740.0	1.32	1.09	1.07	1.05	1.11
3778.8	6.41	6.17	6.07	6.45	0.38	28.18	21.13	28.28	3778.8	1.30	1.08	1.07	1.06	1.10
3818.8	6.42	6.17	6.07	6.47	0.40	28.07	20.72	28.12	3818.8	1.30	1.07	1.07	1.06	1.09
3857.5	6.41	6.17	6.06	6.47	0.41	27.97	20.30	27.95	3857.5	1.31	1.06	1.07	1.06	1.09
3883.8	6.40	6.17	6.06	6.46	0.40	27.95	20.05	27.90	3883.8	1.33	1.05	1.06	1.06	1.08
3910.0	6.39	6.16	6.04	6.44	0.40	27.95	19.80	27.88	3910.0	1.35	1.05	1.06	1.06	1.08
3950.0	6.36	6.13	6.01	6.41	0.40	28.02	19.44	27.93	3950.0	1.38	1.05	1.06	1.05	1.09
3990.0	6.38	6.13	6.02	6.43	0.41	28.19	19.16	28.05	3990.0	1.42	1.04	1.05	1.04	1.09
4016.3	6.41	6.15	6.03	6.45	0.42	28.31	18.96	28.18	4016.3	1.45	1.05	1.06	1.03	1.10
4055.0	6.48	6.17	6.05	6.51	0.46	28.55	18.72	28.42	4055.0	1.50	1.06	1.07	1.02	1.11
4095.0	6.53	6.22	6.09	6.54	0.45	28.85	18.49	28.74	4095.0	1.55	1.07	1.09	1.02	1.12
4121.3	6.59	6.27	6.13	6.58	0.46	29.08	18.36	28.97	4121.3	1.58	1.08	1.10	1.03	1.13
4160.0	6.65	6.35	6.21	6.64	0.44	29.42	18.17	29.37	4160.0	1.62	1.09	1.12	1.05	1.14
4200.0	6.75	6.46	6.32	6.71	0.43	29.76	18.00	29.78	4200.0	1.66	1.11	1.14	1.07	1.15

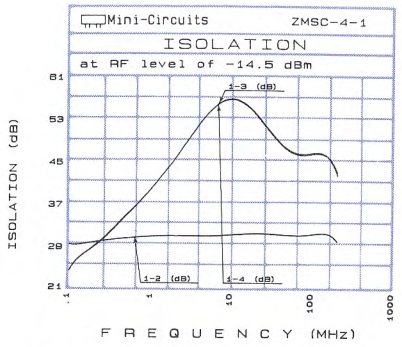
Power Splitter/Combiners

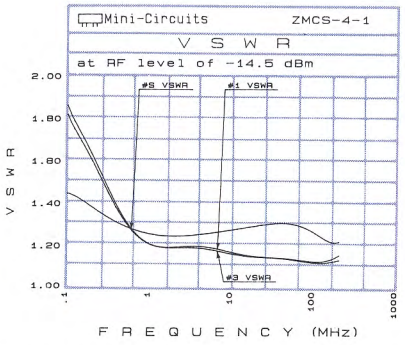
ZMSC-4-1, ZSC-4-1

50 ohms

0.1 to 200MHz





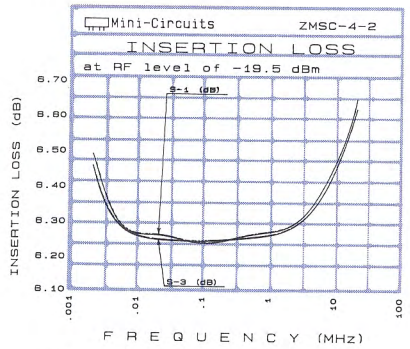


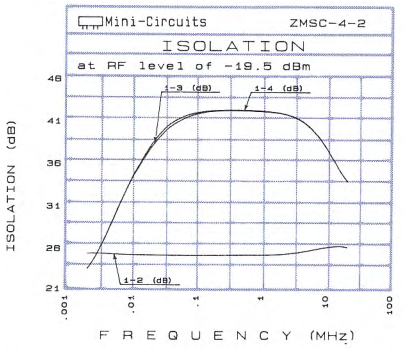
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.1	6.41	6.41	6.50	6.49	0.09	26.03	24.94	26.98	0.1	1.42	1.93	1.93	1.94	1.94
0.6	6.42	6.41	6.44	6.44	0.03	28.44	36.22	28.36	0.6	1.25	1.28	1.27	1.28	1.28
2.1	6.37	6.36	6.37	6.35	0.02	29.26	47.39	29.16	2.1	1.26	1.20	1.19	1.19	1.19
10.1	6.29	6.28	6.29	6.27	0.02	29.44	51.61	29.29	10.1	1.25	1.18	1.20	1.20	1.21
20.1	6.28	6.29	6.29	6.29	0.01	29.71	50.48	29.46	20.1	1.25	1.16	1.17	1.17	1.17
40.1	6.30	6.32	6.32	6.32	0.02	30.15	47.95	29.61	40.1	1.24	1.15	1.15	1.15	1.14
50.1	6.32	6.33	6.33	6.35	0.03	30.37	46.96	29.71	50.1	1.23	1.15	1.14	1.14	1.14
73.6	6.36	6.37	6.38	6.38	0.02	30.89	45.24	29.77	73.6	1.21	1.14	1.13	1.13	1.13
100.1	6.41	6.42	6.43	6.43	0.02	31.74	44.30	29.98	100.1	1.18	1.12	1.12	1.11	1.11
113.5	6.46	6.45	6.48	6.49	0.04	32.24	44.25	30.15	113.5	1.16	1.13	1.12	1.11	1.11
133.5	6.50	6.50	6.53	6.54	0.04	32.92	45.06	30.49	133.5	1.14	1.12	1.11	1.10	1.10
153.5	6.55	6.55	6.59	6.61	0.06	33.18	46.99	30.86	153.5	1.13	1.13	1.12	1.10	1.10
173.5	6.64	6.63	6.68	6.72	0.09	32.63	51.02	31.03	173.5	1.16	1.14	1.13	1.11	1.10
193.5	6.76	6.76	6.82	6.84	0.08	31.16	56.89	30.78	193.5	1.21	1.15	1.14	1.11	1.11
200.0	6.80	6.79	6.86	6.89	0.10	30.55	53.40	30.56	200.0	1.23	1.16	1.15	1.12	1.12

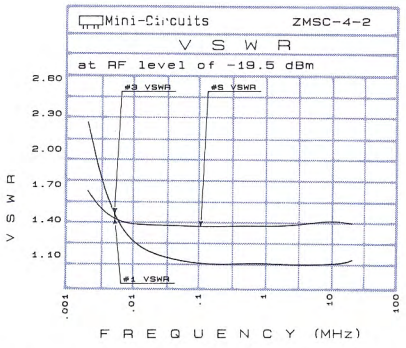
ZMSC-4-2, ZSC-4-2

50 ohms

0.002 to 20MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.002	6.49	6.50	6.45	6.46	0.05	25.49	23.63	26.33	0.002	1.64	2.21	2.22	2.28	2.28
0.003	6.39	6.39	6.36	6.36	0.03	25.48	25.68	27.35	0.003	1.51	1.82	1.82	1.87	1.87
0.01	6.26	6.26	6.26	6.26	0.00	25.27	34.92	29.42	0.01	1.36	1.20	1.20	1.22	1.22
0.02	6.27	6.25	6.25	6.25	0.02	25.27	38.71	29.63	0.02	1.35	1.11	1.10	1.13	1.13
0.1	6.24	6.25	6.25	6.24	0.01	25.23	41.91	29.65	0.1	1.34	1.03	1.03	1.07	1.07
0.2	6.25	6.25	6.25	6.25	0.00	25.27	42.21	29.73	0.2	1.34	1.02	1.02	1.07	1.07
1.0	6.27	6.27	6.27	6.26	0.01	25.33	42.11	29.79	1.0	1.34	1.02	1.02	1.07	1.07
2.0	6.29	6.29	6.28	6.28	0.01	25.39	42.02	29.96	2.0	1.35	1.02	1.01	1.06	1.06
5.0	6.37	6.37	6.35	6.36	0.02	25.85	40.42	30.63	5.0	1.37	1.01	1.01	1.06	1.06
7.5	6.43	6.42	6.41	6.41	0.02	26.10	39.17	30.90	7.5	1.37	1.01	1.01	1.06	1.06
10.0	6.48	6.47	6.45	6.45	0.03	26.24	37.57	31.04	10.0	1.38	1.02	1.02	1.05	1.05
12.6	6.52	6.52	6.52	6.50	0.02	26.36	36.26	31.11	12.6	1.38	1.02	1.02	1.06	1.06
15.6	6.57	6.56	6.55	6.56	0.02	26.36	35.16	31.11	15.6	1.37	1.03	1.03	1.06	1.06
18.4	6.62	6.62	6.60	6.59	0.03	26.26	34.30	31.06	18.4	1.36	1.04	1.04	1.06	1.06
20.0	6.65	6.64	6.62	6.62	0.03	26.21	33.84	31.00	20.0	1.35	1.04	1.04	1.07	1.07

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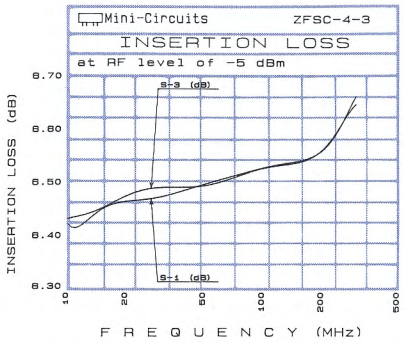
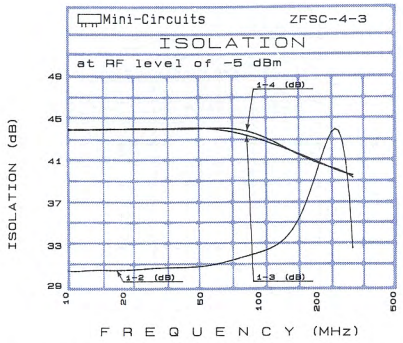
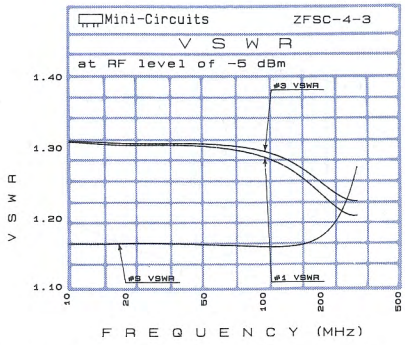
ZMSC-4-3, ZSC-4-3 — 50 ohms — 0.25 to 250MHz

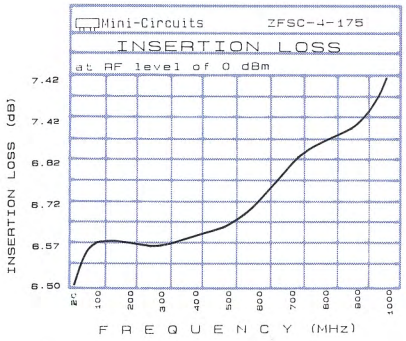


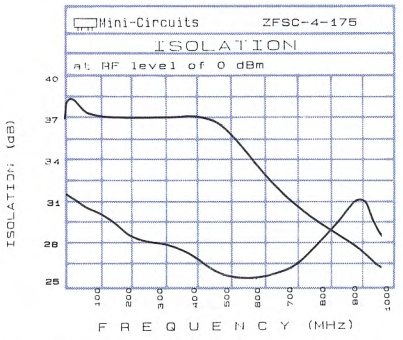


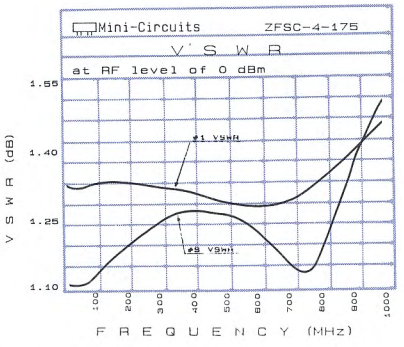


FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.25	6.35	6.38	6.38	6.38	0.03	25.15	50.85	26.87	0.25	1.23	1.38	1.38	1.35	1.35
0.5	6.33	6.36	6.36	6.36	0.03	27.67	50.90	29.42	0.5	1.13	1.22	1.22	1.21	1.20
1.0	6.34	6.35	6.36	6.36	0.02	29.04	50.78	30.51	1.0	1.09	1.17	1.17	1.16	1.16
5.0	6.25	6.24	6.25	6.25	0.01	31.59	50.05	31.90	5.0	1.05	1.09	1.09	1.08	1.08
10.0	6.25	6.25	6.24	6.24	0.01	31.74	48.80	31.71	10.0	1.05	1.07	1.07	1.07	1.07
20.0	6.28	6.27	6.28	6.27	0.01	31.11	45.32	30.91	20.0	1.06	1.07	1.07	1.07	1.07
33.6	6.28	6.27	6.27	6.28	0.01	29.98	42.15	29.70	33.6	1.09	1.07	1.08	1.08	1.07
50.0	6.32	6.33	6.32	6.33	0.01	28.72	39.38	28.38	50.0	1.12	1.07	1.08	1.08	1.08
75.2	6.38	6.39	6.39	6.39	0.01	27.10	36.59	26.71	75.2	1.15	1.07	1.09	1.10	1.08
100.0	6.43	6.45	6.43	6.45	0.02	26.05	34.88	25.63	100.0	1.17	1.07	1.10	1.11	1.08
150.1	6.47	6.49	6.50	6.48	0.03	25.56	33.18	25.13	150.1	1.17	1.05	1.09	1.10	1.07
175.1	6.50	6.53	6.52	6.51	0.03	26.21	33.08	25.85	175.1	1.13	1.04	1.08	1.09	1.05
200.0	6.50	6.54	6.54	6.51	0.04	27.54	33.57	27.46	200.0	1.10	1.05	1.08	1.09	1.05
225.0	6.53	6.57	6.56	6.54	0.04	29.03	34.68	30.13	225.0	1.13	1.10	1.11	1.12	1.09
250.0	6.64	6.70	6.67	6.64	0.06	28.42	36.51	31.57	250.0	1.24	1.17	1.18	1.18	1.15

ZFSC-4-175 — 75 ohms — 10 to 1000MHz







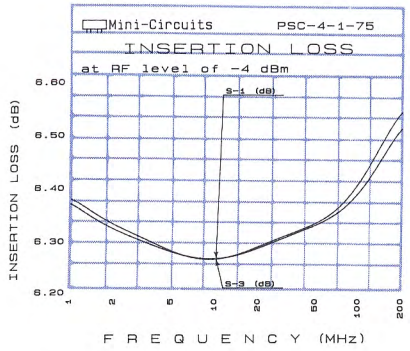
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.52	6.53	6.51	6.52	0.02	31.36	37.03	31.72	10.0	1.11	1.34	1.34	1.34	1.34
19.9	6.55	6.55	6.55	6.54	0.01	31.20	38.46	31.67	19.9	1.10	1.33	1.33	1.33	1.33
39.7	6.56	6.58	6.57	6.58	0.02	31.15	38.52	31.36	39.7	1.10	1.33	1.33	1.34	1.34
69.4	6.58	6.60	6.60	6.60	0.02	30.89	37.72	31.15	69.4	1.11	1.34	1.34	1.34	1.34
99.1	6.60	6.61	6.62	6.62	0.02	30.76	37.30	31.05	99.1	1.13	1.35	1.34	1.35	1.35
156.0	6.60	6.61	6.61	6.62	0.02	29.93	37.28	30.24	156.0	1.16	1.34	1.34	1.35	1.35
272.4	6.58	6.59	6.61	6.60	0.03	28.13	37.29	28.49	272.4	1.24	1.33	1.32	1.34	1.34
329.3	6.59	6.60	6.62	6.62	0.03	27.25	37.16	27.57	329.3	1.26	1.32	1.30	1.34	1.34
418.4	6.61	6.61	6.64	6.64	0.03	26.15	37.46	26.24	418.4	1.28	1.31	1.28	1.33	1.33
500.1	6.66	6.68	6.71	6.69	0.05	25.39	36.55	25.27	500.1	1.27	1.29	1.26	1.32	1.33
591.6	6.72	6.75	6.78	6.77	0.06	25.10	33.73	24.50	591.6	1.21	1.28	1.25	1.31	1.32
708.0	6.85	6.91	6.93	6.91	0.08	25.75	30.92	24.49	708.0	1.14	1.29	1.27	1.31	1.33
913.4	7.12	7.28	7.26	7.20	0.16	30.58	26.87	26.90	913.4	1.39	1.41	1.42	1.40	1.44
970.3	7.31	7.51	7.45	7.39	0.20	30.24	26.24	26.46	970.3	1.49	1.45	1.46	1.43	1.47
1000.0	7.44	7.65	7.60	7.51	0.21	28.68	25.91	25.52	1000.0	1.55	1.47	1.48	1.45	1.49

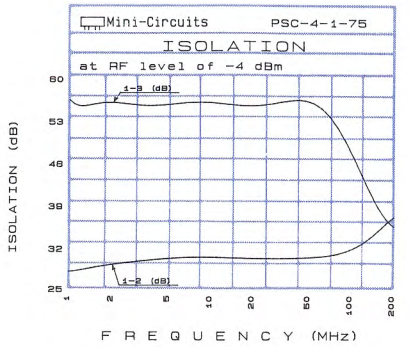
Power Splitter/Combiners

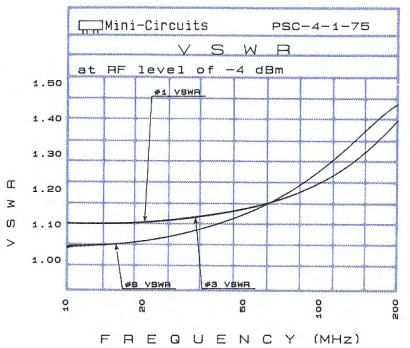
75 ohms

PSC-4-1-75, ZSC-4-1-75

1 to 200MHz



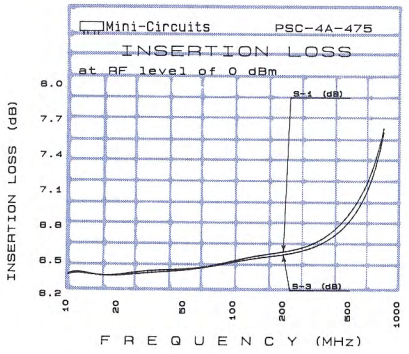


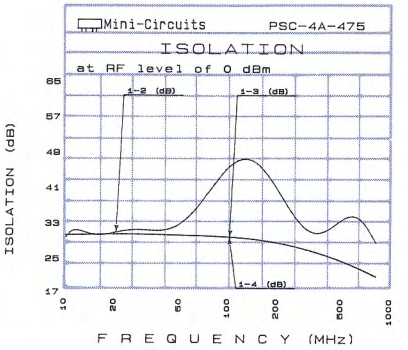


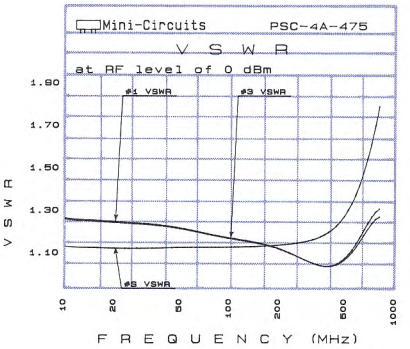
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1.0	6.37	6.38	6.38	6.38	0.01	28.31	56.00	27.46	10.0	1.04	1.10	1.10	1.10	1.10
10.0	6.28	6.27	6.26	6.29	0.03	30.67	56.00	30.62	20.0	1.05	1.11	1.11	1.11	1.11
20.0	6.30	6.31	6.30	6.30	0.01	30.56	56.00	30.63	31.7	1.08	1.12	1.12	1.12	1.12
31.2	6.32	6.31	6.33	6.31	0.02	30.49	56.00	30.58	42.6	1.11	1.14	1.14	1.13	1.13
43.2	6.32	6.33	6.32	6.33	0.01	30.55	56.00	30.66	53.4	1.14	1.15	1.15	1.15	1.15
55.3	6.33	6.33	6.33	6.34	0.01	30.74	56.00	30.81	64.3	1.17	1.16	1.16	1.16	1.16
73.4	6.35	6.36	6.36	6.37	0.02	31.11	56.00	31.12	75.1	1.19	1.18	1.18	1.18	1.18
85.4	6.37	6.38	6.39	6.40	0.03	31.46	51.05	31.42	86.0	1.22	1.20	1.20	1.20	1.20
100.0	6.39	6.39	6.43	6.44	0.05	32.02	47.52	31.89	100.0	1.26	1.22	1.22	1.22	1.22
115.6	6.43	6.43	6.44	6.44	0.01	32.75	45.06	32.51	118.6	1.30	1.25	1.25	1.25	1.25
139.7	6.46	6.47	6.49	6.52	0.06	34.05	41.73	33.61	140.3	1.34	1.29	1.29	1.29	1.29
151.8	6.48	6.46	6.50	6.50	0.04	34.88	39.99	34.20	151.1	1.37	1.31	1.31	1.31	1.31
169.9	6.49	6.49	6.52	6.53	0.04	36.01	38.14	35.15	167.4	1.40	1.34	1.34	1.34	1.34
187.9	6.50	6.50	6.51	6.52	0.02	36.81	36.33	35.82	189.1	1.43	1.38	1.38	1.38	1.38
200.0	6.53	6.52	6.55	6.56	0.04	36.97	35.26	36.05	200.0	1.44	1.39	1.39	1.39	1.40

PSC-4A-475

10 to 800MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
10.0	6.41	6.40	6.40	6.39	0.02	31.09	30.48	30.75	10.0	1.13	1.26	1.26	1.26	1.26
20.0	6.38	6.39	6.38	6.37	0.02	30.90	30.68	30.54	20.0	1.12	1.24	1.24	1.25	1.25
50.0	6.44	6.46	6.45	6.44	0.02	33.83	30.46	33.99	50.0	1.12	1.21	1.21	1.21	1.21
79.7	6.47	6.48	6.46	6.47	0.02	39.72	30.20	41.18	79.7	1.13	1.18	1.18	1.18	1.18
100.0	6.50	6.51	6.49	6.49	0.02	45.19	30.02	54.00	100.0	1.13	1.17	1.16	1.17	1.17
149.4	6.54	6.53	6.53	6.52	0.02	45.58	29.40	43.11	149.4	1.13	1.14	1.14	1.14	1.14
200.0	6.58	6.56	6.56	6.55	0.03	38.21	28.68	35.87	200.0	1.13	1.11	1.11	1.12	1.12
265.6	6.64	6.62	6.60	6.61	0.04	34.43	27.72	32.12	265.6	1.15	1.08	1.08	1.08	1.09
312.1	6.68	6.65	6.65	6.65	0.03	33.11	27.04	30.59	312.1	1.16	1.06	1.05	1.06	1.06
405.0	6.78	6.74	6.72	6.72	0.06	31.88	25.73	28.87	405.0	1.20	1.02	1.04	1.02	1.02
500.0	6.89	6.83	6.83	6.81	0.08	32.39	24.50	28.39	500.0	1.28	1.08	1.10	1.09	1.07
590.9	7.07	7.01	7.00	6.99	0.08	34.59	23.39	29.28	590.9	1.39	1.14	1.17	1.16	1.14
707.1	7.34	7.26	7.24	7.21	0.13	33.56	22.10	33.22	707.1	1.59	1.22	1.25	1.25	1.23
753.5	7.49	7.39	7.40	7.35	0.14	30.08	21.65	34.48	753.5	1.68	1.25	1.29	1.29	1.27
800.0	7.58	7.59	7.60	7.56	0.04	26.74	21.17	32.34	800.0	1.78	1.29	1.33	1.32	1.31

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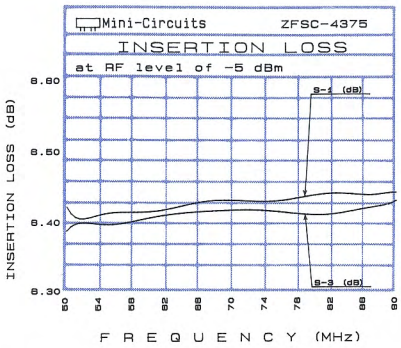
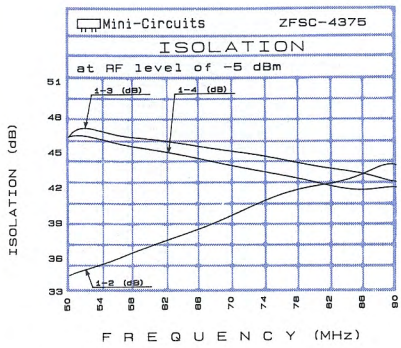
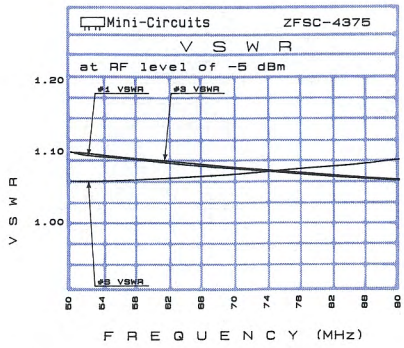
ZFSC-4375

50 to 90MHz



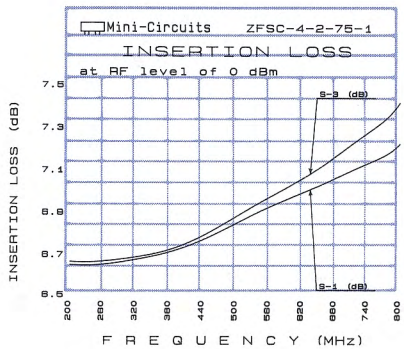


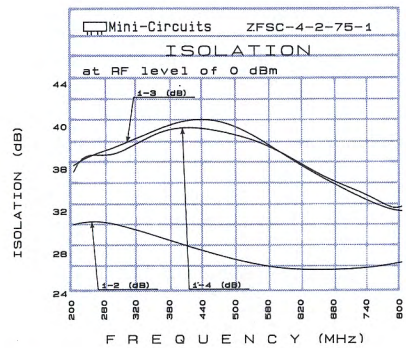


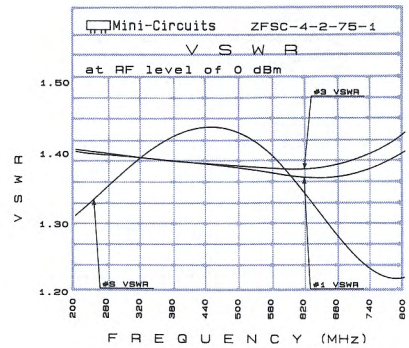
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
50.0	6.41	6.41	6.39	6.41	0.02	34.64	46.97	34.51	50.0	1.06	1.10	1.09	1.10	1.10
52.1	6.40	6.40	6.40	6.41	0.01	35.03	48.14	34.83	52.1	1.06	1.09	1.09	1.10	1.10
55.1	6.43	6.40	6.41	6.41	0.03	35.77	47.64	35.48	55.1	1.06	1.09	1.09	1.09	1.09
57.2	6.40	6.40	6.40	6.42	0.02	36.25	47.48	35.92	57.2	1.06	1.09	1.09	1.09	1.09
60.3	6.42	6.42	6.41	6.41	0.01	37.03	47.11	36.61	60.3	1.06	1.08	1.08	1.09	1.09
63.3	6.42	6.40	6.42	6.42	0.02	37.79	46.87	37.34	63.3	1.06	1.08	1.08	1.08	1.09
65.4	6.41	6.41	6.42	6.42	0.01	38.31	46.72	37.82	65.4	1.06	1.08	1.08	1.08	1.08
70.5	6.43	6.41	6.41	6.41	0.02	39.71	46.17	39.06	70.5	1.07	1.07	1.07	1.08	1.08
72.6	6.43	6.41	6.41	6.41	0.02	40.34	45.84	39.59	72.6	1.07	1.07	1.07	1.07	1.08
75.6	6.42	6.42	6.40	6.42	0.02	41.25	45.51	40.40	75.6	1.07	1.07	1.07	1.07	1.07
77.7	6.44	6.42	6.42	6.42	0.02	41.87	45.34	40.93	77.7	1.08	1.07	1.07	1.07	1.07
80.8	6.44	6.41	6.41	6.41	0.03	41.86	44.91	41.74	80.8	1.08	1.07	1.06	1.07	1.07
85.9	6.46	6.44	6.41	6.44	0.05	43.08	44.29	42.02	85.9	1.08	1.06	1.06	1.06	1.06
87.9	6.43	6.41	6.41	6.41	0.02	43.52	43.85	42.34	87.9	1.08	1.06	1.06	1.06	1.06
90.0	6.45	6.43	6.43	6.43	0.02	43.97	43.63	42.66	90.0	1.09	1.06	1.05	1.06	1.06

ZFSC-4-2-75-1

200 to 800MHz







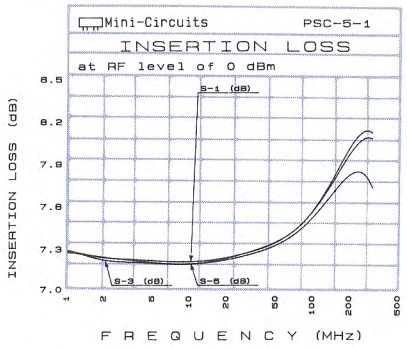
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
200.0	6.65	6.64	6.67	6.66	0.03	30.74	36.90	36.14	200.0	1.31	1.40	1.39	1.41	1.40
216.5	6.65	6.63	6.66	6.65	0.03	31.03	37.21	36.50	216.5	1.32	1.40	1.39	1.41	1.40
249.5	6.66	6.64	6.67	6.67	0.03	30.99	37.93	36.83	249.5	1.35	1.40	1.38	1.40	1.39
300.5	6.66	6.64	6.68	6.68	0.04	30.51	39.02	36.75	300.5	1.38	1.40	1.37	1.40	1.38
350.0	6.70	6.67	6.71	6.72	0.05	29.75	40.33	36.32	350.0	1.41	1.39	1.36	1.39	1.38
399.5	6.72	6.68	6.74	6.74	0.06	28.86	40.42	35.72	399.5	1.43	1.39	1.34	1.39	1.37
450.5	6.78	6.73	6.80	6.81	0.08	28.10	39.31	35.17	450.5	1.44	1.39	1.33	1.39	1.37
500.0	6.85	6.80	6.88	6.89	0.09	27.41	39.85	34.66	500.0	1.43	1.38	1.32	1.38	1.36
549.5	6.92	6.86	6.97	6.98	0.12	26.84	37.98	34.47	549.5	1.40	1.37	1.31	1.38	1.36
600.5	6.97	6.90	7.03	7.05	0.15	26.56	35.91	34.67	600.5	1.36	1.37	1.30	1.38	1.36
650.5	7.03	6.96	7.11	7.13	0.17	26.42	34.48	35.07	650.0	1.31	1.37	1.29	1.38	1.36
699.5	7.09	7.02	7.20	7.23	0.21	26.56	33.17	35.44	699.5	1.27	1.37	1.30	1.39	1.38
750.5	7.14	7.07	7.29	7.31	0.24	26.73	32.19	35.77	750.5	1.23	1.38	1.32	1.41	1.40
783.5	7.19	7.11	7.36	7.38	0.27	26.99	31.68	35.57	783.5	1.22	1.40	1.33	1.42	1.41
800.0	7.21	7.14	7.41	7.42	0.28	27.14	31.35	35.29	800.0	1.23	1.40	1.34	1.43	1.42

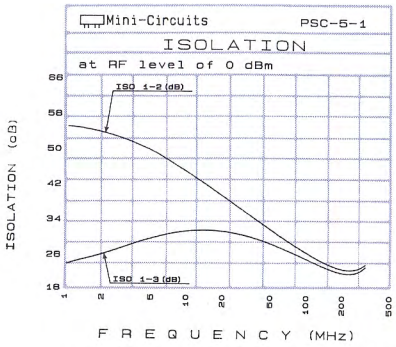
Power Splitter/Combiners

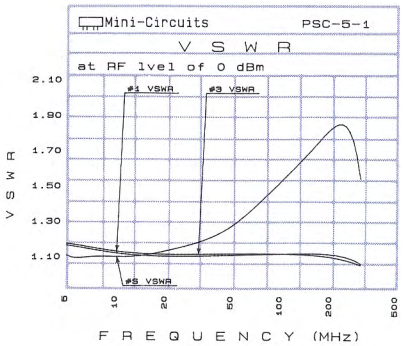
PSC-5-1, ZFSC-5-1

50 ohms

1 to 300MHz





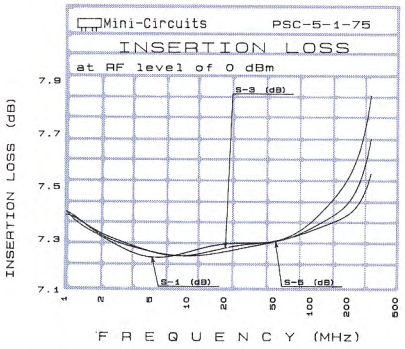


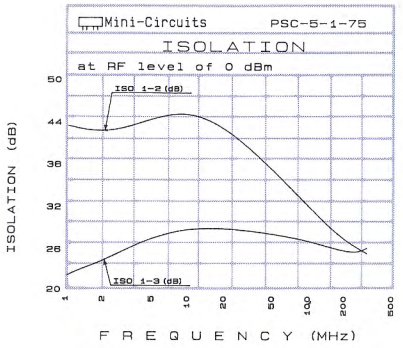
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	(dB) S-5	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 1-3	(dB) 2-3	(dB) 3-5	(dB) 4-5	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	7.29	7.30	7.30	7.30	7.29	0.01	55.23	24.07	42.62	23.72	39.80	5.0	1.10	1.17
10.0	7.19	7.19	7.18	7.19	7.18	0.01	44.51	31.68	41.44	31.41	40.99	10.0	1.10	1.12
20.0	7.20	7.20	7.20	7.20	7.16	0.04	39.03	31.44	37.27	31.12	37.15	20.0	1.13	1.10
38.4	7.23	7.23	7.23	7.23	7.21	0.02	33.66	29.65	32.51	29.16	32.45	39.7	1.23	1.11
50.0	7.30	7.30	7.30	7.30	7.27	0.03	31.52	28.54	30.46	27.95	30.41	50.0	1.28	1.11
66.4	7.37	7.38	7.37	7.36	7.34	0.04	29.33	27.15	28.37	26.51	28.30	83.1	1.45	1.12
85.1	7.46	7.49	7.46	7.46	7.41	0.08	27.52	25.86	26.55	25.16	26.48	100.0	1.53	1.12
100.0	7.53	7.56	7.55	7.53	7.48	0.08	26.35	24.99	25.39	24.25	25.34	135.2	1.66	1.12
122.5	7.66	7.69	7.66	7.65	7.58	0.11	25.05	23.92	24.11	23.14	24.03	152.5	1.71	1.12
150.5	7.80	7.88	7.84	7.80	7.72	0.16	23.91	22.97	22.98	22.15	22.89	169.9	1.76	1.12
178.5	7.92	8.01	7.97	7.91	7.80	0.21	23.22	22.35	22.25	21.49	22.16	200.0	1.83	1.11
200.0	8.02	8.12	8.06	7.99	7.86	0.26	22.92	22.09	21.95	21.22	21.82	230.6	1.85	1.11
243.9	8.07	8.21	8.13	8.05	7.85	0.36	22.94	22.13	21.83	21.19	21.72	265.3	1.78	1.09
281.3	8.08	8.27	8.15	8.04	7.78	0.49	23.59	22.91	22.24	21.83	22.06	282.7	1.67	1.08
300.0	8.09	8.31	8.18	8.05	7.78	0.53	24.07	23.65	22.47	22.41	22.25	300.0	1.56	1.07

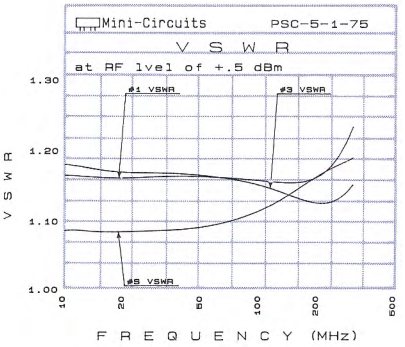
PSC-5-1-75

75 ohms

1 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	(dB) S-5	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 1-3	(dB) 2-3	(dB) 3-5	(dB) 4-5	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	7.40	7.42	7.40	7.41	7.41	0.02	43.47	22.47	44.90	22.10	36.42	10.0	1.09	1.17
10.0	7.24	7.24	7.24	7.26	7.24	0.02	45.39	28.95	48.20	28.76	41.61	27.4	1.09	1.16
20.0	7.27	7.26	7.26	7.26	7.24	0.03	42.90	28.98	43.39	28.90	40.15	44.1	1.09	1.16
38.4	7.29	7.31	7.31	7.31	7.29	0.02	38.98	28.42	38.22	28.40	36.70	52.8	1.09	1.16
50.0	7.30	7.28	7.28	7.28	7.26	0.04	37.09	28.16	36.08	28.05	34.94	78.2	1.11	1.16
75.8	7.33	7.33	7.33	7.31	7.32	0.02	34.03	27.65	32.76	27.41	31.98	95.6	1.11	1.16
100.0	7.33	7.36	7.36	7.36	7.32	0.04	31.90	27.11	30.52	26.76	29.91	112.2	1.12	1.16
122.5	7.38	7.40	7.40	7.38	7.33	0.07	30.46	26.74	29.03	26.22	28.45	137.6	1.14	1.15
150.5	7.37	7.45	7.45	7.43	7.38	0.08	29.11	26.37	27.60	25.63	27.00	155.0	1.15	1.16
178.5	7.42	7.54	7.51	7.49	7.39	0.15	28.00	25.99	26.43	25.11	25.82	180.4	1.16	1.16
200.0	7.45	7.57	7.56	7.49	7.42	0.15	27.36	25.83	25.73	24.78	25.13	200.0	1.17	1.16
225.3	7.47	7.65	7.60	7.55	7.43	0.22	26.73	25.72	25.08	24.54	24.42	231.9	1.17	1.18
253.3	7.56	7.74	7.69	7.66	7.49	0.25	26.21	25.80	24.49	24.36	23.75	257.2	1.18	1.20
281.3	7.62	7.84	7.78	7.69	7.51	0.33	25.80	26.02	23.98	24.34	23.22	274.6	1.18	1.21
300.0	7.67	7.91	7.82	7.75	7.55	0.36	25.54	26.27	23.67	24.38	22.87	300.0	1.19	1.23

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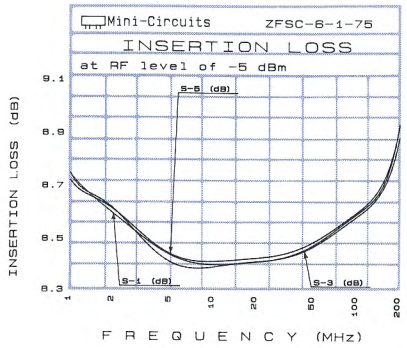
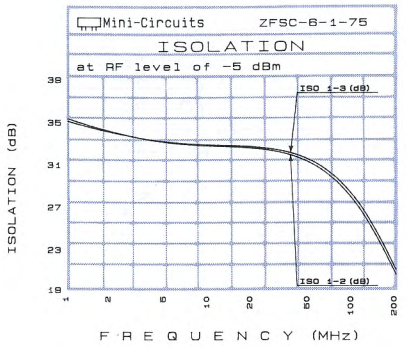
Mini-Circuits

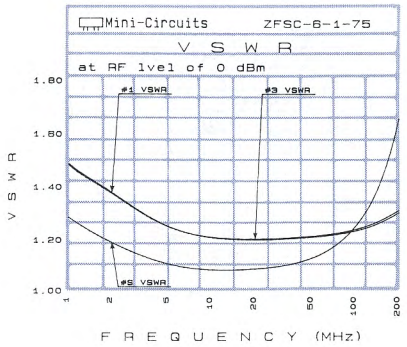
ZFSC-6-1-75

75 ohms

1 to 200MHz



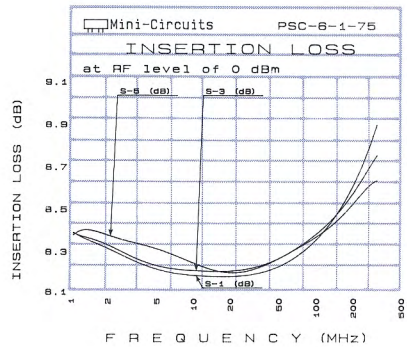


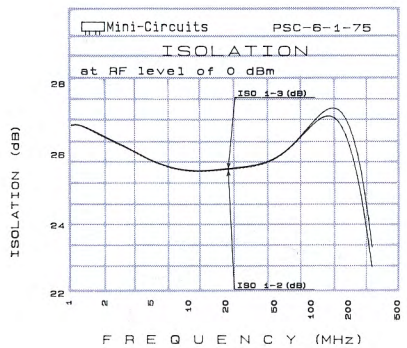


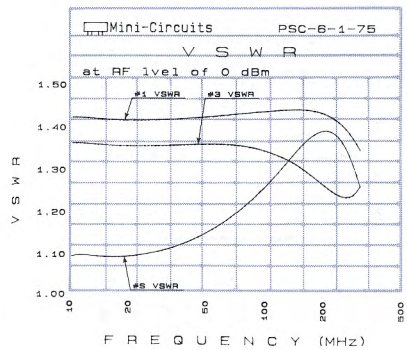
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
1.0	8.74	0.03	35.36	49.00	1.28	1.49
2.0	8.59	0.02	34.14	49.00	1.19	1.38
5.0	8.44	0.03	33.11	49.00	1.11	1.25
10.0	8.41	0.01	32.81	49.00	1.09	1.21
20.0	8.42	0.02	32.56	49.00	1.09	1.20
37.2	8.44	0.01	31.96	49.00	1.11	1.21
50.0	8.50	0.04	31.22	49.00	1.13	1.21
79.4	8.57	0.00	29.29	49.00	1.19	1.23
100.0	8.58	0.02	27.77	49.05	1.25	1.23
121.6	8.63	0.04	26.14	47.72	1.32	1.25
133.7	8.66	0.04	25.21	47.04	1.36	1.26
151.8	8.69	0.05	23.90	46.16	1.43	1.27
175.9	8.81	0.06	22.24	45.50	1.54	1.29
187.9	8.84	0.05	21.44	45.27	1.59	1.30
200.0	8.96	0.08	20.69	45.04	1.65	1.30

PSC-6-1-75

1 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
1.0	8.39	0.04	26.90	30.03	1.10	1.42
2.0	8.31	0.10	26.50	31.48	1.09	1.42
5.0	8.21	0.09	25.77	33.43	1.10	1.42
10.0	8.19	0.12	25.58	34.11	1.11	1.42
20.0	8.18	0.04	25.55	34.23	1.15	1.43
50.0	8.23	0.05	25.97	34.27	1.22	1.43
75.8	8.31	0.03	26.45	34.68	1.27	1.44
100.0	8.35	0.03	26.82	35.20	1.31	1.44
150.5	8.51	0.05	27.11	36.97	1.38	1.44
178.5	8.60	0.10	26.75	38.15	1.39	1.43
200.0	8.63	0.08	26.18	39.01	1.39	1.42
225.3	8.70	0.13	25.36	40.17	1.37	1.41
253.3	8.78	0.19	24.39	40.81	1.33	1.39
272.0	8.85	0.22	23.80	40.95	1.30	1.37
300.0	8.89	0.22	23.06	40.25	1.30	1.37

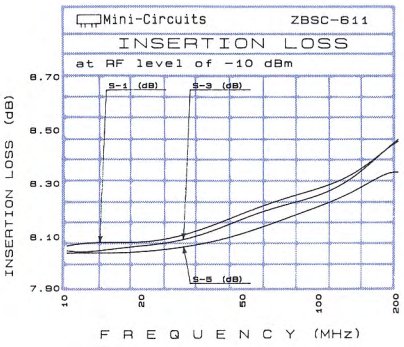
6WAY-0°

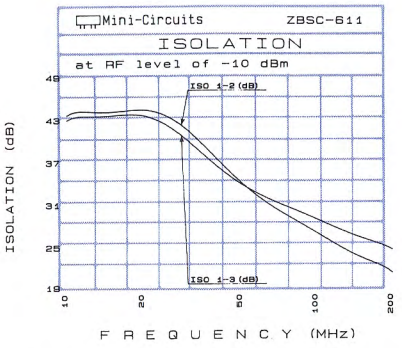
Power Splitter/Combiners

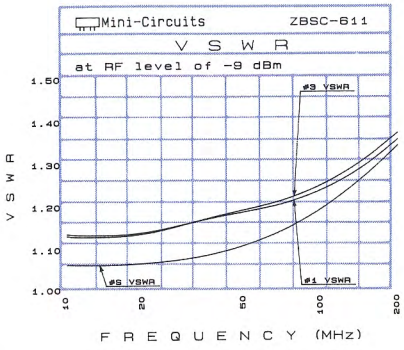
50 ohms

ZBSC-611

10 to 200MHz



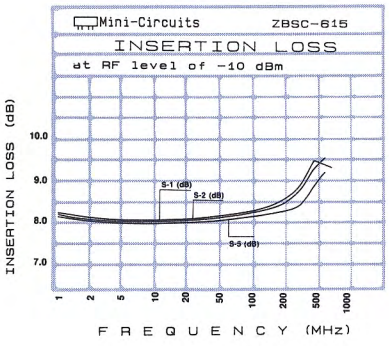


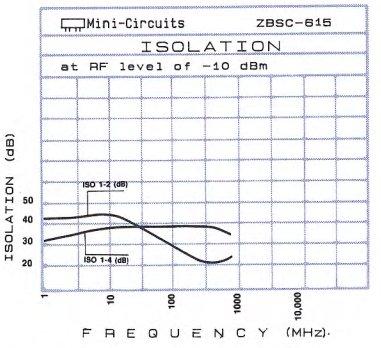


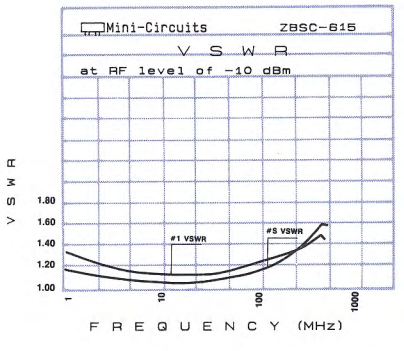
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
10.0	8.07	0.05	44.03	35.75	1.06	1.13
13.4	8.08	0.05	44.25	35.97	1.06	1.13
17.1	8.08	0.06	44.31	36.06	1.06	1.13
22.4	8.08	0.05	44.21	36.10	1.07	1.14
28.69	8.11	0.06	42.65	36.10	1.07	1.15
36.73	8.14	0.08	38.66	36.03	1.08	1.17
47.92	8.18	0.07	34.58	35.96	1.10	1.18
61.35	8.22	0.08	31.73	35.85	1.12	1.19
78.54	8.26	0.09	29.21	35.79	1.15	1.21
100.5	8.28	0.06	26.92	35.69	1.19	1.23
102.4	8.28	0.06	24.68	35.67	1.19	1.24
131.2	8.33	0.07	23.66	36.15	1.24	1.27
167.9	8.41	0.09	22.85	36.11	1.30	1.32
174.4	8.40	0.08	22.58	36.05	1.30	1.32
200.0	8.47	0.13	21.66	36.05	1.34	1.35

ZBSC-615

1 to 500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
1.0	8.26	0.07	40.22	30.14	1.18	1.24
2.2	8.18	0.06	41.83	32.43	1.08	1.17
4.9	8.09	0.05	43.18	34.47	1.06	1.13
10.0	8.07	0.05	44.03	35.75	1.07	1.14
22.4	8.08	0.05	44.21	36.10	1.10	1.18
47.92	8.18	0.07	34.58	35.96	1.19	1.23
100.0	8.28	0.06	26.92	35.69	1.30	1.32
167.9	8.41	0.09	22.85	36.11	1.34	1.35
199.2	8.47	0.13	21.66	36.05	1.43	1.44
280.5	8.80	0.37	19.83	35.72	1.54	1.49
359.1	9.22	0.67	18.86	35.50	1.60	1.50
402.5	9.45	0.84	18.71	35.33	1.65	1.50
468.6	9.64	0.85	18.85	34.59	1.16	1.12
477.6	9.63	0.84	18.93	34.46	1.64	1.50
500.0	9.52	0.37	20.25	33.08	1.64	1.50

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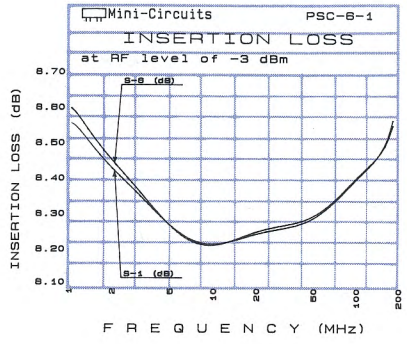
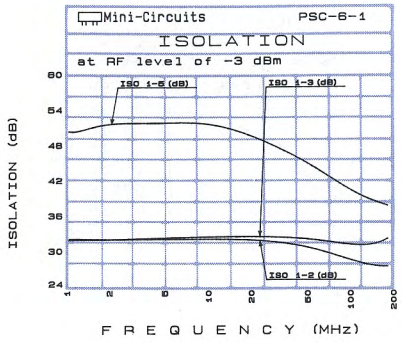
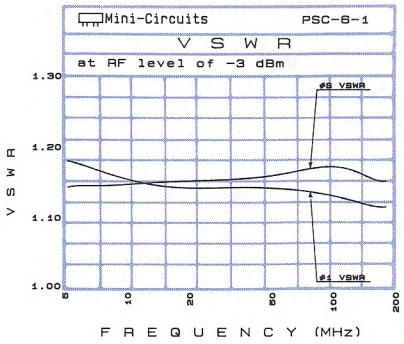
PSC-6-1, ZFSC-6-1

1 to 175MHz



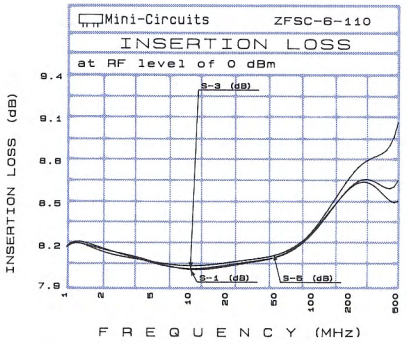


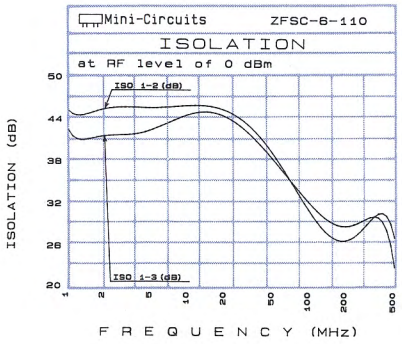


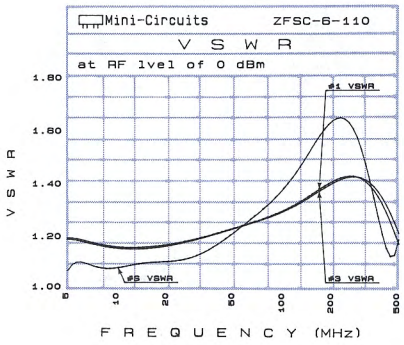
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
1.0	8.56	0.05	31.89	50.14	1.14	1.18
2.0	8.42	0.04	31.96	51.66	1.15	1.15
5.0	8.26	0.03	32.26	51.82	1.15	1.14
10.0	8.20	0.01	32.39	51.50	1.15	1.14
20.0	8.28	0.02	32.42	49.07	1.16	1.14
32.6	8.24	0.02	32.28	47.14	1.16	1.14
50.0	8.28	0.03	32.00	44.61	1.17	1.14
64.3	8.32	0.03	31.68	43.03	1.17	1.14
74.8	8.37	0.03	31.43	41.88	1.17	1.13
100.0	8.38	0.05	31.07	40.16	1.17	1.13
111.7	8.45	0.05	31.00	39.51	1.17	1.12
122.3	8.42	0.05	30.99	39.18	1.16	1.12
143.4	8.44	0.06	31.25	38.38	1.16	1.12
164.5	8.50	0.07	31.70	37.86	1.15	1.12
175.0	8.57	0.08	31.96	37.71	1.15	1.12

ZFSC-6-110

1 to 500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	VSWR S	VSWR OUTPUTS
1.0	8.22	0.01	44.56	29.35	1.09	1.19
2.0	8.19	0.06	45.29	32.10	1.09	1.19
5.0	8.08	0.02	45.99	35.37	1.09	1.19
10.0	8.04	0.04	45.73	37.50	1.08	1.15
20.0	8.06	0.02	45.13	38.38	1.10	1.16
50.0	8.13	0.04	38.35	42.11	1.21	1.22
79.0	8.22	0.04	33.08	49.00	1.31	1.26
100.0	8.33	0.02	30.94	53.19	1.39	1.29
125.8	8.38	0.06	29.30	50.27	1.46	1.31
200.0	8.63	0.09	26.99	42.12	1.62	1.38
250.5	8.70	0.13	26.89	39.63	1.62	1.40
375.3	8.61	0.29	32.00	36.25	1.31	1.34
422.0	8.57	0.39	32.64	35.57	1.10	1.27
468.8	8.64	0.48	27.82	35.22	1.13	1.22
500.0	8.76	0.54	24.76	35.16	1.25	1.19

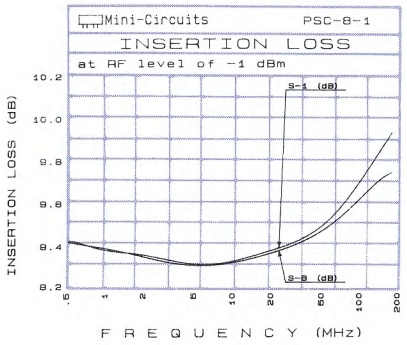
8WAY-0°

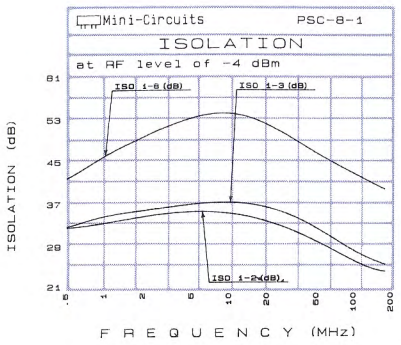
Power Splitter/Combiners

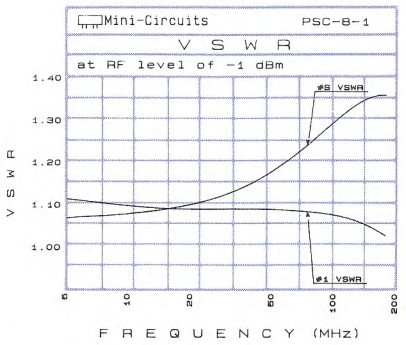
50 ohms

PSC-8-1, ZFSC-8-1

0.5 to 175MHz



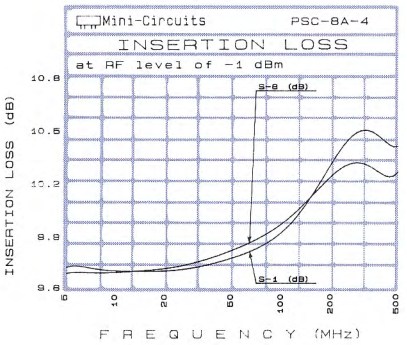


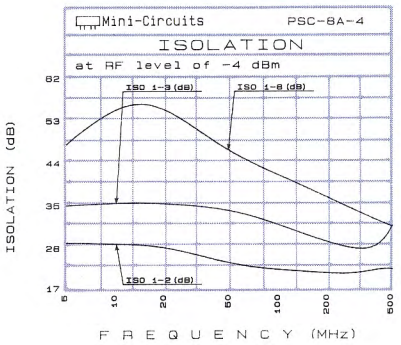


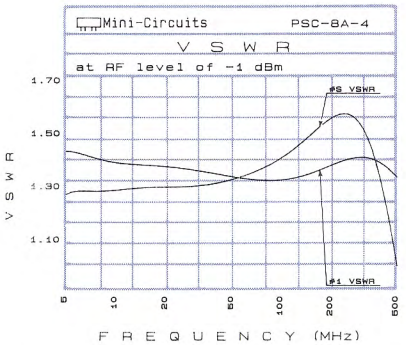
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
0.5	9.43	9.43	9.43	9.44	9.43	9.42	0.02	32.59	41.92	31.98	34.17	5.0	1.07	1.11	1.12
5.0	9.31	9.31	9.31	9.30	9.30	9.30	0.04	35.65	53.40	36.09	37.48	10.0	1.08	1.10	1.10
10.0	9.31	9.33	9.33	9.31	9.33	9.32	0.03	35.33	54.32	35.66	37.74	20.0	1.10	1.09	1.09
20.0	9.39	9.39	9.37	9.37	9.37	9.37	0.02	33.68	51.96	33.73	36.97	34.1	1.14	1.09	1.09
33.2	9.41	9.43	9.43	9.41	9.41	9.41	0.02	31.80	49.30	31.55	35.44	43.9	1.17	1.09	1.09
44.1	9.48	9.48	9.47	9.45	9.47	9.45	0.03	30.49	47.16	30.08	34.05	53.6	1.19	1.09	1.09
55.0	9.53	9.52	9.50	9.50	9.52	9.51	0.03	29.33	46.02	28.83	32.86	68.1	1.23	1.09	1.08
71.4	9.61	9.58	9.56	9.56	9.54	9.56	0.07	27.97	44.68	27.37	31.36	87.6	1.28	1.08	1.08
87.8	9.66	9.63	9.63	9.62	9.61	9.59	0.08	26.81	43.39	26.13	30.11	100.0	1.30	1.08	1.07
100.0	9.72	9.67	9.66	9.62	9.62	9.61	0.11	26.15	42.80	25.45	29.35	111.9	1.32	1.07	1.06
115.0	9.88	9.86	9.83	9.80	9.79	9.79	0.12	25.55	42.00	24.72	28.62	131.3	1.34	1.06	1.05
131.4	9.80	9.75	9.72	9.69	9.67	9.68	0.15	24.96	41.23	24.06	27.98	145.9	1.35	1.05	1.04
147.7	9.84	9.79	9.73	9.70	9.69	9.70	0.17	24.58	40.57	23.60	27.45	155.6	1.36	1.04	1.03
164.1	9.91	9.83	9.77	9.72	9.72	9.74	0.22	24.33	40.07	23.26	27.07	165.3	1.36	1.04	1.03
175.0	9.95	9.86	9.81	9.74	9.76	9.77	0.22	24.21	39.77	23.10	26.90	175.0	1.36	1.03	1.02

PSC-8A-4

5 to 500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
5.0	9.74	9.76	9.75	9.76	9.73	9.70	0.14	27.23	48.22	25.51	36.07	5.0	1.28	1.44	1.40
10.0	9.71	9.72	9.72	9.72	9.70	9.70	0.12	26.95	56.00	25.95	36.34	10.0	1.29	1.39	1.37
20.0	9.71	9.73	9.73	9.72	9.72	9.72	0.13	26.25	56.00	25.68	35.99	20.0	1.30	1.37	1.36
34.1	9.74	9.78	9.77	9.77	9.77	9.77	0.13	24.27	50.04	23.94	35.22	35.0	1.31	1.35	1.34
50.0	9.78	9.84	9.84	9.84	9.83	9.83	0.16	22.89	46.50	22.64	34.02	50.0	1.32	1.33	1.32
77.8	9.84	9.90	9.90	9.90	9.89	9.89	0.16	21.87	43.16	21.75	31.99	80.0	1.37	1.32	1.31
100.0	9.93	10.01	9.98	10.01	9.99	9.97	0.17	21.43	41.39	21.38	30.60	100.0	1.41	1.33	1.31
150.6	10.15	10.18	10.17	10.16	10.16	10.13	0.13	20.99	38.49	21.12	28.20	155.0	1.50	1.35	1.32
200.0	10.32	10.32	10.31	10.30	10.27	10.25	0.13	20.83	36.74	21.16	26.74	200.0	1.55	1.38	1.34
252.5	10.45	10.41	10.41	10.39	10.33	10.32	0.13	20.68	35.10	21.26	25.64	245.0	1.57	1.40	1.34
310.7	10.55	10.48	10.47	10.45	10.37	10.36	0.20	20.85	33.60	21.75	25.10	305.0	1.53	1.41	1.33
354.4	10.47	10.40	10.37	10.36	10.23	10.26	0.25	21.12	32.75	22.29	25.05	350.0	1.45	1.40	1.32
398.1	10.45	10.42	10.37	10.37	10.22	10.27	0.23	21.40	31.92	22.94	25.25	395.0	1.33	1.39	1.29
456.3	10.42	10.41	10.34	10.34	10.17	10.25	0.25	21.69	31.10	24.09	26.29	455.0	1.14	1.36	1.24
500.0	10.41	10.44	10.36	10.36	10.19	10.26	0.25	21.40	30.60	24.75	27.77	500.0	1.03	1.34	1.20

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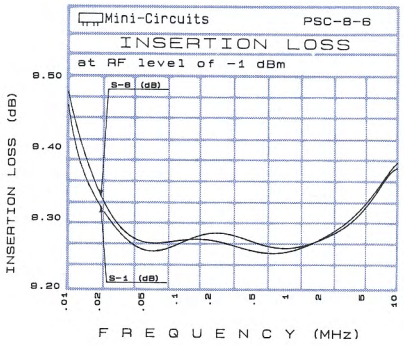
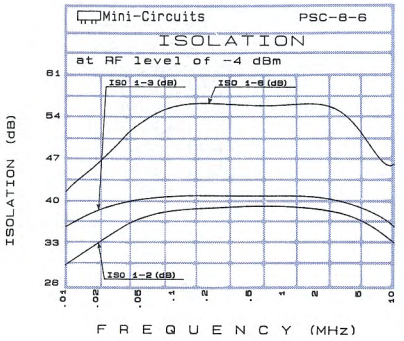
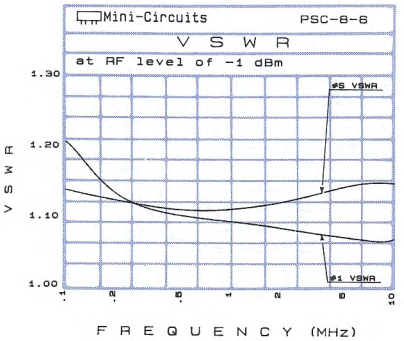
PSC-8-6, ZFSC-8-6

0.01 to 10MHz







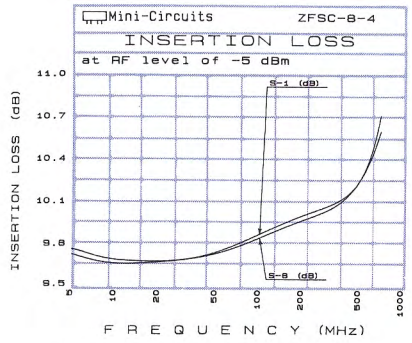
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
0.01	9.44	9.44	9.45	9.44	9.47	9.47	0.03	29.42	41.64	27.29	34.31	0.1	1.14	1.21	1.18
0.1	9.25	9.26	9.26	9.25	9.26	9.27	0.02	38.40	56.00	42.55	38.99	0.5	1.11	1.10	1.08
0.5	9.27	9.26	9.26	9.25	9.28	9.26	0.03	39.17	56.00	45.57	39.12	1.0	1.11	1.09	1.07
1.0	9.28	9.25	9.27	9.26	9.26	9.26	0.03	39.15	56.00	45.59	39.15	2.0	1.12	1.08	1.07
2.0	9.28	9.27	9.28	9.28	9.28	9.28	0.01	38.79	56.00	44.78	39.17	3.0	1.13	1.08	1.06
3.2	9.28	9.31	9.30	9.31	9.29	9.29	0.03	38.20	56.00	43.23	38.96	3.6	1.14	1.08	1.06
4.5	9.32	9.31	9.32	9.32	9.32	9.31	0.01	37.23	51.57	41.44	38.55	4.5	1.14	1.07	1.06
5.0	9.33	9.34	9.34	9.34	9.34	9.34	0.02	36.91	50.75	40.73	38.32	5.0	1.14	1.07	1.06
5.5	9.33	9.33	9.35	9.33	9.33	9.33	0.02	36.56	50.14	40.14	38.30	5.6	1.15	1.07	1.05
6.1	9.34	9.33	9.33	9.33	9.33	9.33	0.01	36.08	49.37	39.40	38.00	6.2	1.15	1.07	1.05
7.1	9.34	9.33	9.32	9.34	9.33	9.33	0.02	35.37	47.54	38.27	37.53	7.1	1.15	1.07	1.05
8.1	9.35	9.34	9.36	9.35	9.36	9.36	0.03	34.68	46.77	37.32	37.01	8.0	1.15	1.07	1.05
9.0	9.36	9.36	9.37	9.37	9.38	9.38	0.02	33.90	45.96	36.30	36.55	8.8	1.15	1.07	1.05
9.7	9.39	9.39	9.39	9.37	9.39	9.37	0.02	33.46	45.54	35.68	36.24	9.7	1.15	1.07	1.05
10.0	9.37	9.38	9.40	9.38	9.38	9.38	0.03	33.35	45.52	35.55	36.10	10.0	1.15	1.07	1.05

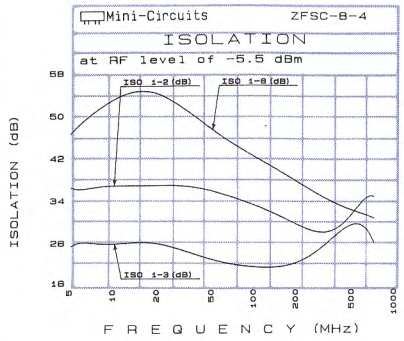
Power Splitter/Combiners

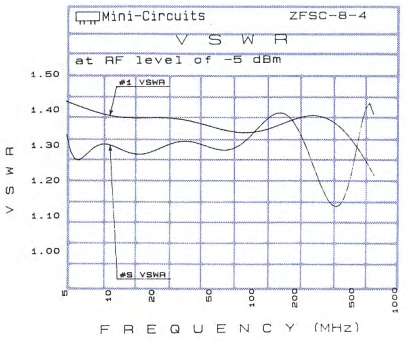
50 ohms

ZFSC-8-4

5 to 700MHz



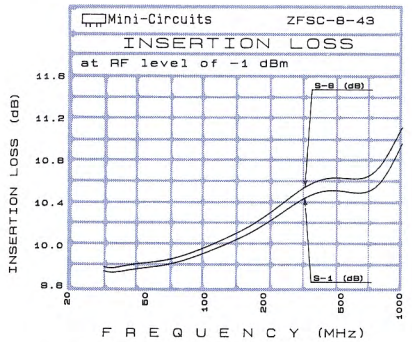


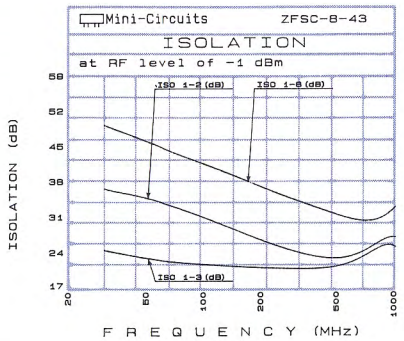


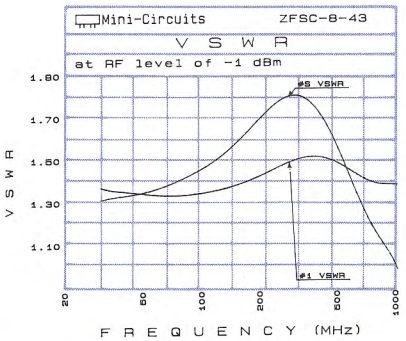
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
5.0	9.76	9.78	9.76	9.74	9.70	9.72	0.08	36.12	46.91	36.16	26.69	5.0	1.28	1.42	1.46
10.0	9.68	9.68	9.67	9.67	9.67	9.65	0.03	36.72	53.57	36.85	26.58	10.0	1.28	1.38	1.39
20.0	9.68	9.69	9.68	9.66	9.67	9.68	0.04	36.90	54.49	37.09	26.28	20.0	1.29	1.37	1.37
50.0	9.72	9.73	9.74	9.73	9.72	9.72	0.02	35.74	47.00	36.19	22.96	50.0	1.29	1.35	1.35
100.0	9.88	9.83	9.84	9.80	9.82	9.82	0.08	32.96	42.10	33.67	21.70	100.0	1.33	1.33	1.33
152.4	9.93	9.92	9.90	9.90	9.90	9.91	0.03	30.70	39.24	31.51	21.94	152.4	1.36	1.35	1.35
200.0	9.99	9.94	9.95	9.96	9.93	9.96	0.06	29.34	37.39	30.10	22.63	200.0	1.35	1.37	1.37
257.7	10.04	10.02	10.01	10.04	10.01	10.02	0.04	28.40	35.65	29.00	23.96	257.7	1.29	1.38	1.38
299.9	10.07	10.04	10.06	10.10	10.06	10.07	0.07	28.14	34.71	28.57	25.27	299.9	1.22	1.38	1.38
342.0	10.09	10.04	10.03	10.07	10.03	10.06	0.06	28.18	33.92	28.36	26.81	342.0	1.13	1.37	1.37
405.2	10.13	10.08	10.11	10.16	10.10	10.10	0.08	28.92	32.98	28.52	29.59	405.2	1.03	1.34	1.35
447.3	10.15	10.15	10.15	10.22	10.17	10.15	0.08	29.81	32.43	28.83	31.57	447.3	1.13	1.32	1.33
500.0	10.28	10.23	10.28	10.32	10.29	10.26	0.11	31.38	31.92	29.39	34.51	500.0	1.26	1.30	1.31
615.8	10.47	10.49	10.53	10.61	10.50	10.43	0.21	34.91	31.14	30.45	42.82	615.8	1.42	1.25	1.25
700.0	10.68	10.70	10.72	10.81	10.65	10.57	0.25	33.59	30.58	30.04	27.47	700.0	1.31	1.19	1.17

ZFSC-8-43

10 to 1000MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
10.0	9.75	9.76	9.76	9.78	9.78	9.79	0.04	36.51	49.17	36.60	23.35	10.0	1.32	1.37	1.37
59.1	9.82	9.82	9.82	9.85	9.85	9.86	0.04	33.98	44.84	34.18	21.64	57.7	1.36	1.34	1.34
100.3	9.94	9.94	9.94	9.96	9.98	9.99	0.05	30.82	41.31	31.09	21.04	100.0	1.46	1.34	1.35
199.8	10.21	10.21	10.23	10.23	10.27	10.28	0.08	26.40	36.89	26.66	20.49	200.0	1.70	1.43	1.44
258.0	10.35	10.36	10.38	10.37	10.43	10.44	0.12	25.01	35.38	25.22	20.39	251.5	1.78	1.47	1.48
342.8	10.48	10.47	10.51	10.49	10.58	10.58	0.16	23.66	33.67	23.79	20.39	334.5	1.81	1.51	1.49
430.1	10.52	10.52	10.58	10.53	10.64	10.64	0.20	23.01	32.39	23.03	20.62	445.3	1.65	1.51	1.49
500.5	10.54	10.52	10.61	10.54	10.66	10.66	0.25	22.87	31.37	22.70	21.04	500.0	1.54	1.48	1.46
599.9	10.48	10.45	10.58	10.46	10.62	10.62	0.31	23.25	30.66	22.89	21.89	583.7	1.39	1.44	1.40
658.1	10.48	10.47	10.59	10.47	10.64	10.63	0.31	23.82	30.33	23.22	22.53	639.1	1.31	1.42	1.37
713.9	10.53	10.52	10.66	10.52	10.70	10.68	0.34	24.46	30.23	23.68	23.26	722.1	1.22	1.40	1.33
801.2	10.66	10.62	10.79	10.60	10.85	10.81	0.40	25.53	30.39	24.32	24.08	805.2	1.14	1.39	1.32
886.0	10.76	10.73	10.91	10.66	10.98	10.93	0.46	26.43	31.01	24.71	24.39	888.3	1.06	1.38	1.32
970.9	10.92	10.93	11.07	10.79	11.15	11.07	0.48	26.95	32.05	24.74	23.10	971.3	1.02	1.38	1.34
1000.0	10.98	11.02	11.12	10.84	11.21	11.13	0.49	27.05	32.51	24.69	22.29	1000.0	1.01	1.38	1.34

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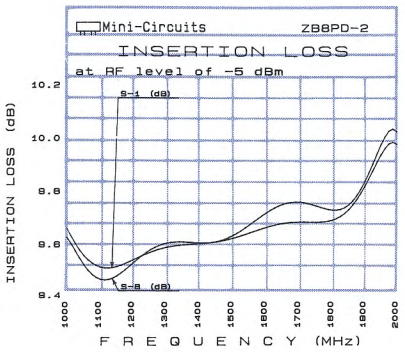
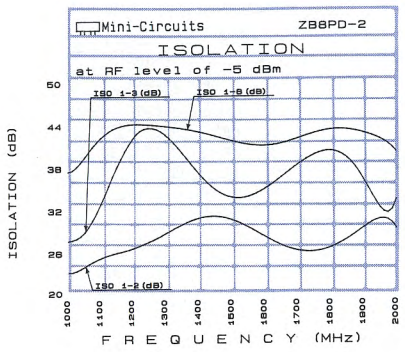
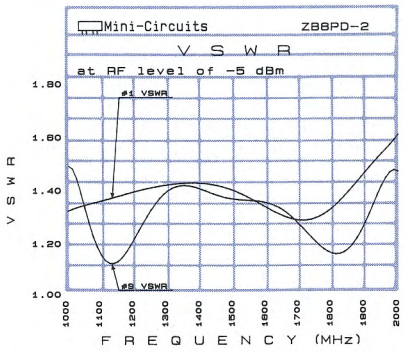
ZB8PD-2

1 to 2.0GHz



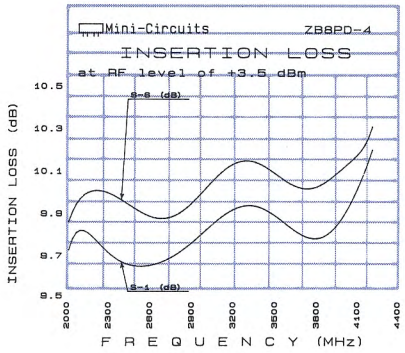


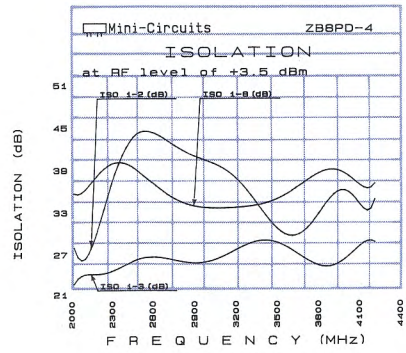


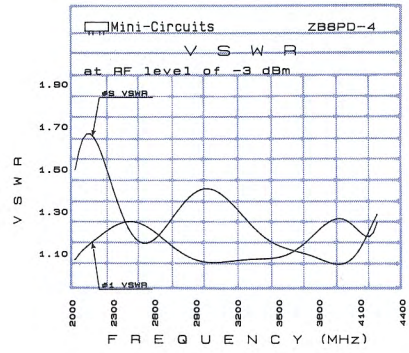
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
1000.0	9.68	9.42	9.40	9.77	9.41	9.65	0.37	23.03	37.42	23.30	27.25	1000.0	1.53	1.33	1.29
1055.0	9.56	9.32	9.29	9.65	9.28	9.52	0.37	24.32	39.69	24.77	29.67	1052.5	1.32	1.34	1.31
1107.5	9.49	9.20	9.18	9.58	9.20	9.46	0.40	25.35	42.74	25.96	32.77	1105.0	1.16	1.37	1.32
1215.0	9.54	9.26	9.26	9.66	9.28	9.55	0.40	26.95	44.00	27.93	39.45	1210.0	1.24	1.40	1.36
1325.0	9.62	9.33	9.35	9.76	9.37	9.63	0.43	29.09	43.82	30.40	36.77	1315.0	1.41	1.43	1.40
1377.5	9.60	9.30	9.33	9.73	9.38	9.61	0.43	30.35	43.57	31.54	34.88	1367.5	1.42	1.43	1.41
1460.0	9.60	9.27	9.28	9.71	9.32	9.60	0.44	31.44	42.00	31.63	33.48	1447.5	1.39	1.42	1.42
1500.0	9.62	9.28	9.28	9.75	9.32	9.63	0.47	30.85	42.99	30.29	33.06	1500.0	1.36	1.40	1.42
1595.0	9.68	9.31	9.30	9.82	9.37	9.73	0.52	28.07	41.27	27.01	33.90	1605.0	1.35	1.33	1.38
1702.5	9.65	9.27	9.25	9.84	9.35	9.74	0.59	26.37	42.39	25.18	38.19	1710.0	1.27	1.29	1.36
1757.5	9.71	9.27	9.23	9.87	9.33	9.75	0.64	26.31	42.70	25.09	44.00	1762.5	1.19	1.30	1.38
1810.0	9.70	9.27	9.23	9.87	9.32	9.73	0.64	27.04	42.87	25.69	44.00	1815.0	1.15	1.35	1.43
1865.0	9.74	9.29	9.28	9.92	9.35	9.77	0.64	28.47	43.33	26.92	39.40	1867.5	1.21	1.41	1.49
1920.0	9.86	9.40	9.38	10.03	9.43	9.88	0.65	30.25	43.28	28.74	34.41	1920.0	1.34	1.50	1.58
2000.0	9.99	9.49	9.49	10.16	9.53	10.04	0.67	29.63	40.72	29.66	30.79	2000.0	1.50	1.61	1.70

ZB8PD-4

2 to 4.2GHz







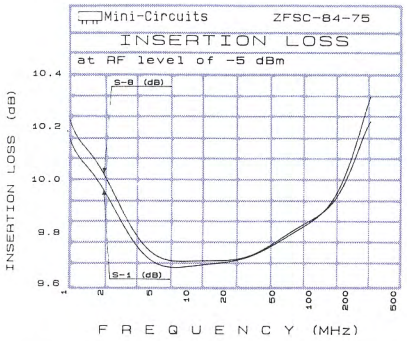
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
2000.0	9.74	9.64	9.61	9.68	9.69	9.86	0.25	25.56	35.13	24.97	24.41	2000.0	1.56	1.08	1.06
2187.0	9.80	9.64	9.59	9.71	9.69	10.03	0.44	31.15	38.43	29.99	25.42	2187.0	1.61	1.19	1.19
2379.5	9.66	9.41	9.42	9.65	9.53	9.96	0.55	41.53	40.23	37.52	26.38	2379.5	1.19	1.25	1.25
2500.5	9.67	9.47	9.50	9.69	9.56	9.91	0.44	46.21	38.82	43.03	27.17	2500.5	1.14	1.23	1.22
2753.5	9.70	9.47	9.47	9.72	9.53	9.90	0.43	40.79	34.85	42.66	26.86	2753.5	1.28	1.12	1.11
2880.0	9.75	9.52	9.55	9.81	9.57	9.91	0.39	38.60	34.04	40.73	26.29	2880.0	1.38	1.05	1.04
3001.0	9.81	9.57	9.63	9.92	9.62	9.97	0.40	41.53	33.65	42.55	26.18	3001.0	1.44	1.03	1.03
3133.0	9.95	9.71	9.83	10.18	9.93	10.21	0.50	41.55	33.73	36.86	27.02	3133.0	1.33	1.09	1.08
3320.0	9.80	9.54	9.69	10.05	9.76	10.04	0.51	32.92	33.98	30.72	28.90	3320.0	1.20	1.09	1.11
3501.5	9.96	9.69	9.70	10.04	9.70	10.09	0.40	30.17	35.04	29.40	29.14	3501.5	1.15	1.04	1.08
3633.5	9.83	9.60	9.63	10.02	9.57	10.10	0.53	30.91	36.42	30.41	26.96	3633.5	1.09	1.15	1.17
3820.5	9.79	9.59	9.62	10.08	9.49	9.94	0.59	33.98	39.41	32.10	24.87	3820.5	1.08	1.24	1.28
4002.0	9.89	9.71	9.81	10.36	9.59	10.14	0.77	34.98	37.56	31.30	25.79	4002.0	1.06	1.23	1.28
4139.5	10.09	9.80	9.84	10.47	9.79	10.21	0.68	34.72	36.94	38.58	27.92	4139.5	1.20	1.20	1.26
4200.0	10.20	9.87	9.91	10.59	9.90	10.30	0.72	31.52	36.06	34.86	28.84	4200.0	1.30	1.18	1.24

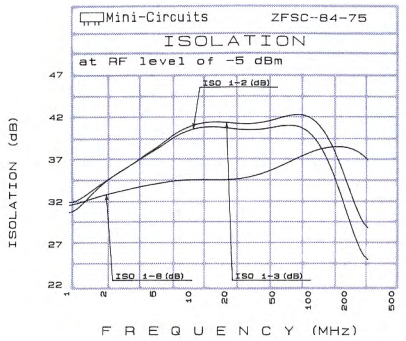
Power Splitter/Combiners

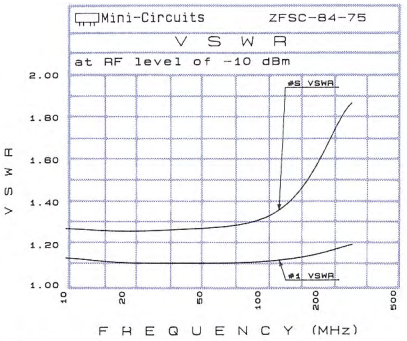
75 ohms

ZFSC-84-75, PSC-8A-4-75

1 to 300MHz



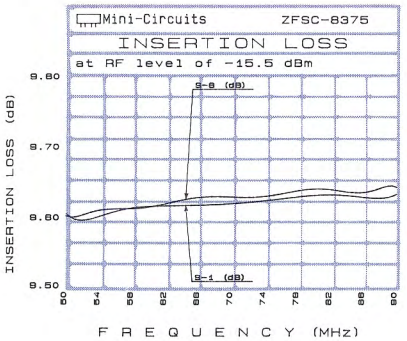


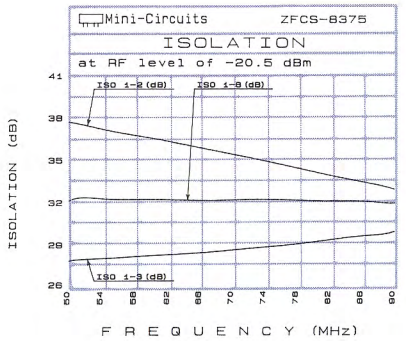


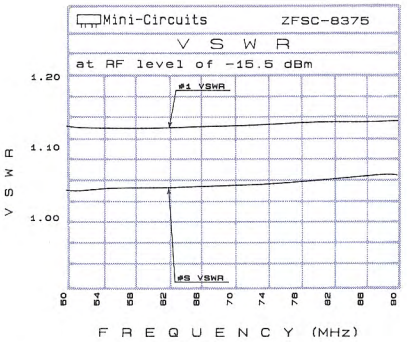
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
1.0	10.16	10.15	10.15	10.15	10.23	10.23	0.08	30.46	31.56	30.53	30.81	10.0	1.28	1.14	1.13
5.0	9.67	9.68	9.67	9.67	9.70	9.70	0.04	38.31	34.17	38.41	37.41	20.0	1.26	1.11	1.11
10.0	9.67	9.68	9.68	9.67	9.69	9.69	0.02	40.46	34.56	40.52	40.14	26.6	1.27	1.11	1.11
20.0	9.69	9.69	9.68	9.68	9.70	9.70	0.03	40.78	34.61	40.80	40.87	50.0	1.28	1.11	1.11
50.0	9.76	9.75	9.76	9.75	9.76	9.76	0.01	40.67	35.95	40.91	40.80	76.3	1.29	1.11	1.11
75.8	9.81	9.80	9.82	9.82	9.83	9.83	0.04	41.03	37.11	41.43	41.10	100.0	1.32	1.12	1.12
100.0	9.86	9.86	9.86	9.86	9.87	9.87	0.02	40.15	37.83	40.79	40.64	117.8	1.35	1.12	1.12
122.5	9.86	9.84	9.86	9.85	9.87	9.85	0.05	38.45	38.22	39.06	39.59	142.6	1.40	1.13	1.13
150.5	9.92	9.91	9.95	9.92	9.92	9.91	0.04	35.44	38.46	35.97	37.75	167.4	1.47	1.14	1.14
178.5	10.03	9.99	10.04	10.01	10.02	10.00	0.05	32.68	38.53	33.12	35.72	192.3	1.56	1.15	1.15
200.0	10.07	10.04	10.09	10.05	10.06	10.03	0.06	30.71	38.41	31.09	34.13	208.9	1.62	1.16	1.15
225.3	10.12	10.09	10.16	10.11	10.09	10.08	0.08	28.84	38.23	29.15	32.48	233.7	1.70	1.17	1.16
253.3	10.19	10.16	10.21	10.18	10.17	10.14	0.07	27.04	37.79	27.36	30.72	258.6	1.78	1.18	1.17
272.0	10.25	10.21	10.27	10.23	10.21	10.17	0.10	26.01	37.52	26.34	29.76	275.1	1.83	1.19	1.18
300.0	10.32	10.27	10.35	10.31	10.26	10.23	0.12	24.66	36.99	24.97	28.64	300.0	1.86	1.20	1.18

ZFSC-8375

50 to 90MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
50.0	9.60	9.60	9.60	9.60	9.60	9.60	0.01	37.75	32.22	36.84	27.75	50.0	1.04	1.13	1.12
54.1	9.60	9.61	9.62	9.62	9.60	9.61	0.02	37.17	32.32	36.43	27.94	54.1	1.04	1.13	1.12
57.2	9.61	9.60	9.62	9.61	9.62	9.61	0.02	36.76	32.18	35.97	28.10	57.2	1.04	1.13	1.12
60.3	9.61	9.62	9.63	9.62	9.63	9.61	0.02	36.69	32.24	35.48	28.19	60.3	1.04	1.12	1.13
63.3	9.62	9.62	9.64	9.62	9.62	9.63	0.02	36.14	32.21	35.18	28.30	63.3	1.04	1.13	1.13
65.4	9.62	9.61	9.62	9.62	9.62	9.62	0.02	35.89	32.12	34.86	28.50	65.4	1.04	1.13	1.13
68.5	9.62	9.63	9.63	9.64	9.64	9.63	0.02	35.63	32.23	34.77	28.66	68.5	1.05	1.13	1.13
70.5	9.63	9.62	9.64	9.64	9.64	9.63	0.02	35.25	32.30	34.52	28.66	70.5	1.05	1.13	1.13
73.6	9.63	9.63	9.65	9.64	9.64	9.63	0.02	35.08	32.21	34.02	28.93	73.6	1.05	1.13	1.13
75.6	9.62	9.63	9.64	9.64	9.63	9.62	0.03	34.74	32.22	33.70	29.13	75.6	1.05	1.14	1.13
78.7	9.63	9.62	9.64	9.64	9.63	9.63	0.03	34.39	32.16	33.14	29.38	78.7	1.05	1.14	1.14
80.8	9.63	9.63	9.64	9.65	9.64	9.64	0.02	34.21	32.05	33.27	29.46	80.8	1.06	1.14	1.14
85.9	9.63	9.63	9.66	9.65	9.65	9.64	0.03	33.57	32.13	32.56	29.92	85.9	1.06	1.14	1.14
89.0	9.63	9.63	9.65	9.65	9.65	9.64	0.03	33.04	31.95	32.07	30.16	89.0	1.06	1.14	1.15
90.0	9.63	9.64	9.66	9.66	9.65	9.65	0.03	33.04	32.00	31.96	30.49	90.0	1.06	1.14	1.14

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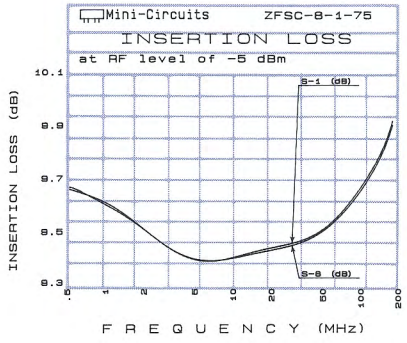
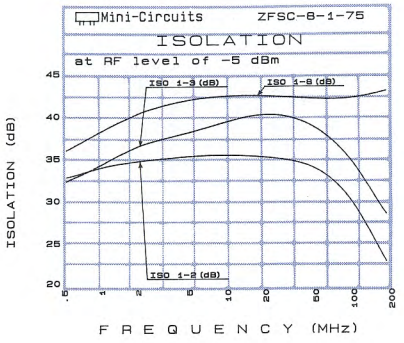
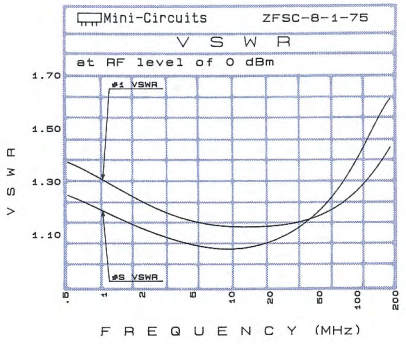
ZFSC-8-1-75, PSC-8-1-75

0.5 to 175MHz



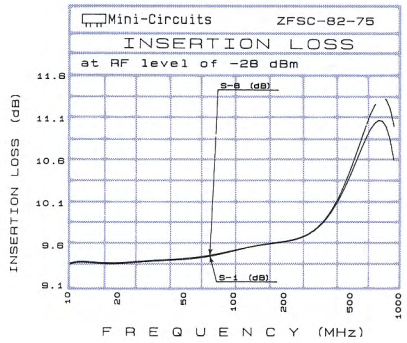


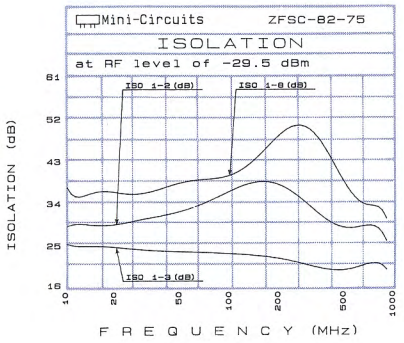


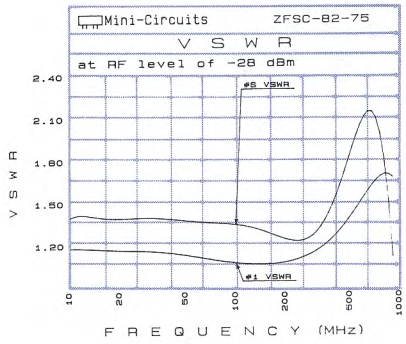
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
0.5	9.67	9.67	9.65	9.66	9.65	9.66	0.03	32.75	35.97	34.21	32.47	0.5	1.25	1.38	1.35
5.0	9.38	9.39	9.39	9.39	9.38	9.38	0.02	35.25	42.03	35.90	37.98	4.9	1.06	1.14	1.13
10.0	9.42	9.42	9.40	9.42	9.41	9.41	0.02	35.38	42.31	35.74	38.84	10.1	1.04	1.13	1.11
20.0	9.45	9.45	9.45	9.44	9.45	9.44	0.01	35.12	42.29	35.32	38.97	20.1	1.07	1.13	1.11
38.7	9.48	9.47	9.48	9.48	9.48	9.48	0.01	34.37	42.10	34.40	38.13	38.9	1.15	1.16	1.48
50.0	9.50	9.51	9.52	9.51	9.51	9.50	0.02	33.66	41.97	33.58	37.38	49.8	1.20	1.17	1.16
65.9	9.56	9.57	9.58	9.57	9.56	9.55	0.03	32.48	41.97	32.30	36.20	65.9	1.26	1.20	1.18
82.3	9.61	9.61	9.61	9.63	9.62	9.60	0.03	30.88	42.03	30.64	34.83	82.5	1.33	1.24	1.21
100.0	9.68	9.68	9.70	9.69	9.68	9.66	0.04	29.17	42.14	28.91	33.37	104.3	1.42	1.28	1.26
115.0	9.71	9.70	9.74	9.72	9.72	9.68	0.06	27.77	42.48	27.46	32.16	120.5	1.47	1.32	1.30
131.4	9.78	9.76	9.81	9.79	9.79	9.78	0.05	26.29	42.40	25.96	30.86	131.4	1.51	1.34	1.32
142.3	9.78	9.79	9.82	9.80	9.78	9.78	0.04	25.33	42.51	24.98	30.08	142.3	1.54	1.36	1.35
153.2	9.83	9.81	9.87	9.85	9.82	9.81	0.06	24.42	42.68	24.07	29.40	153.2	1.57	1.38	1.37
164.1	9.89	9.87	9.94	9.89	9.90	9.87	0.07	23.57	42.78	23.24	28.77	164.1	1.59	1.41	1.38
175.0	9.90	9.90	9.96	9.92	9.91	9.89	0.07	22.75	42.90	22.41	28.20	175.0	1.61	1.43	1.40

ZFSC-82-75

10 to 900MHz







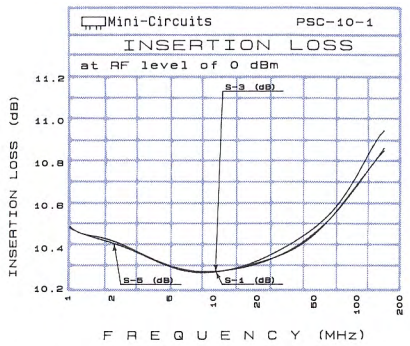
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	S-2	S-3	S-4	S-6	S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	1-8	3-4	5-7	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 8
10.0	9.40	9.41	9.41	9.41	9.42	9.41	0.02	29.52	36.05	29.51	25.17	10.0	1.42	1.18	1.18
69.8	9.48	9.49	9.49	9.48	9.49	9.50	0.02	34.13	38.89	34.42	23.71	69.8	1.37	1.10	1.10
128.3	9.59	9.60	9.60	9.60	9.59	9.59	0.02	38.29	42.62	37.90	23.28	128.3	1.32	1.07	1.06
200.3	9.67	9.68	9.66	9.68	9.67	9.65	0.04	38.05	46.47	38.03	22.53	200.3	1.25	1.08	1.07
247.5	9.74	9.73	9.74	9.75	9.73	9.73	0.05	36.02	51.70	35.74	21.95	247.5	1.24	1.11	1.10
306.0	9.84	9.85	9.85	9.87	9.84	9.84	0.08	33.18	50.48	33.23	21.22	306.0	1.29	1.16	1.14
366.8	9.98	10.00	10.01	10.03	9.98	9.97	0.13	31.21	45.06	30.97	20.73	366.8	1.42	1.23	1.21
400.5	10.10	10.15	10.14	10.15	10.10	10.09	0.12	30.35	42.54	30.06	20.50	400.5	1.52	1.27	1.24
450.0	10.34	10.37	10.38	10.39	10.31	10.29	0.18	29.37	40.07	28.95	20.41	450.0	1.68	1.33	1.30
499.5	10.60	10.65	10.63	10.66	10.57	10.52	0.23	28.91	38.20	28.26	20.50	499.5	1.84	1.41	1.36
573.8	10.94	10.99	10.99	11.02	10.87	10.82	0.31	28.69	36.01	27.82	21.22	573.8	2.06	1.51	1.45
632.3	11.17	11.25	11.23	11.27	11.07	10.99	0.40	28.96	35.06	27.64	22.20	632.3	2.17	1.58	1.51
722.3	11.34	11.48	11.40	11.49	11.18	11.11	0.55	29.20	33.18	27.66	24.58	722.3	2.09	1.67	1.57
810.0	11.23	11.41	11.31	11.41	11.03	10.91	0.73	28.45	32.47	27.44	26.83	810.0	1.72	1.70	1.57
900.0	11.26	11.52	11.34	11.47	10.99	10.86	0.97	26.08	32.11	26.08	26.29	900.0	1.26	1.69	1.54

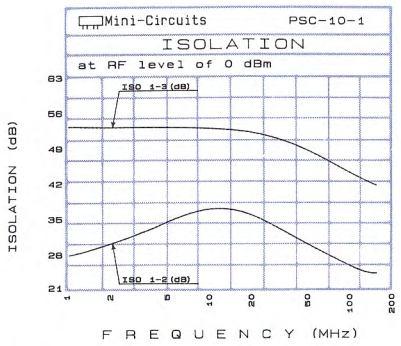
Power Splitter/Combiners

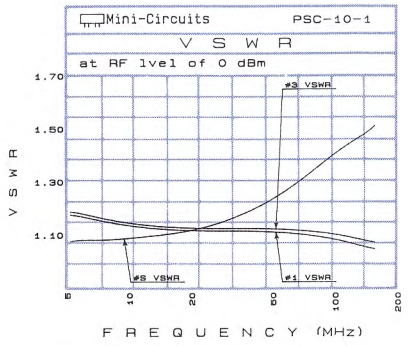
50 ohms

PSC-10-1

1 to 150MHz



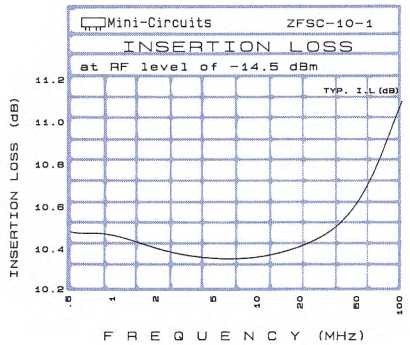


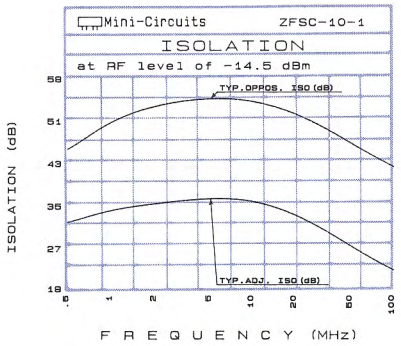


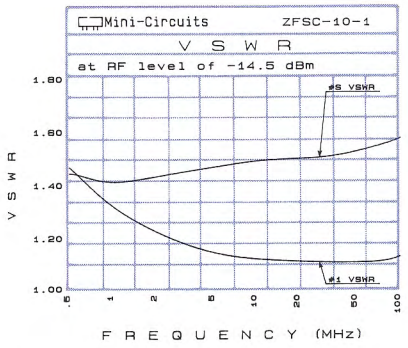
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	10.49	0.01	27.80	32.83	5.00	1.08	1.08
5.0	10.32	0.01	34.56	35.43	10.0	1.09	1.06
10.0	10.29	0.02	37.26	26.24	20.0	1.12	1.06
14.5	10.32	0.01	36.89	36.22	25.7	1.14	1.06
20.0	10.33	0.02	35.61	35.86	34.0	1.18	1.06
37.1	10.46	0.02	31.87	34.18	50.0	1.24	1.05
50.0	10.51	0.03	29.89	32.86	63.0	1.30	1.05
59.7	10.54	0.04	28.77	31.96	75.4	1.34	1.05
73.2	10.62	0.06	27.42	30.93	92.0	1.39	1.04
86.8	10.69	0.08	26.39	30.11	100.0	1.42	1.04
100.0	10.75	0.12	25.61	29.53	112.7	1.45	1.04
109.4	10.82	0.14	25.17	29.21	121.0	1.46	1.03
122.9	10.87	0.16	24.68	28.94	129.3	1.47	1.03
136.5	10.90	0.19	24.35	38.83	137.6	1.48	1.03
150.0	10.98	0.23	24.17	28.95	150.0	1.52	1.02

ZFSC-10-1

0.5 to 100MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.5	10.48	0.19	32.03	45.77	0.5	1.45	1.47
1.0	10.47	0.15	34.31	50.96	1.0	1.41	1.32
2.0	10.40	0.12	35.53	54.05	2.0	1.43	1.22
5.0	10.35	0.08	36.46	55.59	5.0	1.47	1.14
10.0	10.36	0.08	35.93	54.99	10.0	1.49	1.12
15.7	10.39	0.06	34.48	53.16	15.7	1.49	1.11
24.6	10.44	0.04	32.24	51.48	24.6	1.50	1.11
30.8	10.47	0.04	30.86	49.89	30.8	1.50	1.11
42.8	10.57	0.04	28.57	48.00	42.8	1.52	1.11
50.2	10.62	0.07	27.48	46.87	50.2	1.52	1.11
55.1	10.69	0.10	26.84	46.24	55.1	1.53	1.11
75.7	10.89	0.25	24.73	44.26	75.7	1.56	1.11
85.3	10.96	0.31	23.96	43.53	85.3	1.56	1.12
93.6	11.05	0.37	23.42	42.88	93.6	1.57	1.12
100.0	11.10	0.39	23.07	42.61	100.0	1.57	1.13

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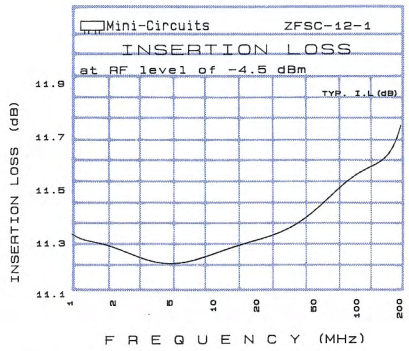
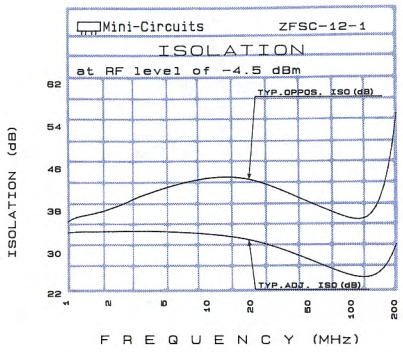
Mini-Circuits

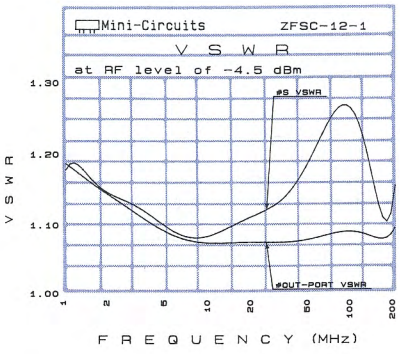
PSC-12-1, ZFSC-12-1

50 ohms

1 to 200MHz



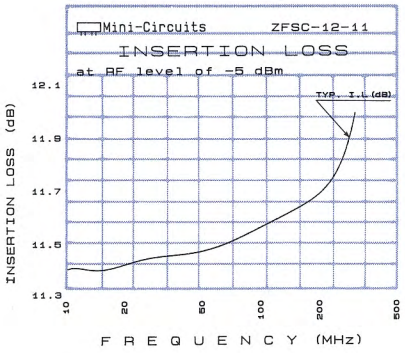


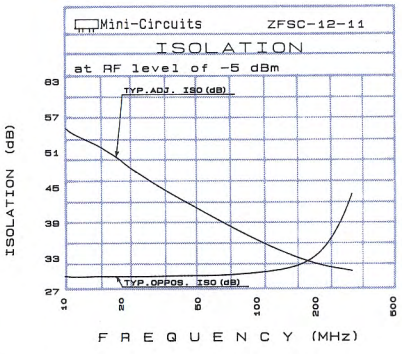


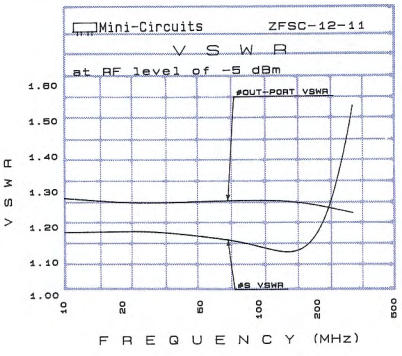
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	11.40	0.02	34.74	51.08	1.0	1.16	1.14
5.0	11.21	0.02	34.82	56.62	5.0	1.06	1.07
10.0	11.23	0.00	34.16	54.77	10.0	1.03	1.07
19.9	11.28	0.01	33.32	52.11	19.9	1.03	1.07
32.3	11.33	0.00	32.57	51.94	32.3	1.05	1.06
49.8	11.40	0.01	31.56	50.39	49.8	1.10	1.06
63.2	11.45	0.01	30.98	49.40	63.2	1.13	1.05
75.6	11.50	0.04	30.41	48.98	75.6	1.17	1.05
100.0	11.59	0.05	29.54	48.19	100.0	1.22	1.05
112.9	11.63	0.07	29.22	47.62	112.9	1.24	1.05
131.4	11.69	0.09	28.99	47.45	131.4	1.27	1.06
150.3	11.76	0.15	28.87	47.60	150.3	1.29	1.06
175.1	11.83	0.21	29.09	48.07	175.1	1.29	1.06
187.6	11.89	0.24	29.38	48.01	187.6	1.29	1.07
200.0	11.94	0.27	29.74	48.35	200.0	1.28	1.07

ZFSC-12-11

10 to 300MHz





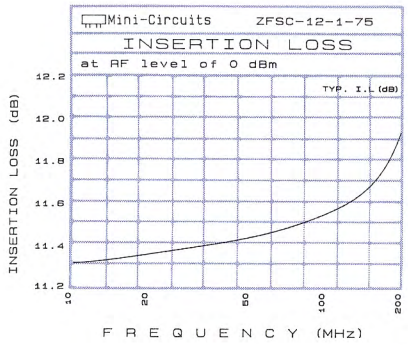


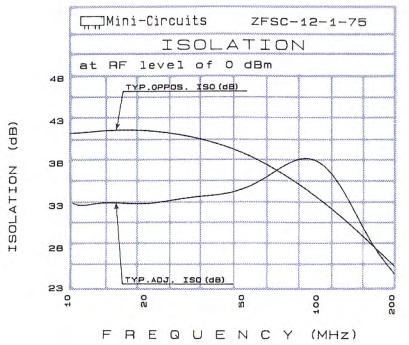
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
10.0	11.41	0.03	54.87	29.90	10.0	1.19	1.28
34.9	11.46	0.07	44.20	29.95	34.7	1.18	1.27
50.0	11.49	0.02	41.26	30.05	49.9	1.17	1.27
84.6	11.53	0.04	37.18	30.32	84.7	1.15	1.27
100.0	11.57	0.04	35.93	30.50	99.9	1.14	1.27
134.3	11.62	0.04	34.04	31.15	134.0	1.12	1.27
150.9	11.63	0.03	33.34	31.59	150.7	1.12	1.26
167.4	11.66	0.03	32.83	32.16	167.3	1.14	1.26
184.0	11.67	0.02	32.33	32.84	184.0	1.16	1.26
200.0	11.68	0.01	31.98	33.69	200.0	1.19	1.25
233.7	11.77	0.00	31.50	36.12	234.0	1.28	1.25
250.3	11.83	0.03	31.29	37.84	250.0	1.33	1.24
266.9	11.87	0.01	31.12	39.97	266.7	1.39	1.24
283.4	11.88	0.05	30.97	42.10	283.3	1.46	1.24
300.0	12.00	0.04	30.83	42.80	300.0	1.54	1.23

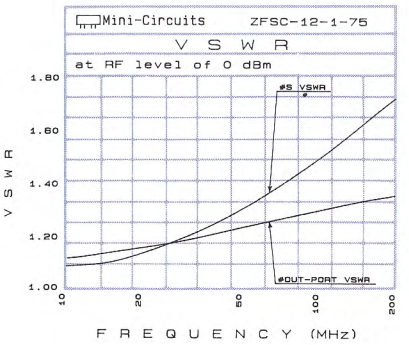
12WAY-0°
Power Splitter/Combiners 75 ohms

ZFSC-12-1-75

10 to 200MHz



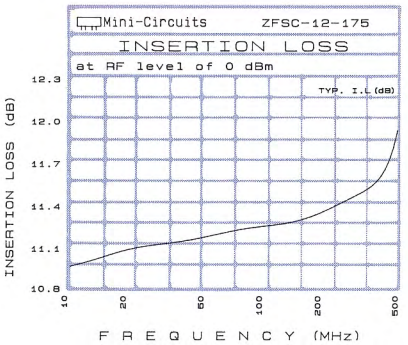


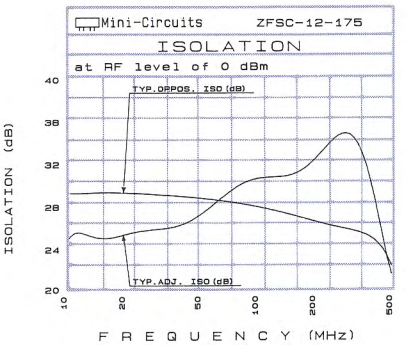


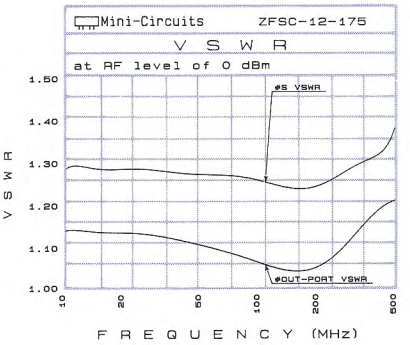
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
10.0	11.32	0.01	33.20	41.53	10.0	1.09	1.12
15.2	11.34	0.01	33.24	41.92	15.4	1.10	1.14
20.5	11.36	0.01	33.41	41.83	20.8	1.14	1.16
30.9	11.41	0.01	33.86	41.06	31.7	1.21	1.19
49.9	11.45	0.00	35.21	39.15	50.0	1.31	1.24
62.7	11.48	0.01	36.44	37.75	64.1	1.37	1.26
78.4	11.51	0.03	38.08	36.05	80.8	1.43	1.28
99.8	11.56	0.04	38.54	33.92	99.7	1.49	1.30
115.5	11.59	0.06	36.37	32.42	113.2	1.53	1.31
125.9	11.61	0.06	34.50	31.46	123.8	1.56	1.32
142.1	11.65	0.07	31.74	30.09	140.7	1.60	1.33
163.0	11.74	0.06	28.76	28.43	162.2	1.65	1.35
179.1	11.80	0.07	26.90	27.28	178.8	1.69	1.35
189.6	11.88	0.05	25.86	26.59	189.8	1.70	1.36
200.0	11.94	0.04	24.94	25.93	200.0	1.72	1.36

ZFSC-12-175

10 to 500MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
10.0	10.97	0.01	25.31	29.33	10.0	1.29	1.14
19.8	11.09	0.00	25.36	29.40	19.8	1.29	1.14
50.4	11.18	0.01	27.55	28.86	50.4	1.28	1.11
79.8	11.24	0.00	29.70	28.37	79.8	1.27	1.08
99.4	11.26	0.01	30.52	28.04	99.4	1.26	1.07
149.7	11.29	0.02	31.43	27.32	149.7	1.24	1.05
199.9	11.36	0.04	32.08	26.69	199.9	1.25	1.05
234.2	11.38	0.05	33.17	26.37	234.2	1.26	1.08
290.5	11.47	0.09	35.39	25.94	290.5	1.28	1.12
317.5	11.49	0.10	35.73	25.76	317.5	1.30	1.14
360.4	11.54	0.14	32.76	25.49	360.4	1.31	1.16
415.5	11.62	0.19	27.82	24.80	415.5	1.32	1.19
458.4	11.74	0.21	24.74	23.90	458.4	1.33	1.20
486.5	11.87	0.22	22.91	23.01	486.5	1.38	1.21
500.0	11.97	0.21	22.06	22.49	500.0	1.41	1.21

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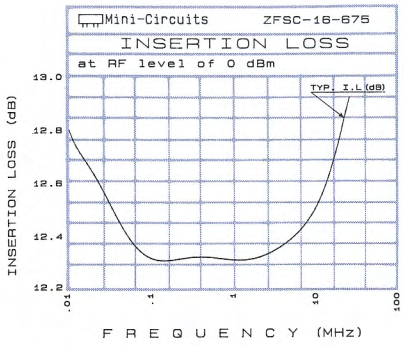
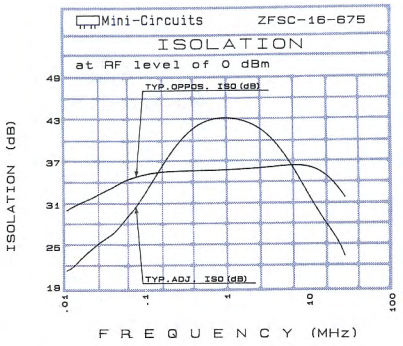
Mini-Circuits

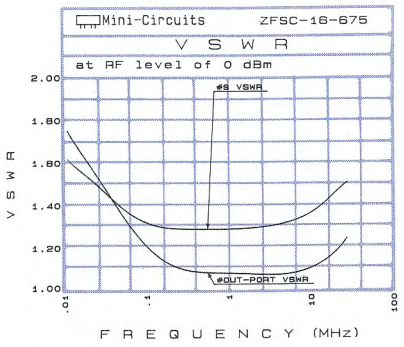
ZFSC-16-675

75 ohms

0.01 to 25MHz



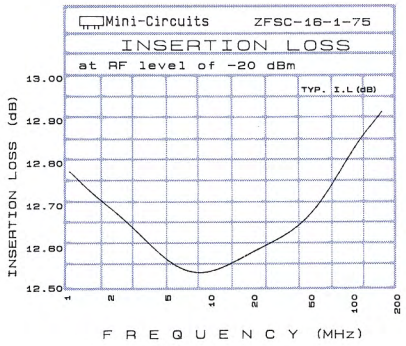


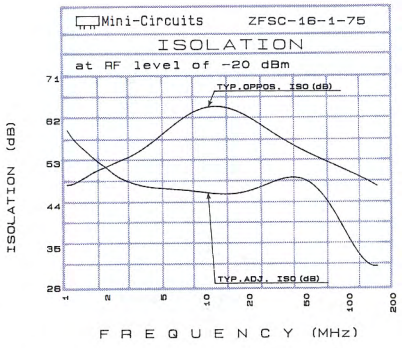


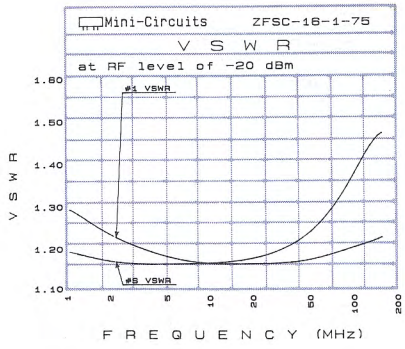
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.01	12.79	0.07	21.62	30.34	0.01	1.62	1.75
0.2	12.31	0.01	39.28	35.84	0.2	1.29	1.10
0.5	12.33	0.01	42.79	35.88	0.5	1.29	1.09
1.0	12.30	0.00	43.35	35.99	1.0	1.30	1.08
2.4	12.33	0.01	41.78	36.27	2.4	1.30	1.08
3.9	12.38	0.01	39.15	36.49	4.1	1.31	1.08
6.3	12.44	0.00	35.74	36.66	6.4	1.35	1.09
7.8	12.44	0.00	33.90	36.57	8.1	1.35	1.10
10.0	12.51	0.01	31.84	36.32	10.0	1.37	1.11
12.5	12.60	0.00	29.95	35.81	12.9	1.41	1.14
14.9	12.66	0.02	28.49	35.22	15.3	1.43	1.16
18.0	12.75	0.01	26.93	34.29	18.6	1.47	1.19
20.3	12.79	0.02	25.96	33.58	20.2	1.48	1.20
22.7	12.89	0.02	25.13	32.88	22.6	1.50	1.22
25.0	12.93	0.03	24.38	32.18	25.0	1.51	1.24

ZFSC-16-1-75

1 to 150MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	12.78	0.02	59.51	48.20	1.0	1.19	1.29
2.1	12.68	0.02	50.39	52.95	2.1	1.17	1.23
5.1	12.57	0.02	47.29	58.44	5.1	1.16	1.18
9.9	12.55	0.00	46.42	65.01	9.9	1.17	1.17
18.9	12.59	0.01	46.59	63.36	18.9	1.18	1.16
32.7	12.62	0.03	48.93	57.78	32.7	1.20	1.17
50.2	12.71	0.01	49.25	54.67	50.2	1.25	1.18
55.0	12.72	0.01	49.14	53.37	55.0	1.26	1.18
73.3	12.76	0.00	42.40	52.47	73.3	1.31	1.19
82.2	12.79	0.00	40.20	52.00	82.2	1.34	1.20
100.1	12.85	0.00	36.15	52.55	100.1	1.39	1.21
118.3	12.87	0.01	33.27	50.30	118.3	1.43	1.21
132.1	12.90	0.02	31.80	49.10	132.1	1.45	1.22
141.1	12.91	0.00	30.92	48.82	141.1	1.46	1.22
150.0	12.90	0.02	30.17	48.80	150.0	1.47	1.23

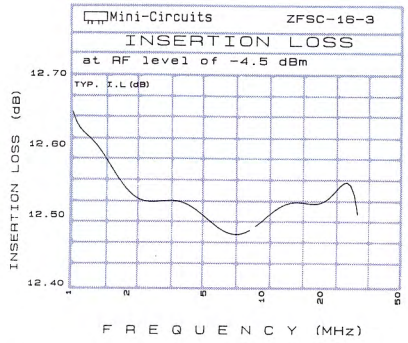
16WAY-0°

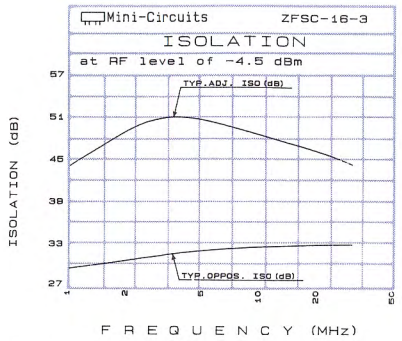
Power Splitter/Combiners

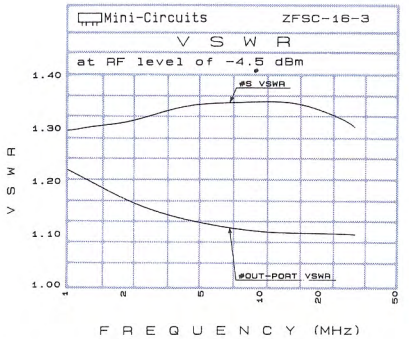
50 ohms

ZFSC-16-3

1 to 30MHz



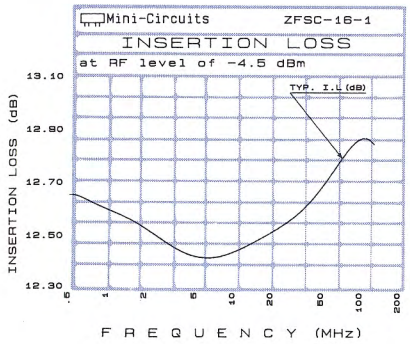


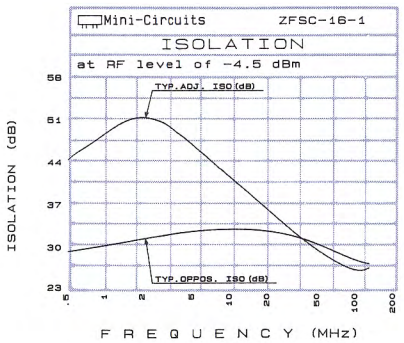


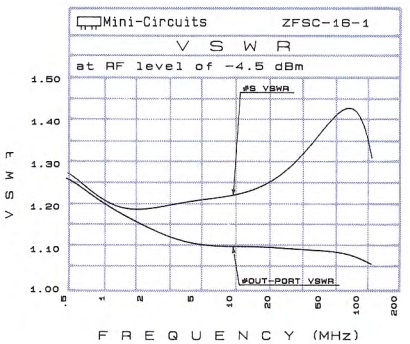
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	12.64	0.03	44.14	29.56	1.0	1.30	1.22
2.0	12.54	0.02	49.18	30.71	2.0	1.31	1.17
4.3	12.52	0.01	50.76	31.92	4.3	1.34	1.12
5.1	12.51	0.01	50.48	32.11	5.1	1.35	1.12
7.6	12.47	0.01	49.27	32.45	7.6	1.35	1.11
10.0	12.53	0.05	48.43	32.61	10.0	1.35	1.10
12.6	12.49	0.04	47.62	32.73	12.6	1.35	1.11
15.9	12.49	0.02	46.86	32.79	15.9	1.35	1.10
18.4	12.49	0.01	46.34	32.83	18.4	1.34	1.09
20.9	12.51	0.01	45.86	32.86	20.9	1.32	1.10
22.5	12.56	0.02	45.56	32.92	22.5	1.32	1.11
24.2	12.53	0.02	45.26	32.88	24.2	1.32	1.09
26.7	12.51	0.02	44.87	32.91	26.7	1.30	1.11
28.3	12.53	0.03	44.53	32.93	28.3	1.31	1.10
30.0	12.51	0.00	44.23	32.94	30.0	1.31	1.09

ZFSC-16-1

0.5 to 125MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.5	12.66	0.01	44.58	29.35	0.5	1.28	1.27
2.1	12.52	0.01	52.00	31.48	2.1	1.19	1.15
4.9	12.41	0.00	47.05	32.63	4.9	1.22	1.11
8.3	12.43	0.00	42.86	32.96	8.3	1.22	1.11
16.1	12.50	0.00	37.73	32.85	16.1	1.24	1.10
23.8	12.54	0.02	34.63	32.36	23.8	1.28	1.10
31.6	12.57	0.02	32.54	31.81	31.6	1.31	1.10
47.2	12.65	0.01	29.72	30.60	47.2	1.37	1.10
55.0	12.75	0.00	28.80	30.08	55.0	1.39	1.10
62.8	12.74	0.01	28.00	29.52	62.8	1.41	1.09
78.3	12.80	0.01	26.92	28.64	78.3	1.43	1.09
90.1	12.85	0.00	26.45	28.13	90.1	1.43	1.09
100.1	12.85	0.01	26.21	27.75	100.1	1.41	1.08
113.5	12.88	0.00	26.21	27.45	113.5	1.37	1.07
125.0	12.84	0.01	26.39	27.22	125.0	1.32	1.07

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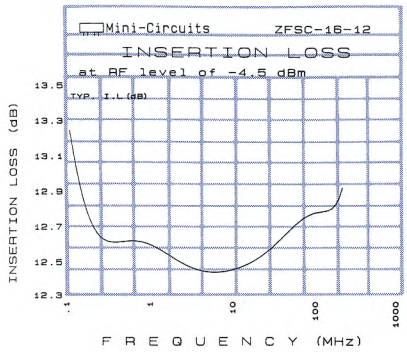
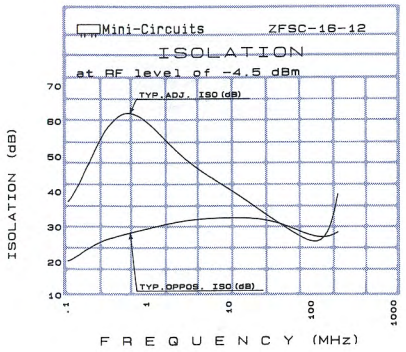
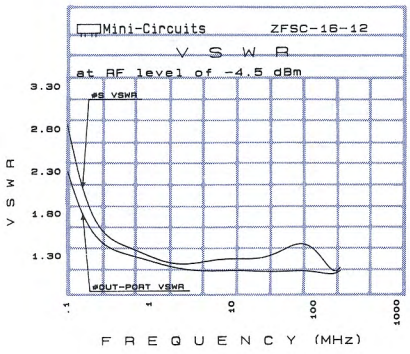
ZFSC-16-12

0.1 to 200MHz



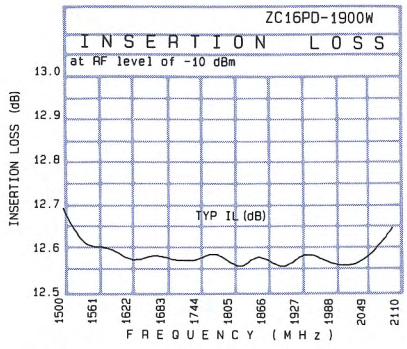


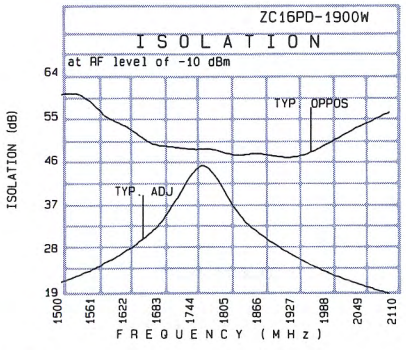


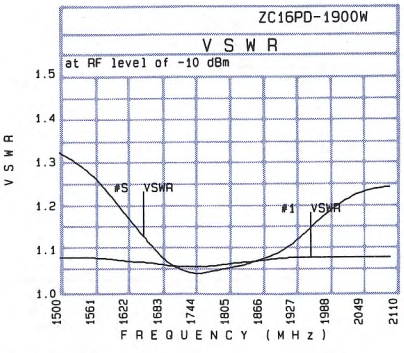
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.1	13.24	0.25	37.26	20.44	0.10	2.83	2.27
0.2	12.70	0.10	49.72	24.56	0.20	1.77	1.57
0.6	12.63	0.03	61.37	27.90	0.60	1.40	1.32
2.1	12.51	0.01	51.07	31.23	2.10	1.21	1.15
10.1	12.45	0.00	40.40	32.59	10.10	1.25	1.10
20.1	12.55	0.01	35.62	32.26	26.59	1.30	1.10
32.6	12.61	0.01	32.06	31.38	40.08	1.35	1.10
45.1	12.65	0.01	29.79	30.36	50.08	1.37	1.10
58.1	12.73	0.00	28.22	29.44	66.57	1.40	1.10
84.1	12.79	0.01	26.50	27.99	93.55	1.39	1.09
100.1	12.80	0.02	26.13	27.44	113.54	1.32	1.08
122.5	12.79	0.03	26.40	27.03	140.03	1.17	1.07
155.0	12.79	0.06	28.68	27.17	173.51	1.05	1.07
174.0	12.84	0.06	31.71	27.58	193.50	1.18	1.09
200.0	12.95	0.06	42.17	28.16	200.0	1.22	1.10

ZC16PD-1900W

1500 to 2100 MHz







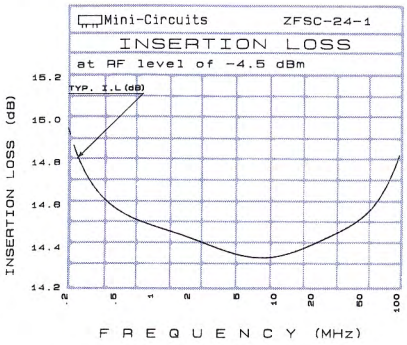
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1500.000	12.70	0.19	21.85	60.19	1500.000	1.33	1.09
1542.000	12.60	0.19	23.60	60.85	1542.000	1.30	1.09
1582.500	12.62	0.19	25.75	55.05	1582.500	1.25	1.09
1624.500	12.57	0.17	28.37	54.07	1624.500	1.18	1.08
1665.000	12.60	0.14	31.60	49.78	1665.000	1.12	1.08
1699.500	12.58	0.14	35.77	49.82	1699.500	1.07	1.07
1749.000	12.58	0.15	46.49	48.82	1749.000	1.05	1.07
1774.500	12.61	0.14	45.83	49.55	1774.500	1.06	1.07
1825.500	12.55	0.15	35.46	47.33	1825.500	1.07	1.08
1851.000	12.61	0.14	32.95	48.68	1851.000	1.08	1.08
1900.500	12.55	0.15	28.98	47.46	1900.500	1.10	1.09
1935.000	12.61	0.17	26.81	47.46	1935.000	1.13	1.09
1975.500	12.58	0.19	24.47	49.37	1975.500	1.18	1.09
2038.500	12.56	0.24	21.67	53.64	2038.500	1.24	1.09
2100.000	12.66	0.19	19.66	56.81	2100.000	1.25	1.09

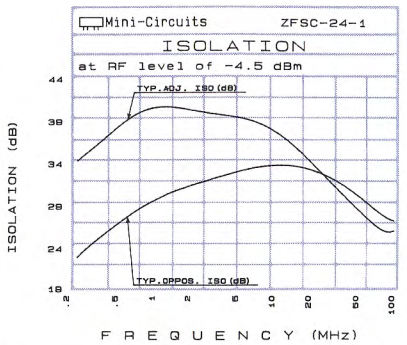
24WAY-0°

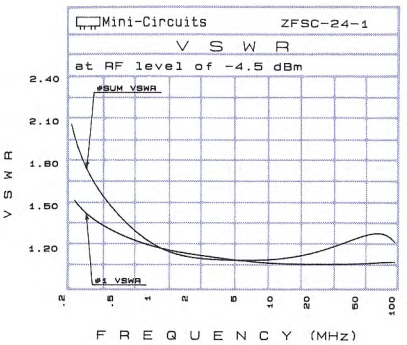
Power Splitter/Combiners 50 ohms

ZFSC-24-1

0.2 to 100MHz



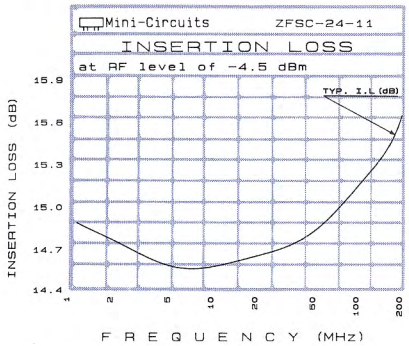


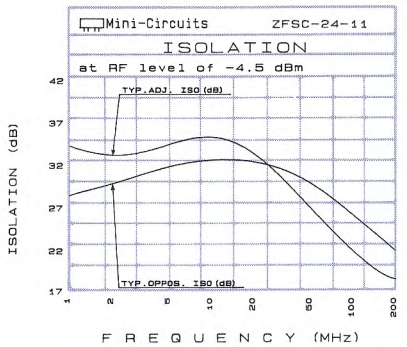


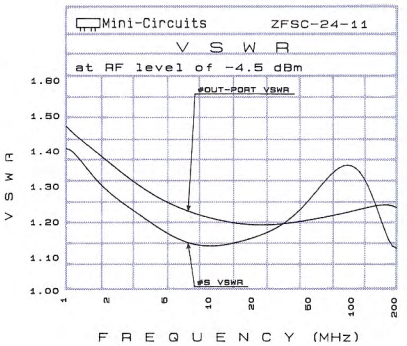
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.2	14.96	0.01	33.37	21.91	0.2	2.23	1.65
0.6	14.54	0.02	39.28	27.79	0.6	1.40	1.29
1.1	14.50	0.03	41.12	30.21	1.1	1.21	1.21
2.1	14.43	0.02	40.21	31.51	2.1	1.15	1.17
5.1	14.37	0.01	39.68	33.23	5.1	1.12	1.12
10.1	14.36	0.02	37.83	33.89	10.1	1.13	1.10
20.1	14.44	0.02	34.36	33.44	20.1	1.17	1.10
29.1	14.45	0.01	32.03	32.48	29.1	1.21	1.10
42.1	14.50	0.02	29.64	31.04	42.1	1.26	1.10
50.1	14.54	0.02	28.57	30.26	50.1	1.29	1.10
61.3	14.60	0.03	27.46	29.29	61.3	1.31	1.11
71.0	14.63	0.04	26.77	28.58	71.0	1.32	1.11
80.8	14.69	0.04	26.30	28.04	80.8	1.31	1.12
90.3	14.77	0.06	26.06	27.62	90.3	1.29	1.12
100.0	14.83	0.06	25.95	27.24	100.0	1.26	1.12

ZFSC-24-11

1 to 200MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.0	14.92	0.03	34.27	28.56	1.0	1.42	1.47
5.0	14.58	0.01	34.41	31.97	5.0	1.17	1.25
12.9	14.63	0.02	35.13	32.76	12.9	1.13	1.20
24.9	14.70	0.03	32.14	32.17	24.9	1.17	1.19
37.3	14.75	0.04	29.30	31.14	37.3	1.21	1.21
55.2	14.86	0.03	26.29	29.48	55.2	1.29	1.21
73.1	14.99	0.03	24.20	28.05	73.1	1.34	1.22
100.0	15.16	0.04	22.02	26.27	100.0	1.36	1.23
109.5	15.20	0.04	21.45	25.74	109.5	1.35	1.24
121.4	15.25	0.05	20.83	25.11	121.4	1.32	1.24
139.8	15.32	0.05	20.05	24.27	139.8	1.27	1.24
151.7	15.36	0.07	19.66	23.77	151.7	1.22	1.25
169.7	15.47	0.07	19.22	23.12	169.7	1.15	1.25
182.1	15.55	0.08	18.98	22.71	182.1	1.13	1.25
200.0	15.63	0.09	18.71	22.10	200.0	1.17	1.24

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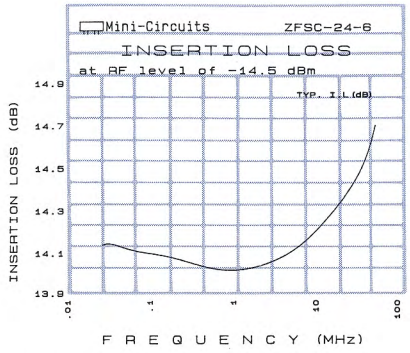
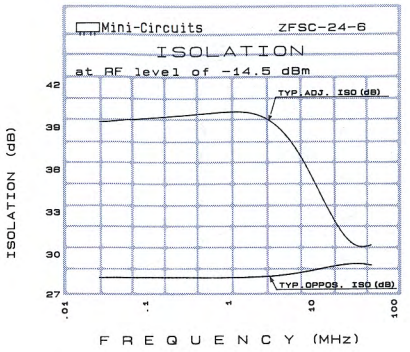
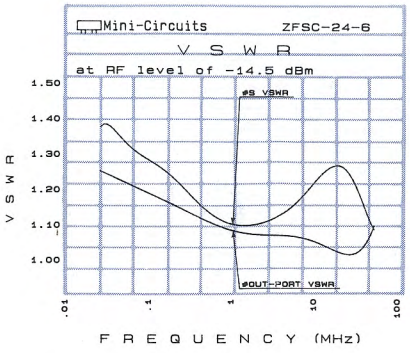
ZFSC-24-6

50 ohms

0.025 to 50MHz





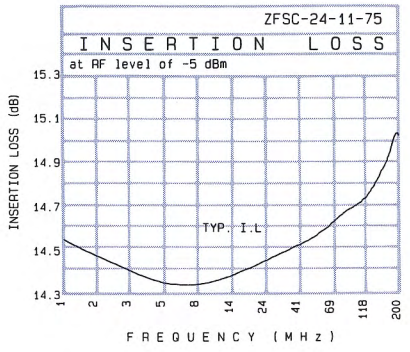


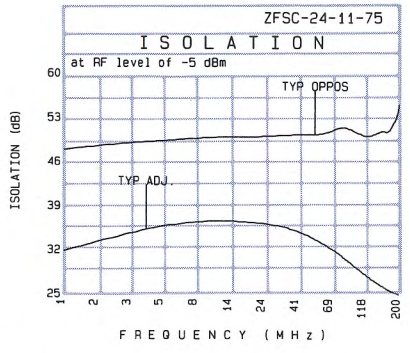
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
0.025	14.15	0.01	39.37	28.38	0.03	1.39	1.25
1.0	14.01	0.00	40.07	28.32	1.0	1.09	1.08
1.5	14.03	0.01	40.07	28.32	1.5	1.09	1.08
2.0	14.04	0.00	39.83	28.35	2.0	1.11	1.07
2.9	14.07	0.01	39.52	28.43	2.9	1.11	1.07
6.0	14.12	0.01	37.53	28.60	6.0	1.16	1.06
10.3	14.23	0.01	35.14	28.83	10.3	1.22	1.05
14.8	14.28	0.01	33.25	29.01	14.8	1.26	1.03
20.5	14.37	0.01	31.84	29.18	20.5	1.27	1.02
25.2	14.40	0.01	31.10	29.23	25.2	1.26	1.00
31.1	14.48	0.01	30.62	29.26	31.1	1.22	1.02
35.5	14.51	0.01	30.47	29.27	35.5	1.17	1.03
41.3	14.57	0.03	30.51	29.21	41.3	1.10	1.06
45.5	14.64	0.03	30.55	29.19	45.5	1.09	1.07
50.0	14.73	0.05	30.50	29.21	50.0	1.17	1.08

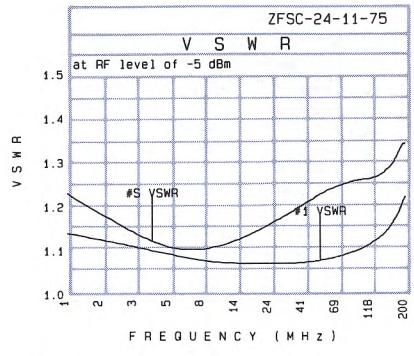
ZFSC-24-11-75

75 ohms

1 to 200 MHz







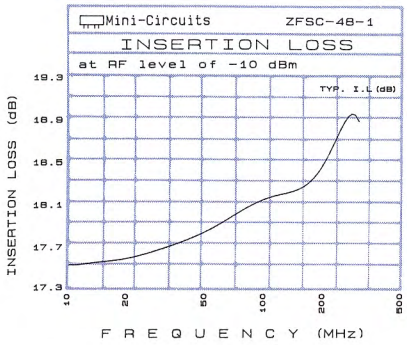
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
1.000	14.57	0.06	32.39	48.53	1.000	1.24	1.15
2.784	14.43	0.07	35.24	49.66	2.784	1.15	1.12
5.008	14.36	0.05	36.40	49.90	5.008	1.11	1.10
10.523	14.36	0.05	37.40	50.59	10.523	1.11	1.08
24.953	14.48	0.05	36.80	50.51	24.953	1.17	1.08
39.776	14.54	0.07	35.74	50.98	39.776	1.21	1.08
62.319	14.61	0.06	33.43	50.69	62.319	1.25	1.09
79.364	14.69	0.06	31.75	52.37	79.364	1.26	1.10
99.339	14.72	0.08	29.94	51.48	99.339	1.27	1.11
124.343	14.77	0.11	28.11	50.12	124.343	1.27	1.13
150.356	14.88	0.17	26.80	51.69	150.356	1.29	1.15
169.676	14.94	0.15	26.08	50.94	169.676	1.31	1.18
178.699	15.01	0.16	25.80	52.51	178.699	1.33	1.19
191.479	15.06	0.19	25.58	53.20	191.479	1.35	1.22
200.000	15.04	0.19	25.43	55.56	200.000	1.35	1.23

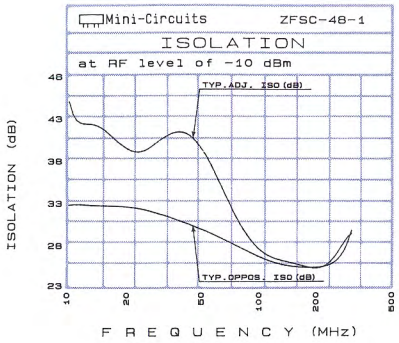
Power Splitter/Combiners

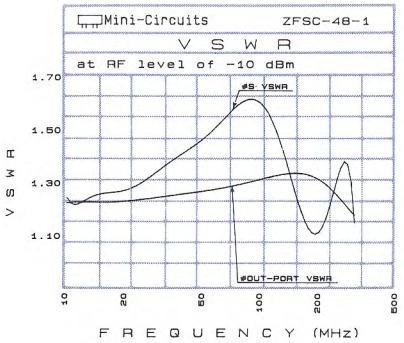
ZFSC-48-1

50 ohms

10 to 300MHz





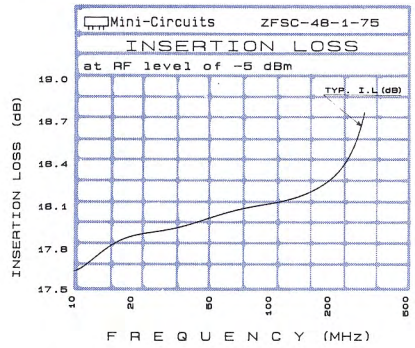


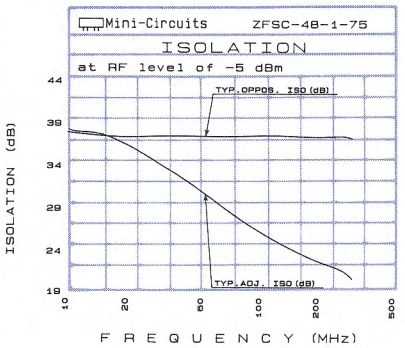
FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
10.0	17.53	0.00	43.84	32.90	10.0	1.22	1.23
20.0	17.61	0.03	39.93	32.62	20.0	1.28	1.23
35.6	17.74	0.04	40.49	31.21	35.6	1.38	1.26
50.0	17.83	0.07	39.60	29.83	50.0	1.48	1.27
78.2	18.03	0.11	30.36	27.73	78.2	1.60	1.30
100.0	18.15	0.10	27.79	26.64	100.0	1.58	1.32
112.4	18.23	0.08	26.95	26.24	112.4	1.54	1.33
120.9	18.21	0.07	26.44	25.97	120.9	1.49	1.33
137.9	18.22	0.07	25.86	25.62	137.9	1.37	1.34
155.0	18.24	0.04	25.54	25.42	155.0	1.23	1.34
200.0	18.51	0.10	25.57	25.53	200.0	1.12	1.31
231.8	18.76	0.12	26.22	25.89	231.8	1.30	1.27
250.0	18.86	0.09	26.93	26.15	250.0	1.35	1.25
274.4	18.93	0.03	28.31	27.38	274.4	1.33	1.21
300.0	18.97	0.07	29.68	30.05	300.0	1.25	1.19

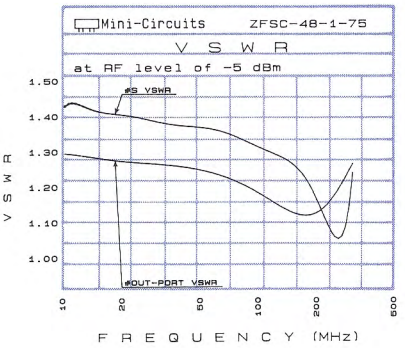
ZFSC-48-1-75

75 ohms

10 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) ADJACENT	ISOLATION (dB) OPPOSITE	FREQUENCY (MHz)	VSWR S	VSWR OUTPUTS
10.0	17.64	0.05	38.23	37.93	10.0	1.44	1.30
20.2	17.90	0.05	35.98	37.46	20.2	1.40	1.27
49.9	18.02	0.05	30.93	37.71	49.9	1.37	1.25
60.0	18.05	0.06	29.45	37.30	60.0	1.36	1.24
76.0	18.08	0.04	27.89	37.54	76.0	1.34	1.22
101.4	18.12	0.06	26.08	37.47	101.4	1.31	1.18
126.0	18.12	0.06	24.80	37.36	126.0	1.29	1.14
142.7	18.19	0.10	24.23	37.85	142.7	1.26	1.13
150.7	18.18	0.08	23.98	37.32	150.7	1.25	1.13
176.0	18.25	0.09	23.31	37.28	176.0	1.21	1.12
200.7	18.29	0.11	22.81	37.71	200.7	1.16	1.13
225.3	18.37	0.12	22.41	37.30	225.3	1.10	1.15
250.0	18.46	0.11	21.97	37.99	250.0	1.03	1.19
275.4	18.58	0.10	21.46	37.17	275.4	1.10	1.23
300.0	18.77	0.10	20.91	37.16	300.0	1.23	1.27

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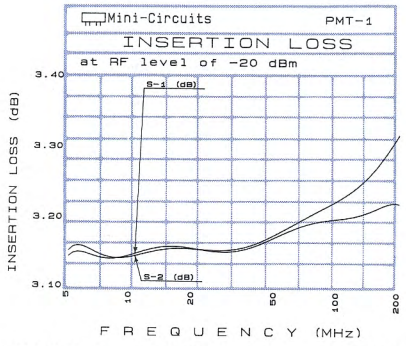
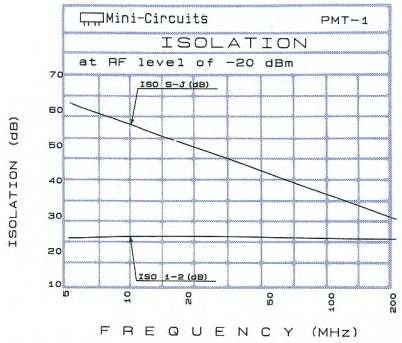
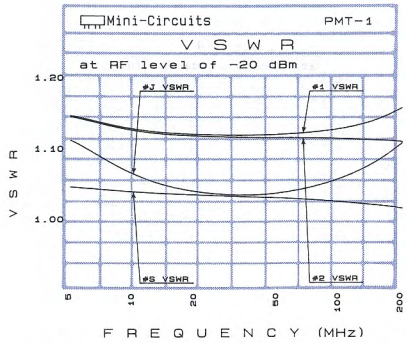
PMT-1 50 ohms 5 to 200MHz

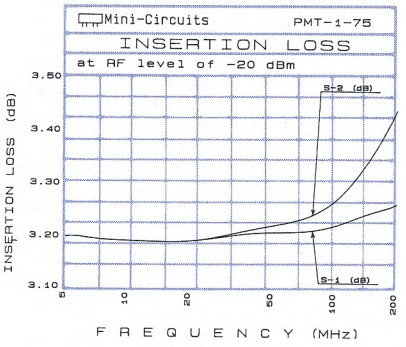


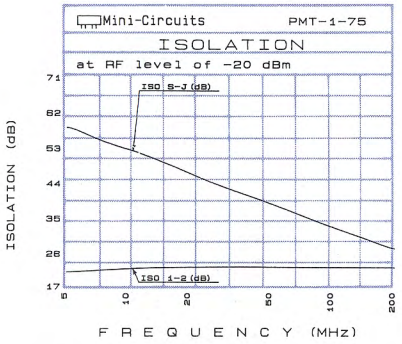


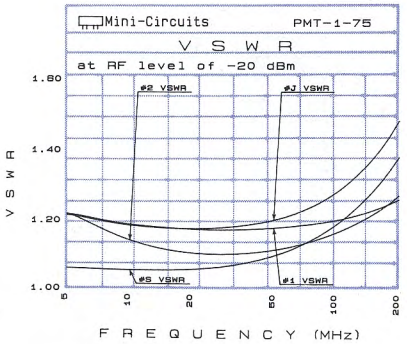


FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) (S-1) − (S-2)	INSERTION LOSS (dB) J-1	INSERTION LOSS (dB) J-2	AMPLITUDE UNBALANCE (dB) (J-1) − (J-2)	ISOLATION (dB) 1-2	ISOLATION (dB) S-J	PHASE UNBALANCE (Degrees) S-2	PHASE UNBALANCE (Degrees) J-2	VSWR S	VSWR 1	VSWR 2
5.0	3.15	3.16	.01	3.76	3.76	0.00	23.77	61.92	.05	179.94	1.05	1.15	1.15
10.0	3.14	3.14	0.00	3.69	3.69	0.00	24.36	55.90	.12	179.88	1.04	1.13	1.13
20.0	3.16	3.16	0.00	3.70	3.70	0.00	24.57	49.97	.27	179.65	1.03	1.12	1.12
27.5	3.15	3.15	0.00	3.69	3.69	0.00	24.49	27.50	.31	179.55	1.03	1.12	1.12
44.0	3.17	3.17	0.00	3.74	3.73	.01	24.43	43.13	.54	179.34	1.03	1.12	1.12
50.0	3.17	3.17	0.00	3.74	3.73	.01	24.40	42.48	.63	179.23	1.03	1.12	1.12
66.5	3.18	3.19	.01	3.78	3.77	.01	24.33	39.40	.81	178.94	1.03	1.12	1.11
88.5	3.19	3.21	.02	3.81	3.78	.03	24.26	37.01	1.00	178.67	1.03	1.13	1.11
94.0	3.20	3.22	.02	3.82	3.79	.03	24.25	36.61	1.11	178.51	1.03	1.13	1.11
100.0	3.20	3.23	.03	3.84	3.80	.04	24.25	35.88	1.20	178.43	1.02	1.13	1.12
122.0	3.22	3.25	.03	3.87	3.82	.05	24.20	34.34	1.44	178.13	1.02	1.13	1.11
133.0	3.20	3.25	.05	3.87	3.81	.06	24.22	33.48	1.54	177.91	1.02	1.14	1.11
150.0	3.21	3.27	.06	3.90	3.82	.08	24.15	32.36	1.69	177.60	1.02	1.14	1.11
177.5	3.22	3.30	.08	3.95	3.82	.13	24.18	30.91	1.99	177.28	1.02	1.15	1.11
200.0	3.22	3.31	.09	3.97	3.81	.16	24.20	29.79	2.30	176.84	1.02	1.16	1.11

PMT-1-75 75 ohms 5 to 200MHz







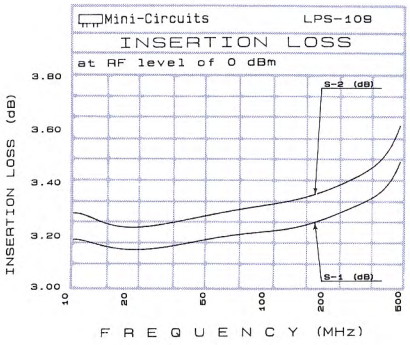
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) (S-1) − (S-2)	INSERTION LOSS (dB) J-1	INSERTION LOSS (dB) J-2	AMPLITUDE UNBALANCE (dB) (J-1) − (J-2)	ISOLATION (dB) 1-2	ISOLATION (dB) S-J	PHASE UNBALANCE (Degrees) S-2	PHASE UNBALANCE (Degrees) J-2	VSWR S	VSWR 1	VSWR 2
5.0	3.20	3.20	0.00	4.15	4.15	0.00	21.37	58.57	.09	179.87	1.06	1.22	1.22
10.0	3.19	3.19	0.00	4.03	4.03	0.00	22.20	52.38	.21	179.76	1.06	1.19	1.14
20.0	3.19	3.19	0.00	4.00	4.00	0.00	22.54	46.33	.38	179.50	1.06	1.17	1.11
27.5	3.20	3.20	0.00	4.00	4.00	0.00	22.63	43.29	.62	179.34	1.07	1.17	1.10
44.0	3.20	3.21	.01	4.02	4.02	0.00	22.57	39.73	.89	178.90	1.09	1.17	1.11
50.0	3.21	3.22	.01	4.03	4.04	.01	22.55	38.61	.98	178.74	1.10	1.18	1.12
66.5	3.20	3.23	.03	4.04	4.05	.01	22.54	36.34	1.26	178.35	1.13	1.18	1.13
88.5	3.21	3.25	.04	4.07	4.07	0.00	22.52	33.84	1.68	177.84	1.17	1.19	1.15
94.0	3.21	3.26	.05	4.07	4.08	.01	22.48	33.22	1.80	177.73	1.18	1.20	1.16
100.0	3.22	3.26	.04	4.07	4.08	.01	22.46	32.82	1.92	177.54	1.19	1.20	1.16
122.0	3.23	3.31	.08	4.11	4.11	0.00	22.51	31.17	2.34	177.04	1.23	1.21	1.19
133.0	3.24	3.32	.08	4.11	4.13	.02	22.44	30.45	2.56	176.75	1.25	1.22	1.20
150.0	3.25	3.36	.11	4.13	4.14	.01	22.42	29.38	2.79	176.41	1.28	1.23	1.22
177.5	3.25	3.39	.14	4.14	4.14	0.00	22.42	28.04	3.28	175.78	1.34	1.24	1.25
200.0	3.26	3.45	.19	4.16	4.16	0.00	22.40	27.16	3.72	175.35	1.38	1.26	1.27

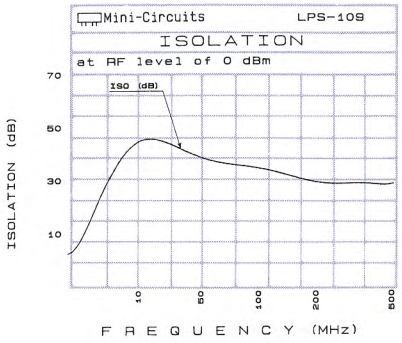
Power Splitter/Combiners

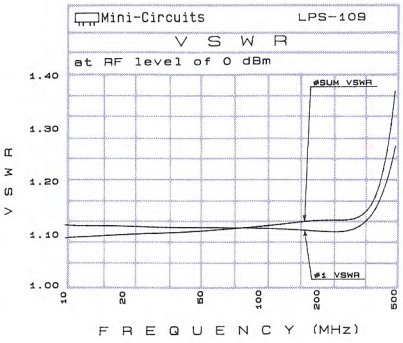
50 ohms

LPS-109

10 to 500MHz





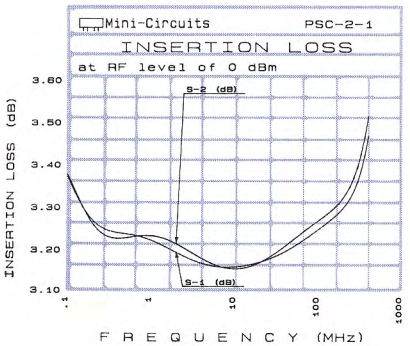


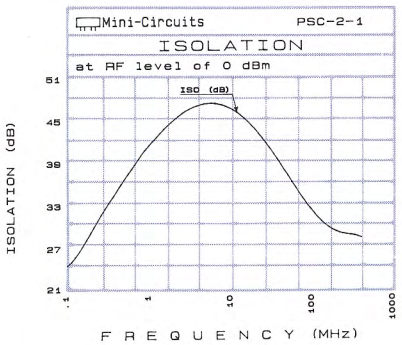
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	3.19	3.29	0.10	49.87
34.5	3.16	3.25	0.09	42.08
59.0	3.19	3.28	0.09	37.67
83.5	3.20	3.29	0.09	35.19
108.0	3.21	3.30	0.09	33.43
132.5	3.22	3.33	0.11	32.10
157.0	3.24	3.34	0.10	31.06
206.0	3.27	3.36	0.09	29.55
255.0	3.28	3.39	0.11	28.67
304.0	3.31	3.42	0.11	28.29
353.0	3.34	3.46	0.12	28.41
402.0	3.36	3.48	0.12	28.79
426.5	3.36	3.48	0.12	28.93
451.0	3.40	3.52	0.12	28.84
500.0	3.49	3.63	0.14	27.07

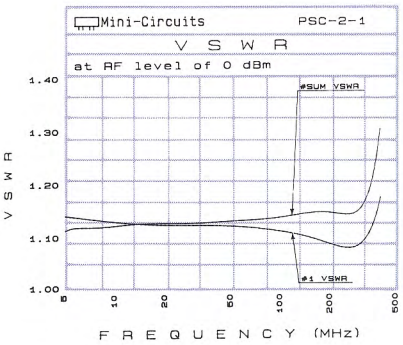
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.09	1.12	1.14
34.5	1.10	1.11	1.13
59.0	1.11	1.11	1.13
83.5	1.11	1.11	1.13
108.0	1.11	1.11	1.13
132.5	1.12	1.11	1.13
157.0	1.12	1.11	1.13
206.0	1.12	1.10	1.12
255.0	1.12	1.10	1.12
304.0	1.13	1.11	1.11
353.0	1.14	1.12	1.12
402.0	1.18	1.15	1.13
426.5	1.21	1.17	1.14
451.0	1.25	1.20	1.16
500.0	1.37	1.26	1.20

PSC-2-1

0.1 to 400MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.1	3.37	3.38	0.01	24.33
0.2	3.26	3.25	0.01	29.63
0.5	3.24	3.23	0.01	37.19
1.0	3.22	3.22	0.00	41.80
10.0	3.16	3.16	0.00	47.10
20.0	3.18	3.18	0.00	43.53
50.0	3.20	3.20	0.00	37.27
100.0	3.24	3.24	0.00	32.42
148.2	3.27	3.29	0.02	30.09
200.0	3.31	3.33	0.02	28.94
251.9	3.32	3.35	0.03	28.80
296.3	3.34	3.39	0.05	29.45
340.8	3.40	3.45	0.05	29.74
370.4	3.42	3.48	0.06	28.61
400.0	3.48	3.53	0.05	26.04

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.12	1.14	1.14
10.0	1.12	1.13	1.13
17.3	1.13	1.12	1.12
20.0	1.13	1.12	1.12
50.0	1.13	1.12	1.12
66.7	1.13	1.12	1.12
100.0	1.14	1.11	1.11
140.8	1.14	1.10	1.1
190.2	1.15	1.09	1.09
227.2	1.14	1.08	1.08
276.6	1.15	1.08	1.08
313.6	1.16	1.09	1.09
350.6	1.20	1.12	1.11
375.3	1.24	1.14	1.13
400.0	1.30	1.17	1.16

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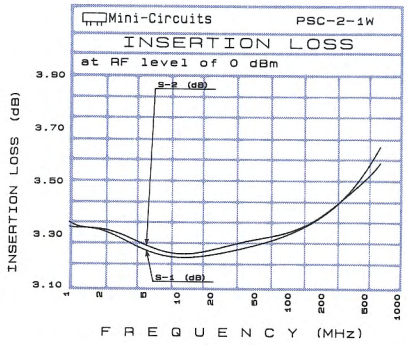
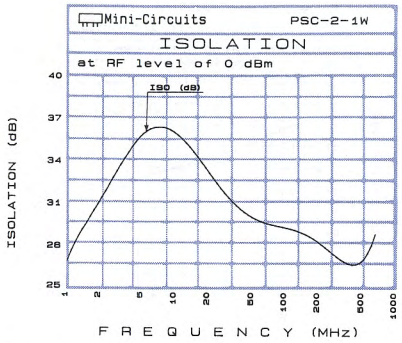
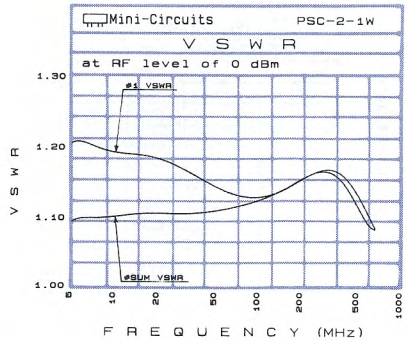
PSC-2-1W

1 to 650MHz





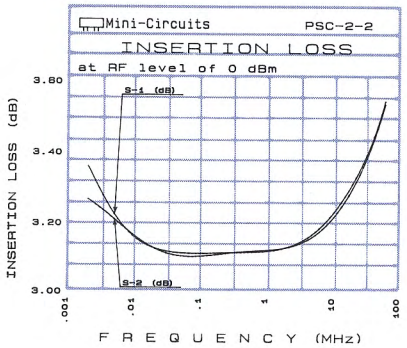


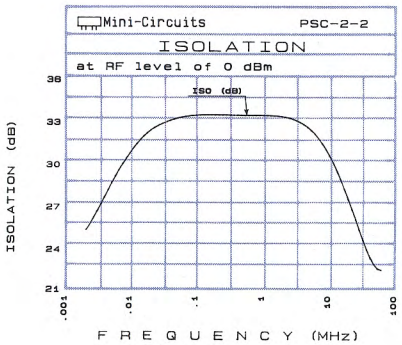
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
1.0	3.33	3.34	.01	27.14
5.0	3.24	3.27	.03	36.17
10.0	3.21	3.21	0.00	36.31
20.0	3.23	3.26	.03	33.11
50.0	3.27	3.28	.01	29.97
100.0	3.31	3.33	.02	29.30
147.6	3.33	3.34	.01	28.78
200.0	3.36	3.36	0.00	28.24
252.2	3.41	3.41	0.00	27.69
294.1	3.45	3.45	0.00	27.28
398.8	3.50	3.51	.01	26.67
461.6	3.54	3.51	-.03	26.73
500.0	3.55	3.52	-.03	26.97
566.3	3.61	3.56	-.05	27.70
650.0	3.66	3.59	-.07	28.72

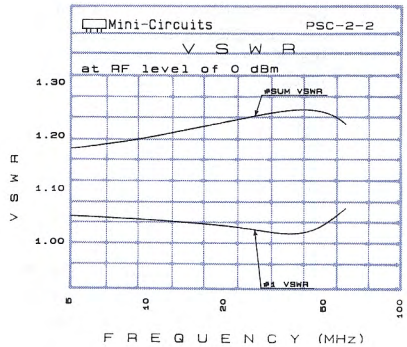
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.0	1.10	1.21	1.21
5.0	1.10	1.21	1.21
10.0	1.10	1.19	1.19
20.0	1.11	1.18	1.19
50.0	1.11	1.14	1.14
100.0	1.12	1.13	1.13
147.6	1.14	1.14	1.14
200.0	1.15	1.15	1.16
252.2	1.16	1.16	1.18
294.1	1.16	1.17	1.18
398.8	1.15	1.16	1.17
461.6	1.13	1.15	1.16
500.0	1.11	1.13	1.14
566.3	1.09	1.11	1.11
650.0	1.09	1.09	1.08

PSC-2-2

0.004 to 60MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.002	3.36	3.27	0.09	25.29
0.005	3.22	3.21	0.01	28.78
0.01	3.13	3.12	0.01	32.59
0.1	3.11	3.11	0.00	33.31
0.1	3.12	3.11	0.01	33.50
1.0	3.13	3.13	0.00	33.49
5.0	3.17	3.17	0.00	32.63
10.0	3.23	3.22	0.01	30.64
20.0	3.32	3.31	0.01	27.22
25.0	3.35	3.34	0.01	25.94
30.0	3.39	3.38	0.01	24.99
40.0	3.44	3.43	0.01	23.60
45.0	3.46	3.46	0.00	23.13
55.0	3.53	3.52	0.01	22.57
60.0	3.55	3.55	0.00	22.47

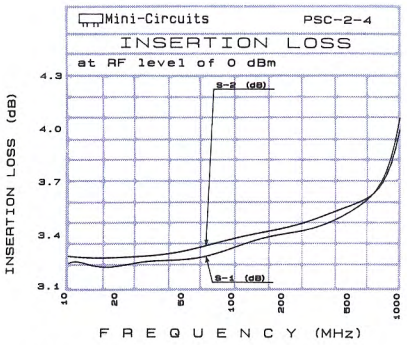
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.18	1.05	1.05
6.6	1.18	1.05	1.05
9.9	1.20	1.04	1.04
10.0	1.20	1.04	1.04
11.5	1.20	1.04	1.04
16.3	1.22	1.03	1.03
20.0	1.23	1.03	1.03
24.4	1.23	1.02	1.02
32.5	1.24	1.02	1.02
37.4	1.25	1.01	1.01
40.6	1.25	1.02	1.01
47.1	1.25	1.03	1.03
50.0	1.24	1.03	1.03
55.1	1.23	1.05	1.05
58.4	1.23	1.06	1.06

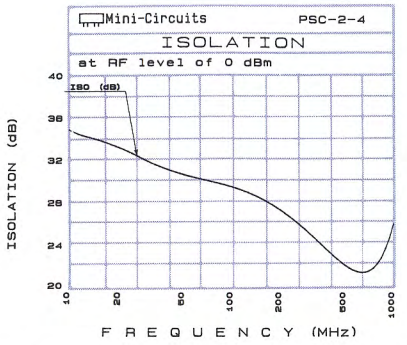
Power Splitter/Combiners

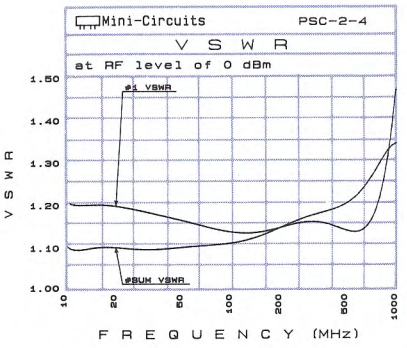
50 ohms

PSC-2-4

10 to 1000MHz





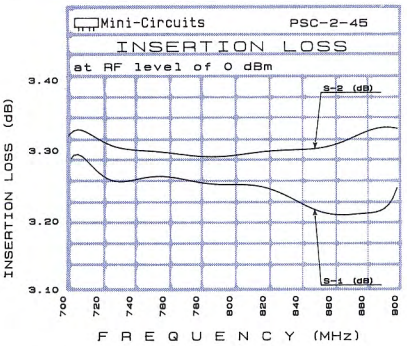


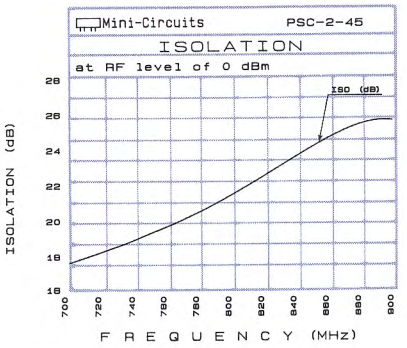
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	3.25	3.28	0.03	34.82
20.0	3.22	3.27	0.05	33.24
50.0	3.27	3.30	0.03	30.72
100.0	3.34	3.40	0.06	29.51
155.4	3.38	3.40	0.02	28.35
200.0	3.41	3.43	0.02	27.34
300.9	3.45	3.52	0.07	25.24
417.2	3.49	3.55	0.06	23.16
500.0	3.48	3.51	0.03	22.18
562.7	3.57	3.57	0.00	21.75
649.9	3.59	3.61	0.02	21.48
737.2	3.65	3.66	0.01	21.75
853.6	3.77	3.73	0.04	23.02
940.8	3.93	3.88	0.05	24.78
1000.0	4.06	4.00	0.06	25.69

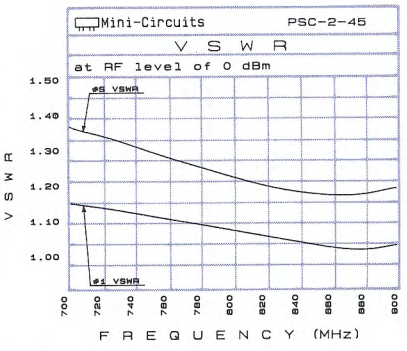
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.10	1.20	1.20
20.0	1.10	1.20	1.19
50.0	1.10	1.16	1.16
100.0	1.11	1.14	1.15
155.4	1.13	1.14	1.16
200.0	1.15	1.15	1.17
300.9	1.17	1.16	1.20
417.2	1.20	1.16	1.21
500.0	1.21	1.14	1.20
562.7	1.21	1.13	1.19
649.9	1.24	1.14	1.17
737.2	1.28	1.18	1.16
853.6	1.33	1.28	1.20
940.8	1.34	1.38	1.26
1000.0	1.32	1.44	1.31

PSC-2-45

700 to 900MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
700.0	3.25	3.30	0.05	17.60
711.1	3.28	3.34	0.06	17.93
722.2	3.27	3.31	0.04	18.30
733.3	3.26	3.30	0.04	18.68
750.0	3.25	3.29	0.04	19.32
761.1	3.27	3.30	0.03	19.70
777.8	3.24	3.29	0.05	20.38
800.0	3.25	3.28	0.03	21.45
811.1	3.26	3.31	0.05	22.06
822.2	3.24	3.30	0.06	22.63
850.0	3.22	3.32	0.10	24.18
861.1	3.21	3.30	0.09	24.73
877.8	3.20	3.32	0.12	25.40
888.9	3.22	3.34	0.12	25.69
900.0	3.24	3.34	0.10	25.68

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
700.0	1.37	1.15	1.18
711.1	1.35	1.14	1.17
722.2	1.34	1.14	1.17
733.3	1.33	1.13	1.16
750.0	1.29	1.11	1.14
761.1	1.27	1.10	1.13
777.8	1.26	1.09	1.12
800.0	1.23	1.07	1.10
811.1	1.21	1.06	1.09
822.2	1.20	1.05	1.09
850.0	1.17	1.03	1.06
861.1	1.17	1.02	1.05
877.8	1.17	1.02	1.04
888.9	1.18	1.02	1.03
900.0	1.19	1.03	1.03

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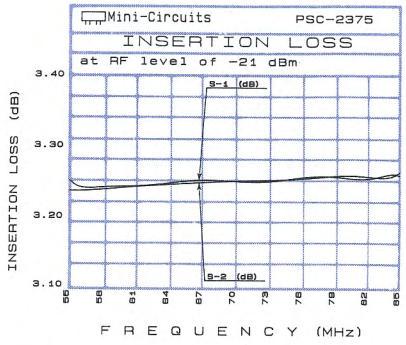
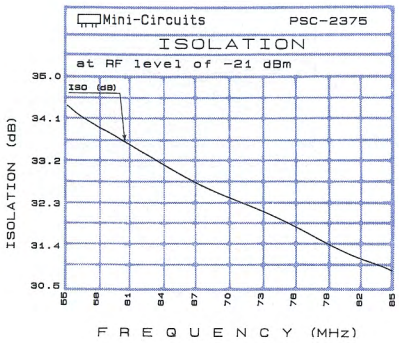
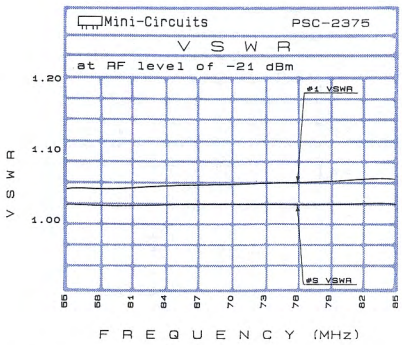
Mini-Circuits

PSC-2375

55 to 85MHz





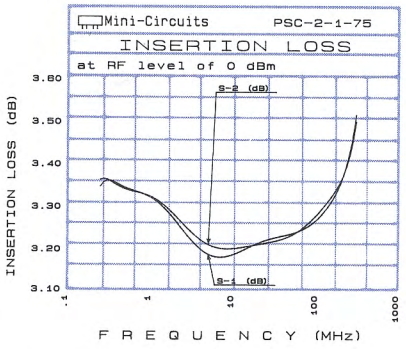


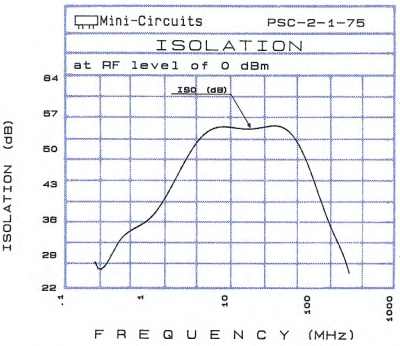
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
55.0	3.25	3.24	0.01	34.39
57.5	3.24	3.24	0.00	34.10
59.2	3.24	3.24	0.00	33.79
62.5	3.23	3.23	0.00	33.29
65.8	3.24	3.25	0.01	32.84
68.4	3.25	3.25	0.00	32.63
70.0	3.25	3.25	0.00	32.49
71.7	3.25	3.25	0.00	32.18
74.2	3.25	3.25	0.00	32.05
75.9	3.25	3.24	0.01	31.99
77.5	3.26	3.26	0.00	31.52
79.2	3.26	3.26	0.00	31.41
80.8	3.25	3.25	0.00	31.16
83.4	3.26	3.25	0.01	31.01
85.0	3.26	3.26	0.00	30.87

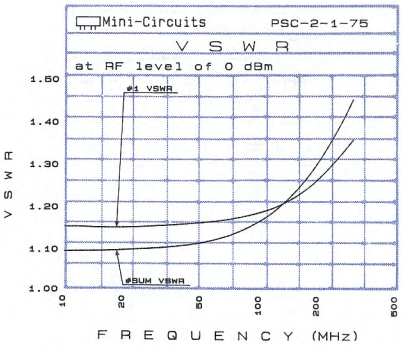
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
55.0	1.02	1.05	1.05
57.5	1.02	1.05	1.05
59.2	1.02	1.05	1.04
62.5	1.02	1.05	1.05
65.8	1.03	1.05	1.05
68.4	1.02	1.05	1.05
70.0	1.03	1.06	1.05
71.7	1.02	1.05	1.05
74.2	1.02	1.06	1.05
75.9	1.02	1.06	1.06
77.5	1.02	1.06	1.05
79.2	1.03	1.06	1.06
80.8	1.03	1.06	1.06
83.4	1.03	1.06	1.06
85.0	1.03	1.06	1.06

PSC-2-1-75

0.25 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.3	3.28	3.28	0.00	26.02
5.0	3.17	3.18	0.01	47.23
10.1	3.18	3.18	0.00	55.78
20.0	3.20	3.20	0.00	52.41
45.3	3.25	3.24	0.01	44.45
77.4	3.30	3.29	0.01	40.51
89.9	3.33	3.33	0.00	39.18
102.5	3.36	3.36	0.00	38.01
123.3	3.39	3.39	0.00	36.35
141.0	3.44	3.44	0.00	35.27
161.4	3.46	3.47	0.01	33.80
175.4	3.48	3.48	0.00	33.08
200.0	3.53	3.51	0.02	31.92
250.0	3.66	3.64	0.02	28.99
300.0	3.80	3.78	0.02	28.86

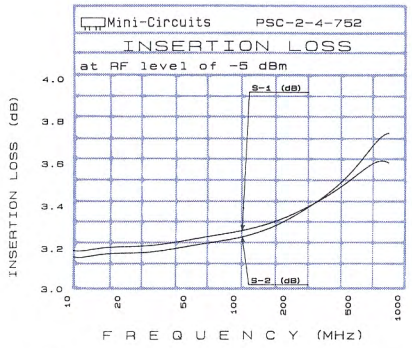
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.3	1.25	1.43	1.43
5.0	1.09	1.15	1.16
10.1	1.10	1.15	1.15
20.0	1.11	1.16	1.16
45.3	1.17	1.21	1.19
77.4	1.27	1.28	1.26
89.9	1.31	1.32	1.29
102.5	1.36	1.36	1.32
123.3	1.42	1.43	1.37
141.0	1.48	1.49	1.42
161.4	1.54	1.56	1.48
175.4	1.58	1.61	1.52
200.0	1.64	1.70	1.60
250.0	1.71	1.78	1.76
300.0	1.74	1.89	1.90

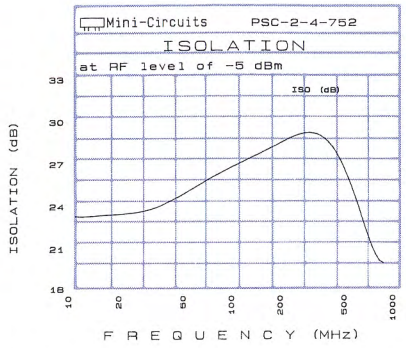
Power Splitter/Combiners

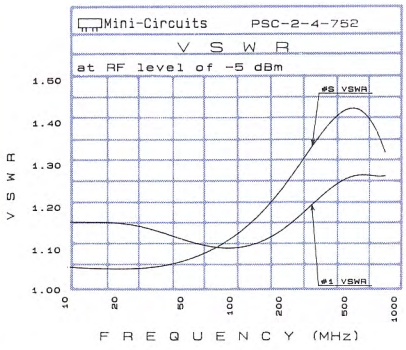
75 ohms

PSC-2-4-752

10 to 850MHz







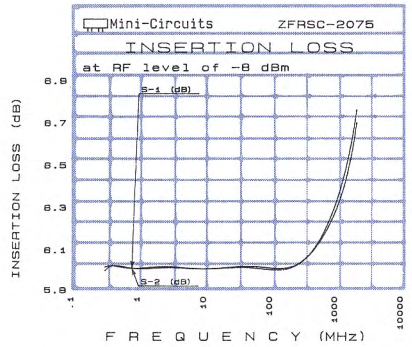
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	3.19	3.16	0.03	23.30
20.5	3.21	3.18	0.03	23.42
49.9	3.24	3.21	0.03	24.94
100.3	3.29	3.27	0.02	26.90
159.1	3.31	3.29	0.02	27.92
199.0	3.33	3.32	0.01	28.45
232.6	3.38	3.37	0.01	28.82
306.1	3.41	3.41	0.00	29.20
404.8	3.48	3.49	0.01	28.42
499.3	3.51	3.54	0.03	26.32
528.7	3.53	3.57	0.04	25.58
602.2	3.56	3.62	0.06	23.79
700.9	3.61	3.70	0.09	21.73
776.5	3.63	3.74	0.11	20.54
850.0	3.63	3.78	0.15	19.61

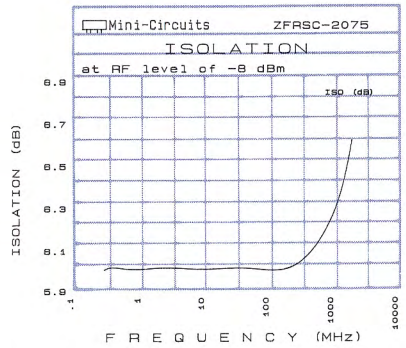
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.06	1.17	1.17
20.5	1.05	1.16	1.16
49.9	1.07	1.12	1.12
100.3	1.13	1.10	1.11
159.1	1.20	1.13	1.13
199.0	1.24	1.14	1.16
232.6	1.28	1.16	1.18
306.1	1.34	1.21	1.23
404.8	1.41	1.25	1.27
499.3	1.43	1.27	1.30
528.7	1.43	1.27	1.30
602.2	1.43	1.27	1.31
700.9	1.40	1.28	1.31
776.5	1.37	1.27	1.32
850.0	1.33	1.28	1.33

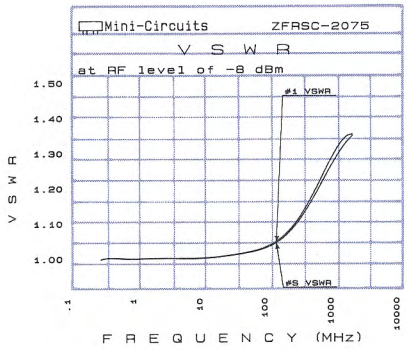
ZFRSC-2075

Resistive

DC to 2000MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.3	6.02	6.03	.01	6.03
0.5	6.02	6.02	0.00	6.02
1.0	6.02	6.02	0.01	6.01
11.9	6.02	6.02	0.00	6.02
30.0	6.03	6.02	0.01	6.03
75.3	6.02	6.03	0.01	6.02
101.6	6.03	6.02	0.01	6.03
255.3	6.03	6.03	0.00	6.03
497.8	6.11	6.12	0.01	6.11
993.3	6.35	6.36	0.01	6.34
1503.5	6.47	6.50	0.03	6.45
1611.0	6.56	6.59	0.03	6.52
1892.8	6.80	6.84	0.03	6.79
1982.0	6.79	6.83	0.04	6.76
2123.8	6.85	6.92	0.07	6.89

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.3	1.00	1.00	1.00
0.5	1.00	1.00	1.00
1.0	1.00	1.00	1.00
11.9	1.00	1.00	1.00
30.0	1.00	1.01	1.01
75.3	1.02	1.02	1.02
101.6	1.03	1.03	1.03
255.3	1.08	1.09	1.09
397.8	1.16	1.17	1.18
993.3	1.27	1.28	1.30
1503.5	1.31	1.32	1.34
1611.0	1.32	1.33	1.35
1892.8	1.35	1.37	1.38
1982.0	1.37	1.38	1.39
2123.8	1.40	1.41	1.41

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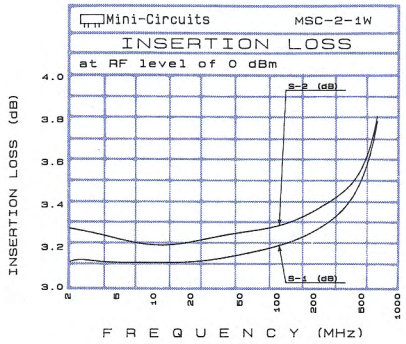
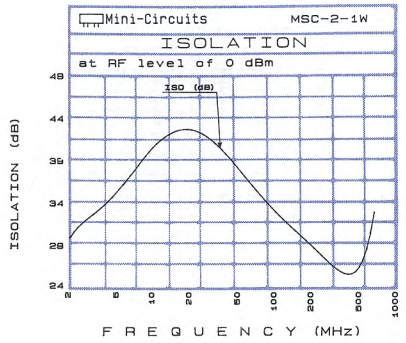
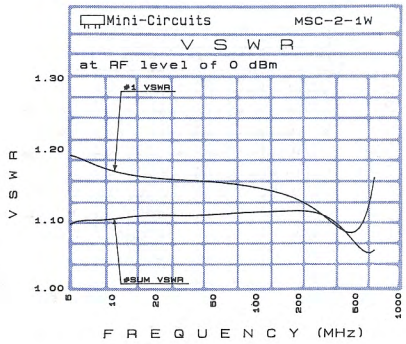
MSC-2-1W

2 to 650MHz





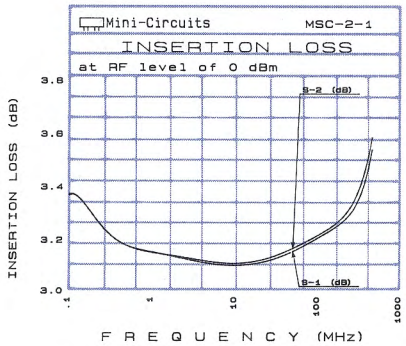


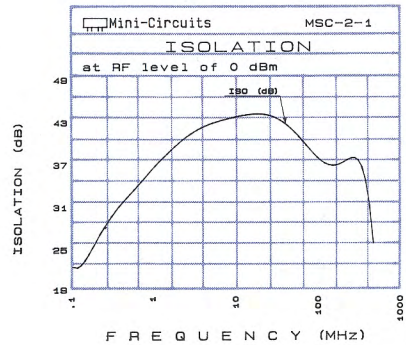
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
2.0	3.14	3.29	0.15	30.21
5.0	3.13	3.24	0.11	35.43
10.0	3.12	3.20	0.08	40.84
20.0	3.14	3.23	0.09	43.34
50.0	3.16	3.27	0.11	37.81
100.0	3.20	3.32	0.12	33.19
200.0	3.28	3.37	0.09	28.69
265.3	3.31	3.40	0.09	27.12
326.0	3.37	3.45	0.08	26.26
366.5	3.40	3.49	0.09	25.93
407.0	3.45	3.51	0.06	25.83
500.0	3.53	3.59	0.06	26.55
548.8	3.59	3.65	0.06	27.68
629.8	3.75	3.78	0.03	32.14
650.0	3.84	3.85	0.01	34.46

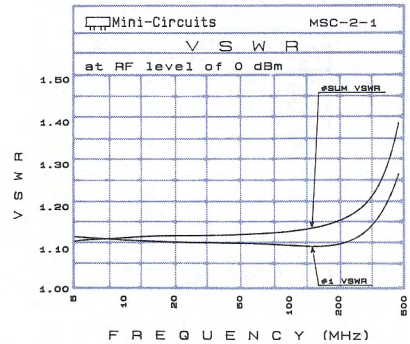
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.10	1.19	1.22
10.0	1.10	1.17	1.19
20.0	1.11	1.16	1.18
24.5	1.11	1.16	1.18
63.6	1.11	1.15	1.17
102.7	1.11	1.14	1.17
200.5	1.11	1.13	1.14
278.6	1.11	1.11	1.11
337.3	1.10	1.09	1.10
376.4	1.09	1.09	1.08
415.5	1.08	1.08	1.07
500.0	1.06	1.08	1.07
552.3	1.05	1.10	1.09
630.4	1.06	1.14	1.13
650.0	1.06	1.15	1.14

MSC-2-1

0.1 to 450MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.1	3.39	3.39	0.00	21.64
1.0	3.16	3.16	0.00	36.97
5.0	3.10	3.11	0.01	43.22
20.0	3.12	3.13	0.01	44.05
50.0	3.17	3.17	0.00	41.60
80.4	3.20	3.21	0.01	39.41
100.0	3.20	3.20	0.00	38.34
144.7	3.25	3.27	0.02	36.80
200.0	3.28	3.30	0.02	36.48
257.2	3.29	3.33	0.04	37.75
305.4	3.36	3.39	0.03	39.19
353.6	3.44	3.46	0.02	36.07
400.0	3.45	3.50	0.05	30.89
417.9	3.49	3.53	0.04	29.10
450.0	3.55	3.61	0.06	26.00

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.12	1.13	1.13
19.4	1.13	1.12	1.12
48.1	1.14	1.12	1.12
76.8	1.14	1.11	1.11
105.5	1.15	1.11	1.11
134.2	1.15	1.11	1.11
162.9	1.16	1.11	1.11
200.0	1.17	1.11	1.11
249.0	1.19	1.13	1.13
300.0	1.22	1.15	1.15
335.2	1.25	1.17	1.17
363.9	1.27	1.19	1.2
406.9	1.33	1.23	1.24
435.7	1.37	1.26	1.26

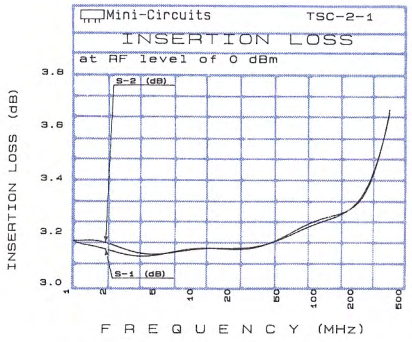
2WAY-0°

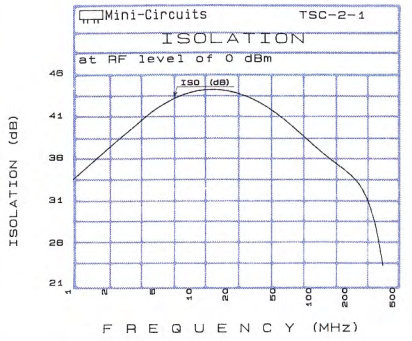
Power Splitter/Combiners

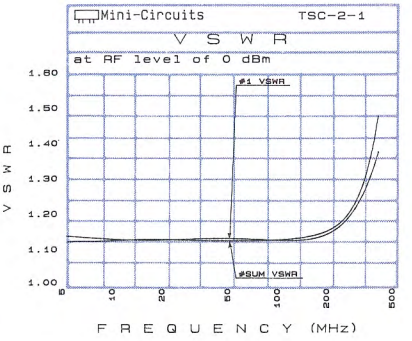
50 ohms

TSC-2-1

1 to 400MHz







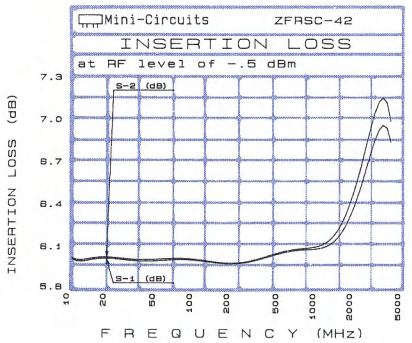
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
1.0	3.17	3.17	0.00	33.08
10.0	3.15	3.15	0.00	43.64
20.0	3.12	3.12	0.00	43.77
50.0	3.18	3.18	0.00	41.30
75.8	3.21	3.18	0.03	39.22
100.0	3.25	3.22	0.03	37.61
125.7	3.24	3.24	0.00	36.42
163.1	3.26	3.26	0.00	35.09
200.0	3.28	3.29	0.01	34.19
237.9	3.33	3.35	0.02	33.19
275.3	3.37	3.38	0.01	32.11
312.7	3.50	3.51	0.01	30.09
350.1	3.50	3.51	0.01	27.45
375.1	3.61	3.62	0.01	25.61
400.0	3.70	3.67	0.03	23.63

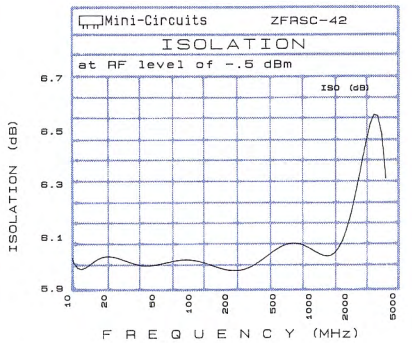
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.12	1.14	1.13
20.0	1.13	1.13	1.12
50.0	1.12	1.13	1.12
74.7	1.12	1.13	1.12
100.0	1.13	1.12	1.12
132.8	1.13	1.13	1.12
156.0	1.14	1.13	1.13
179.3	1.14	1.14	1.14
200.0	1.15	1.14	1.15
237.4	1.18	1.17	1.17
272.2	1.21	1.20	1.21
307.1	1.26	1.23	1.25
341.9	1.32	1.28	1.30
376.8	1.41	1.33	1.36
400.0	1.48	1.38	1.40

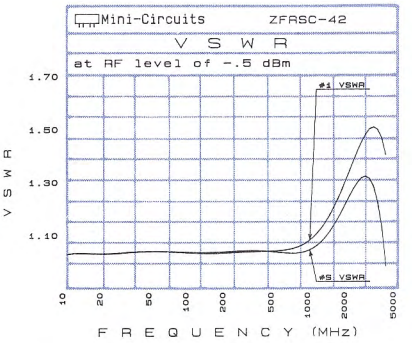
ZFRSC-42

Resistive

DC to 4200MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
10.0	6.01	6.02	0.01	6.00
51.9	6.01	6.02	0.01	6.01
104.3	5.99	6.00	0.01	5.99
198.6	5.99	6.00	0.01	5.99
502.3	6.02	6.02	0.00	6.01
1005.1	6.13	6.15	0.02	6.09
1225.1	6.16	6.18	0.02	6.10
1497.5	6.11	6.15	0.04	6.04
2042.2	6.26	6.36	0.10	6.04
2440.2	6.68	6.85	0.17	6.30
2995.4	6.92	7.09	0.17	6.59
3519.1	6.73	6.94	0.21	6.47
3791.5	6.91	7.10	0.19	6.52
4063.8	6.99	7.15	0.16	6.38
4200.0	7.01	7.17	0.16	6.34

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.0	1.03	1.03	1.03
51.9	1.04	1.04	1.04
104.3	1.04	1.04	1.03
198.6	1.04	1.03	1.04
502.3	1.03	1.05	1.04
1005.1	1.05	1.08	1.07
1225.1	1.08	1.12	1.10
1497.5	1.11	1.17	1.15
2042.2	1.22	1.32	1.28
2440.2	1.34	1.43	1.39
2995.4	1.33	1.50	1.42
3519.1	1.20	1.48	1.36
3791.5	1.13	1.45	1.32
4063.8	1.10	1.46	1.33
4200.0	1.09	1.50	1.37

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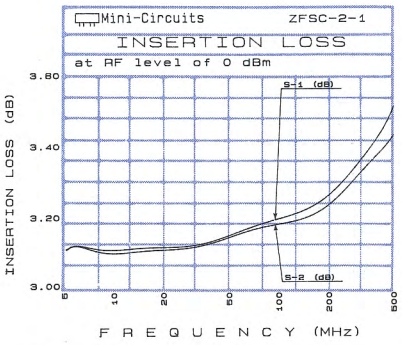
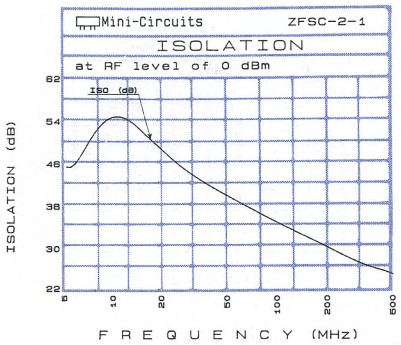
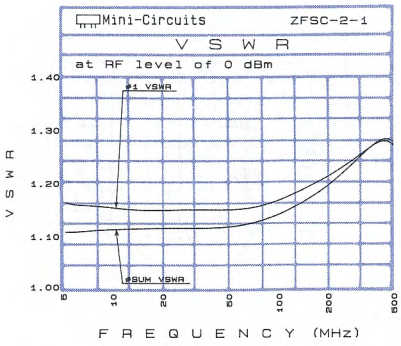
ZFSC-2-1 50 ohms 5 to 500MHz



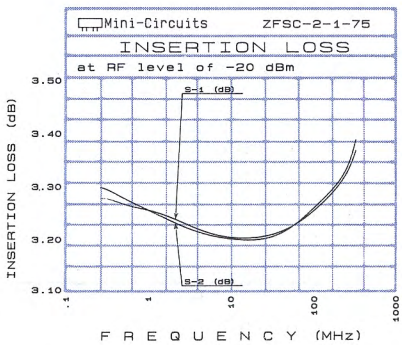


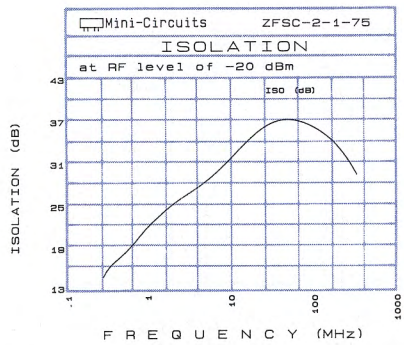


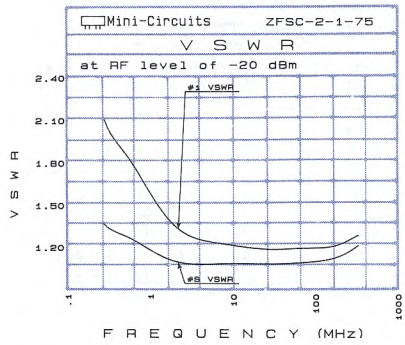
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
5.0	3.12	3.12	0.00	44.52
10.0	3.11	3.10	0.01	56.33
20.0	3.13	3.13	0.00	48.46
34.1	3.12	3.11	0.01	42.76
50.0	3.15	3.15	0.00	39.71
100.0	3.20	3.18	0.02	34.91
150.6	3.22	3.20	0.02	32.05
200.0	3.30	3.27	0.03	30.16
252.5	3.32	3.29	0.03	28.61
310.7	3.37	3.35	0.02	27.41
354.4	3.38	3.33	0.05	26.63
412.7	3.47	3.42	0.05	25.97
456.3	3.49	3.42	0.07	25.56
485.5	3.51	3.43	0.08	25.30
500.0	3.52	3.43	0.09	25.21

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.0	1.11	1.16	1.16
10.0	1.11	1.15	1.15
20.0	1.12	1.15	1.15
34.1	1.12	1.15	1.15
50.0	1.12	1.15	1.15
100.0	1.15	1.17	1.17
150.6	1.17	1.20	1.19
200.0	1.20	1.22	1.21
252.5	1.23	1.24	1.23
310.7	1.26	1.25	1.25
354.4	1.27	1.27	1.27
412.7	1.29	1.28	1.27
456.3	1.28	1.28	1.27
485.5	1.28	1.27	1.27
500.0	1.28	1.27	1.26

ZFSC-2-1-75 75 ohms 0.25 to 300MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB)
0.3	3.28	3.30	0.02	15.40
5.0	3.21	3.21	0.00	28.80
10.1	3.20	3.20	0.00	32.39
20.0	3.21	3.20	0.01	35.80
45.3	3.22	3.21	0.01	37.28
77.4	3.26	3.26	0.00	36.58
89.9	3.25	3.25	0.00	36.28
102.5	3.25	3.25	0.00	35.92
123.3	3.27	3.28	0.01	35.37
141.0	3.28	3.29	0.01	34.84
161.4	3.29	3.29	0.00	34.22
175.4	3.30	3.31	0.01	33.54
200.0	3.31	3.32	0.01	32.87
250.0	3.34	3.34	0.00	31.18
300.0	3.36	3.39	0.03	29.72

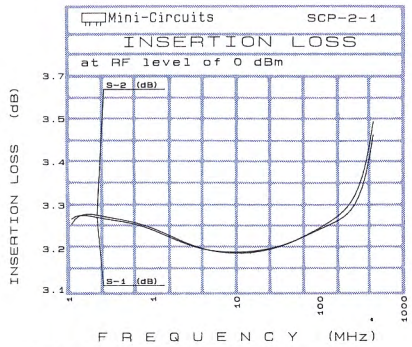
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.3	1.36	2.09	2.09
5.0	1.09	1.25	1.25
10.1	1.09	1.20	1.20
20.0	1.09	1.19	1.19
45.3	1.09	1.19	1.19
77.4	1.10	1.20	1.20
89.9	1.10	1.20	1.20
102.5	1.11	1.20	1.20
123.3	1.11	1.20	1.20
141.0	1.12	1.21	1.21
161.4	1.13	1.21	1.22
175.4	1.13	1.22	1.22
200.0	1.15	1.22	1.23
250.0	1.18	1.26	1.27
300.0	1.21	1.29	1.29

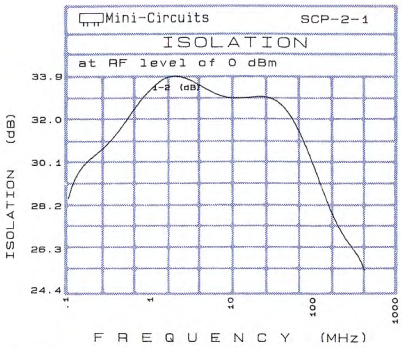
Power Splitter/Combiners

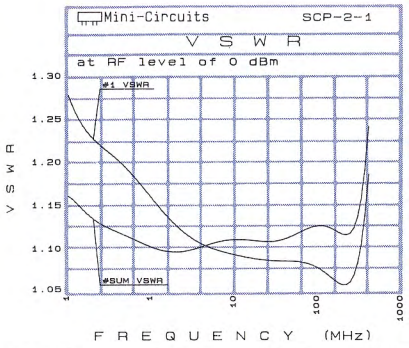
50 ohms

SCP-2-1

0.1 to 400 MHz





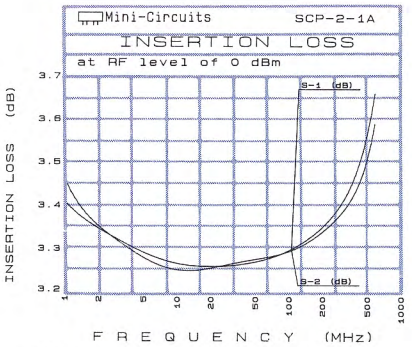


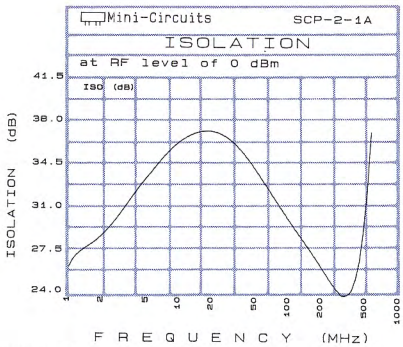
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
0.100	3.26	3.25	0.01	28.83
0.200	3.26	3.27	0.01	30.54
0.500	3.24	3.24	0.00	31.67
1.000	3.22	3.23	0.01	33.78
2.000	3.19	3.19	0.00	33.87
5.000	3.16	3.16	0.00	33.17
10.000	3.16	3.16	0.00	33.01
20.000	3.17	3.16	0.01	33.04
50.000	3.19	3.19	0.00	32.14
100.000	3.24	3.23	0.01	29.88
102.787	3.24	3.22	0.02	29.70
113.036	3.22	3.21	0.01	29.39
133.533	3.23	3.23	0.00	28.70
200.000	3.32	3.28	0.04	26.99
400.000	3.62	3.55	0.07	24.42

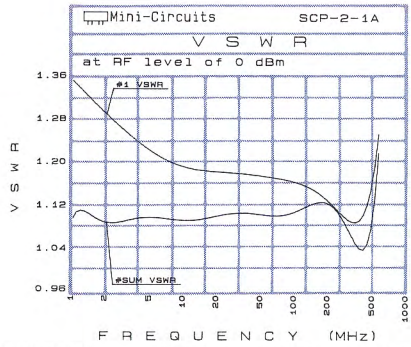
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.100	1.16	1.27	1.28
0.200	1.13	1.22	1.22
0.500	1.12	1.20	1.20
1.000	1.10	1.15	1.15
2.000	1.10	1.13	1.13
5.000	1.10	1.10	1.10
10.000	1.11	1.09	1.09
20.000	1.11	1.09	1.09
50.000	1.11	1.08	1.09
100.000	1.12	1.08	1.08
102.787	1.12	1.08	1.08
113.036	1.12	1.07	1.08
133.533	1.12	1.07	1.07
200.000	1.12	1.06	1.06
400.000	1.27	1.19	1.16

SCP-2-1A

1 to 550 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
1.000	3.35	3.39	0.04	26.45
2.000	3.29	3.29	0.00	28.70
5.000	3.24	3.23	0.01	33.26
10.000	3.21	3.19	0.02	36.59
20.000	3.21	3.21	0.00	37.33
50.000	3.22	3.23	0.01	34.01
100.000	3.27	3.24	0.03	29.89
120.000	3.27	3.26	0.01	28.73
135.000	3.27	3.29	0.02	27.97
149.000	3.25	3.26	0.01	27.34
164.000	3.29	3.28	0.01	26.85
179.000	3.31	3.30	0.01	26.23
200.000	3.32	3.33	0.01	25.81
275.000	3.33	3.33	0.00	24.35
550.000	3.64	3.56	0.08	41.47

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.000	1.11	1.35	1.35
2.000	1.09	1.29	1.29
5.000	1.09	1.22	1.22
10.000	1.10	1.19	1.19
20.000	1.10	1.18	1.18
50.000	1.10	1.17	1.17
100.000	1.11	1.16	1.16
120.000	1.11	1.16	1.16
135.000	1.11	1.15	1.15
149.000	1.12	1.14	1.15
164.000	1.11	1.14	1.14
179.000	1.11	1.13	1.13
200.000	1.12	1.12	1.13
275.000	1.10	1.10	1.10
550.000	1.23	1.25	1.21

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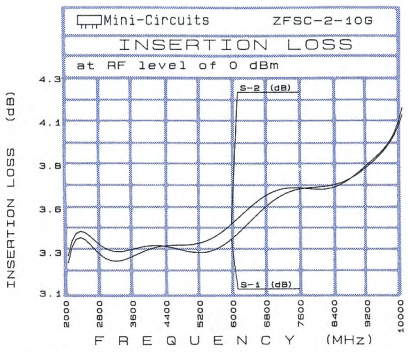
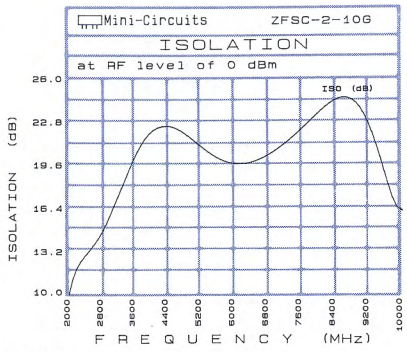
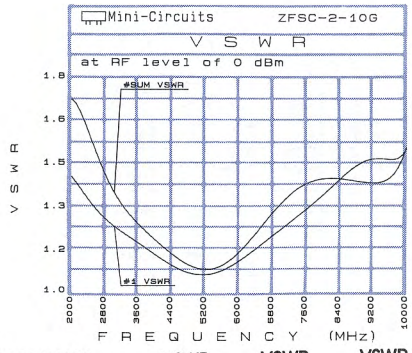
ZFSC-2-10G

2.0 to 10.0 GHz





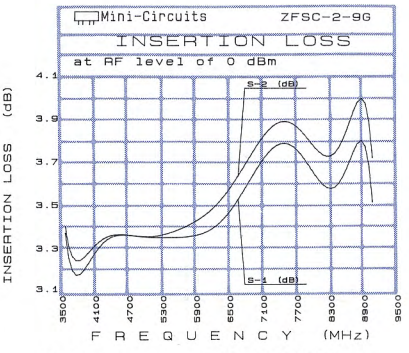


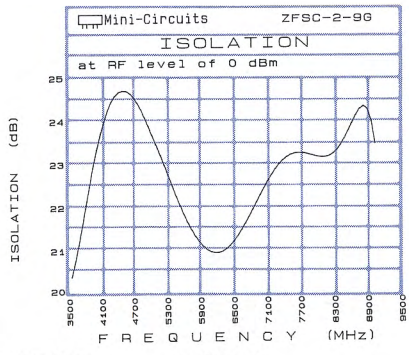
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
2000.000	3.37	3.34	0.03	10.78
2200.000	3.37	3.33	0.04	11.69
2420.000	3.42	3.38	0.04	12.83
2620.000	3.38	3.33	0.05	13.84
2820.000	3.36	3.31	0.05	14.95
3440.000	3.28	3.22	0.06	18.78
4000.000	3.29	3.28	0.01	21.88
4660.000	3.41	3.46	0.05	22.52
5000.000	3.35	3.39	0.04	21.69
5280.000	3.14	3.16	0.02	20.66
5480.000	3.34	3.42	0.08	20.37
5700.000	3.37	3.44	0.07	19.91
5900.000	3.40	3.53	0.13	19.62
6300.000	3.47	3.54	0.07	19.56
10000.000	4.24	4.27	0.03	16.07

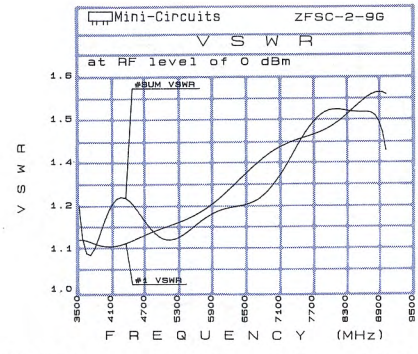
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
2000.000	1.71	1.41	1.34
2200.000	1.62	1.36	1.31
2420.000	1.51	1.31	1.33
2620.000	1.46	1.28	1.27
2820.000	1.46	1.26	1.19
3440.000	1.22	1.19	1.17
4000.000	1.26	1.13	1.19
4660.000	1.14	1.07	1.20
5000.000	1.01	1.07	1.25
5280.000	1.04	1.07	1.36
5480.000	1.08	1.07	1.31
5700.000	1.16	1.08	1.18
5900.000	1.19	1.09	1.18
6300.000	1.15	1.14	1.29
10000.000	1.49	1.49	1.45

ZFSC-2-9G

3.5 to 9.0 GHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
3500.000	3.30	3.25	0.05	19.77
4000.000	3.29	3.26	0.03	22.93
4480.000	3.40	3.41	0.01	24.29
4760.000	3.42	3.43	0.01	23.90
5000.000	3.32	3.31	0.01	23.10
5480.000	3.38	3.43	0.05	21.63
6000.000	3.40	3.47	0.07	20.62
6320.000	3.47	3.57	0.10	20.47
6600.000	3.50	3.62	0.12	20.77
7000.000	3.60	3.71	0.11	22.03
7300.000	3.73	3.83	0.10	22.61
7880.000	3.65	3.77	0.12	22.57
8440.000	3.76	3.94	0.18	23.24
8860.000	3.77	3.97	0.20	23.64
9000.000	3.60	3.80	0.20	23.36

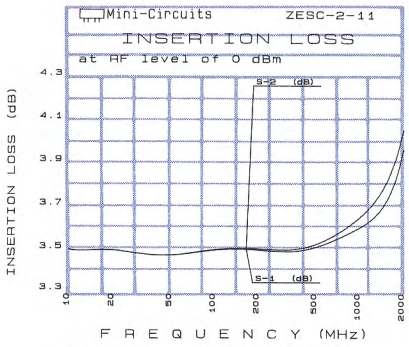
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
3500.000	1.19	1.15	1.10
4000.000	1.26	1.13	1.17
4480.000	1.26	1.14	1.25
4760.000	1.19	1.16	1.20
5000.000	1.10	1.17	1.25
5480.000	1.22	1.21	1.42
6000.000	1.14	1.26	1.39
6320.000	1.23	1.30	1.35
6600.000	1.24	1.34	1.43
7000.000	1.32	1.41	1.44
7300.000	1.37	1.41	1.51
7880.000	1.52	1.44	1.54
8440.000	1.53	1.51	1.64
8860.000	1.47	1.55	1.57
9000.000	1.43	1.55	1.53

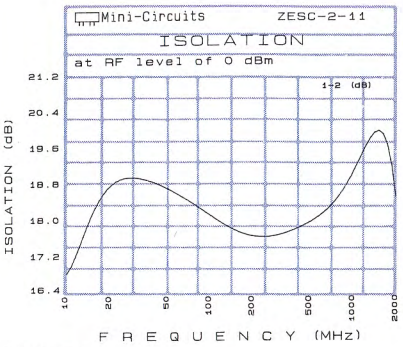
Power Splitter/Combiners

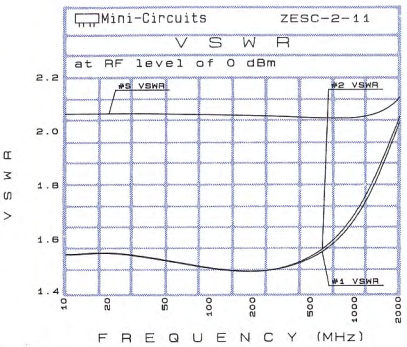
50 ohms

ZFSC-2-11, ZESC-2-11, MSC-2-11

10 to 2000 MHz





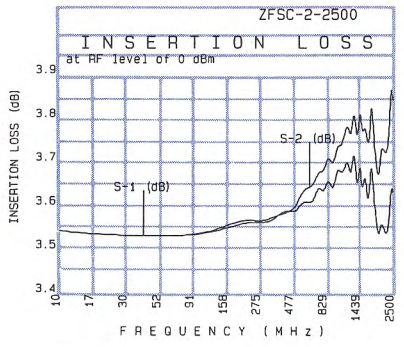


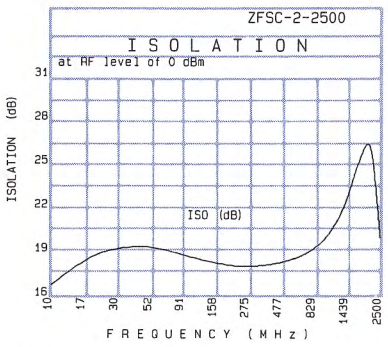
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
10.000	3.48	3.48	0.00	16.77
20.000	3.48	3.48	0.00	18.92
50.000	3.45	3.45	0.00	18.76
100.000	3.49	3.49	0.00	18.08
200.000	3.52	3.52	0.00	17.57
375.000	3.50	3.50	0.00	17.75
500.000	3.52	3.54	0.02	17.88
640.000	3.48	3.50	0.02	18.20
850.000	3.53	3.56	0.03	18.64
1000.000	3.58	3.62	0.04	18.99
1110.000	3.57	3.64	0.07	19.41
1265.000	3.57	3.65	0.08	19.81
1530.000	3.69	3.77	0.08	20.01
1790.000	3.84	3.93	0.09	19.47
2000.000	3.96	4.06	0.10	18.55

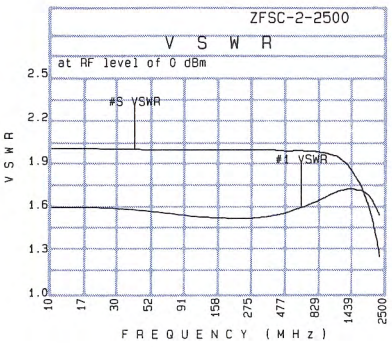
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.000	2.06	1.54	1.54
20.000	2.06	1.55	1.55
50.000	2.06	1.52	1.52
100.000	2.06	1.49	1.49
200.000	2.05	1.48	1.48
375.000	2.05	1.50	1.51
500.000	2.04	1.53	1.54
640.000	2.04	1.57	1.58
850.000	2.04	1.63	1.65
1000.000	2.04	1.68	1.70
1110.000	2.05	1.72	1.74
1265.000	2.05	1.77	1.80
1530.000	2.07	1.87	1.89
1790.000	2.10	1.96	1.99
2000.000	2.12	2.03	2.05

ZFSC-2-2500

10 to 2500 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
10.000	3.54	3.54	0.00	16.74
19.340	3.53	3.53	0.00	19.30
100.260	3.53	3.53	0.00	18.54
336.810	3.56	3.57	0.01	18.08
598.260	3.61	3.64	0.03	18.56
862.820	3.67	3.72	0.05	19.40
1124.270	3.68	3.76	0.08	20.60
1248.770	3.65	3.74	0.09	21.29
1320.360	3.75	3.84	0.09	21.83
1451.090	3.72	3.84	0.12	22.83
1712.540	3.65	3.76	0.11	25.16
1998.890	3.51	3.64	0.13	27.03
2238.550	3.65	3.82	0.17	24.88
2434.640	3.48	3.73	0.25	21.18
2500.000	3.63	3.84	0.21	20.03

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.000	2.01	1.61	1.60
19.340	2.01	1.61	1.61
100.260	2.00	1.54	1.54
336.810	2.00	1.54	1.55
598.260	2.00	1.60	1.61
862.820	1.98	1.66	1.68
1124.270	1.96	1.71	1.75
1248.770	1.92	1.72	1.77
1320.360	1.91	1.73	1.77
1451.090	1.85	1.73	1.78
1712.540	1.73	1.72	1.77
1998.890	1.54	1.66	1.71
2238.550	1.31	1.56	1.62
2434.640	1.12	1.49	1.54
2500.000	1.06	1.46	1.51

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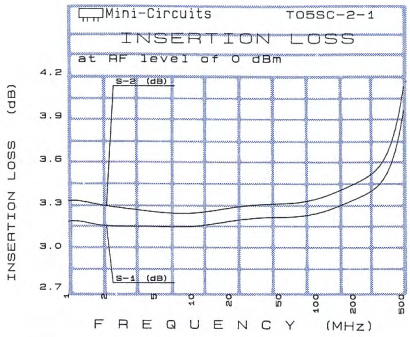
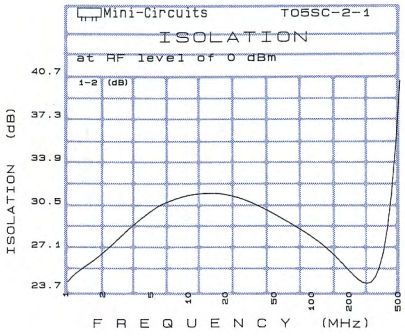
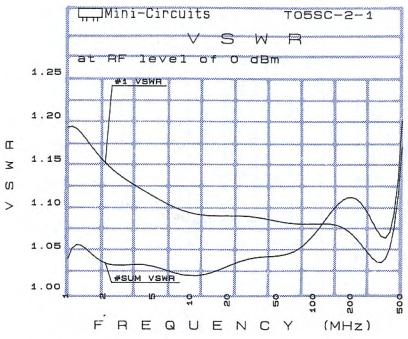
TO5SC-2-1

1 to 500 MHz







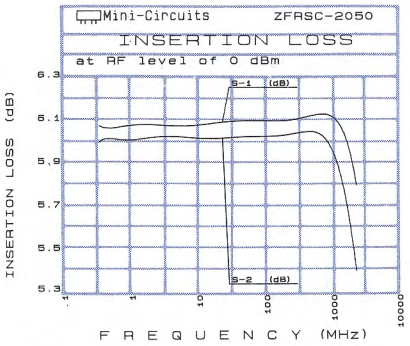
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
1.000	3.18	3.32	0.14	24.30
2.000	3.14	3.28	0.14	26.55
5.000	3.13	3.24	0.11	29.87
10.000	3.14	3.22	0.08	31.11
20.000	3.17	3.27	0.10	31.07
50.000	3.21	3.29	0.08	29.50
100.000	3.23	3.34	0.11	27.56
116.150	3.22	3.33	0.11	26.92
200.000	3.32	3.44	0.12	24.91
218.510	3.35	3.45	0.10	24.65
250.000	3.37	3.48	0.11	24.39
320.870	3.42	3.56	0.14	24.56
400.000	3.57	3.70	0.13	27.54
487.210	3.91	4.07	0.16	36.16
500.000	3.97	4.13	0.16	31.52

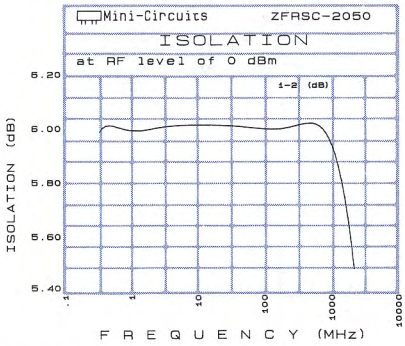
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.000	1.05	1.19	1.25
2.000	1.03	1.15	1.19
5.000	1.02	1.10	1.13
10.000	1.02	1.09	1.11
20.000	1.02	1.08	1.11
50.000	1.04	1.08	1.10
100.000	1.07	1.08	1.10
116.150	1.08	1.07	1.10
200.000	1.10	1.06	1.08
218.510	1.10	1.06	1.07
250.000	1.10	1.05	1.06
320.870	1.08	1.03	1.04
400.000	1.04	1.04	1.06
487.210	1.20	1.15	1.17
500.000	1.25	1.17	1.19

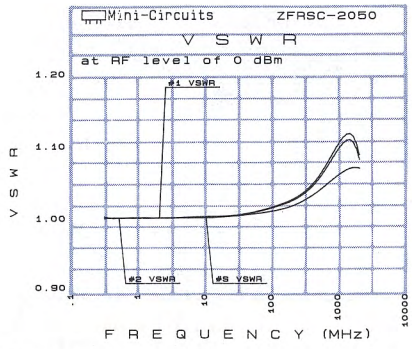
ZFRSC-2050, PRSC-2050

Resistive

DC to 2000 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
0.300	6.06	6.00	0.06	6.00
1.007	6.05	6.00	0.05	6.01
1.992	6.07	6.00	0.07	5.99
5.021	6.07	6.01	0.06	6.00
9.934	6.05	6.01	0.04	6.01
20.093	6.08	6.01	0.07	6.02
49.544	6.08	6.00	0.08	6.01
100.208	6.07	6.01	0.06	6.00
499.763	6.14	6.05	0.09	6.01
759.277	6.11	5.98	0.13	5.99
1010.828	6.06	5.88	0.18	5.90
1287.759	6.05	5.79	0.26	5.85
1406.286	6.02	5.71	0.31	5.79
1714.398	5.94	5.57	0.37	5.66
2000.000	5.81	5.46	0.35	5.56

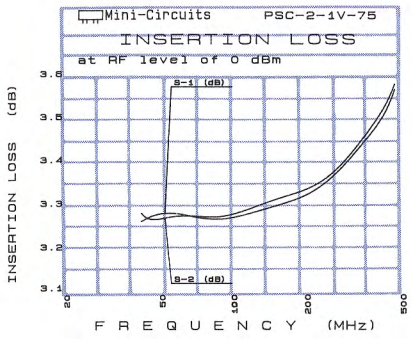
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.300	1.00	1.00	1.00
0.498	1.00	1.00	1.00
1.007	1.00	1.00	1.00
1.992	1.00	1.00	1.00
5.021	1.00	1.00	1.00
9.934	1.00	1.00	1.00
20.093	1.00	1.00	1.00
49.544	1.01	1.01	1.01
428.397	1.03	1.05	1.05
726.575	1.05	1.07	1.08
1010.828	1.06	1.10	1.11
1259.722	1.07	1.11	1.12
1406.286	1.07	1.11	1.12
1714.398	1.06	1.10	1.11
2000.000	1.08	1.09	1.09

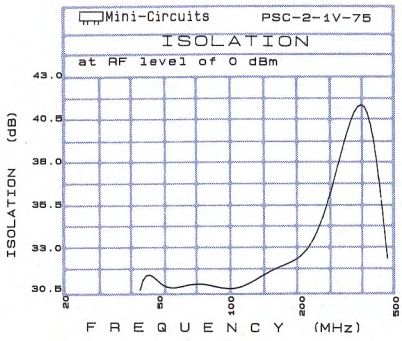
Power Splitter/Combiners

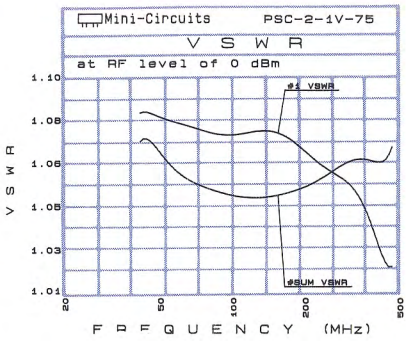
75 ohms

PSC-2-1V-75

40 to 450 MHz





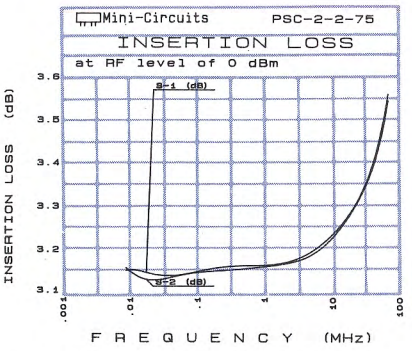


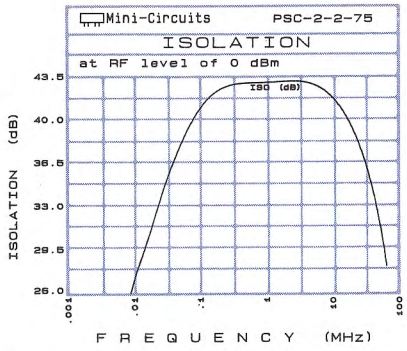
FREQUENCY (MHz)	ISOLATION LOSS (dB) S-1	ISOLATION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
40.000	3.26	3.27	0.01	31.23
50.000	3.28	3.26	0.02	31.07
100.000	3.27	3.28	0.01	30.86
114.000	3.29	3.29	0.00	31.04
124.000	3.27	3.29	0.02	31.05
134.000	3.29	3.31	0.02	31.28
150.000	3.29	3.30	0.01	31.67
156.000	3.30	3.32	0.02	31.74
166.000	3.31	3.31	0.00	31.92
176.000	3.31	3.33	0.02	32.27
188.000	3.31	3.33	0.02	32.63
200.000	3.32	3.34	0.02	33.06
224.000	3.35	3.36	0.01	34.17
400.000	3.50	3.53	0.03	37.53
450.000	3.55	3.58	0.03	33.08

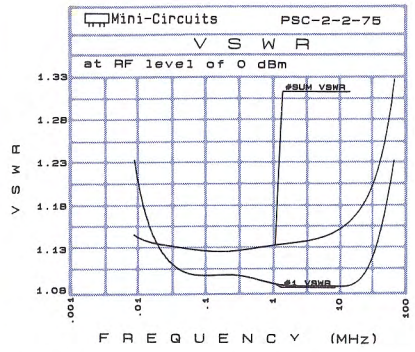
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
40.000	1.08	1.09	1.09
50.000	1.07	1.08	1.08
100.000	1.05	1.08	1.07
114.000	1.05	1.08	1.07
124.000	1.05	1.08	1.07
134.000	1.05	1.08	1.07
150.000	1.05	1.08	1.07
156.000	1.05	1.08	1.07
166.000	1.05	1.08	1.06
176.000	1.05	1.07	1.06
188.000	1.06	1.07	1.06
200.000	1.06	1.07	1.05
224.000	1.06	1.06	1.05
400.000	1.07	1.03	1.02
450.000	1.06	1.02	1.04

PSC-2-2-75, ZSC-2-2-75

0.008 to 60 MHz







FREQUENCY (MHz)	ISOLATION LOSS (dB) S-1	ISOLATION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
0.008	3.12	3.10	0.02	25.97
0.010	3.09	3.10	0.01	27.68
0.016	3.11	3.08	0.03	31.19
0.020	3.09	3.07	0.02	32.70
0.050	3.09	3.10	0.01	38.53
0.100	3.10	3.09	0.01	41.35
0.200	3.11	3.10	0.01	42.61
1.987	3.13	3.13	0.00	43.07
10.073	3.20	3.20	0.00	41.52
11.331	3.20	3.20	0.00	41.15
13.219	3.22	3.22	0.00	40.71
15.107	3.24	3.23	0.01	40.04
16.916	3.25	3.24	0.01	39.55
30.113	3.30	3.29	0.01	36.11
60.000	3.52	3.50	0.02	28.19

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
0.008	1.15	1.23	1.24
0.010	1.15	1.20	1.20
0.016	1.14	1.15	1.15
0.020	1.14	1.13	1.13
0.050	1.14	1.11	1.11
0.100	1.13	1.10	1.10
0.200	1.13	1.10	1.11
1.987	1.14	1.09	1.09
10.073	1.16	1.09	1.09
11.331	1.16	1.09	1.09
13.219	1.17	1.10	1.10
15.107	1.17	1.09	1.09
16.916	1.18	1.10	1.10
30.113	1.22	1.13	1.13
60.000	1.33	1.24	1.24

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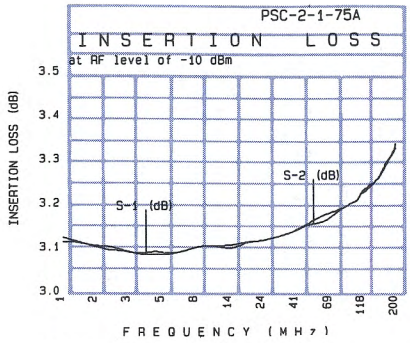
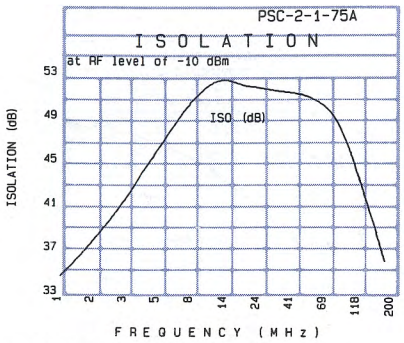
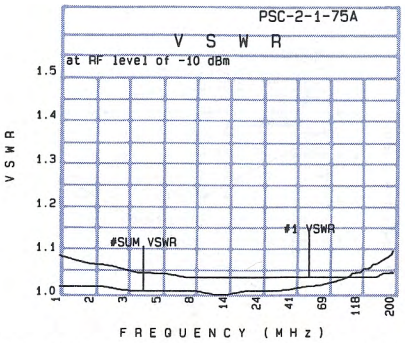
PSC-2-1-75A

1 to 200 MHz





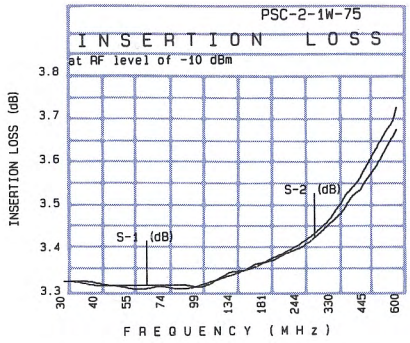


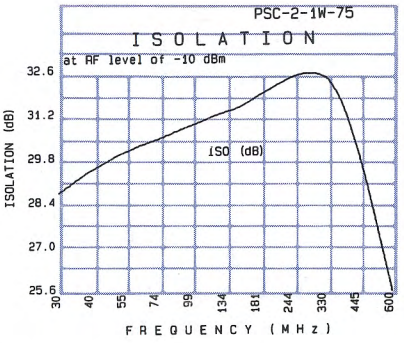
FREQUENCY (MHz)	ISOLATION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
1.00	3.13	3.12	0.01	34.68
2.07	3.10	3.11	0.00	39.32
3.38	3.09	3.09	0.00	43.19
8.90	3.11	3.11	0.00	51.03
11.29	3.11	3.11	0.00	52.43
29.69	3.13	3.13	0.00	51.63
79.13	3.19	3.19	0.00	49.52
100.44	3.21	3.21	0.01	46.40
110.20	3.22	3.22	0.00	44.93
120.90	3.24	3.23	0.01	43.34
139.87	3.25	3.25	0.00	40.59
159.67	3.29	3.28	0.01	38.07
179.89	3.31	3.30	0.01	35.86
194.77	3.33	3.32	0.00	34.40
200.00	3.33	3.34	0.01	33.86

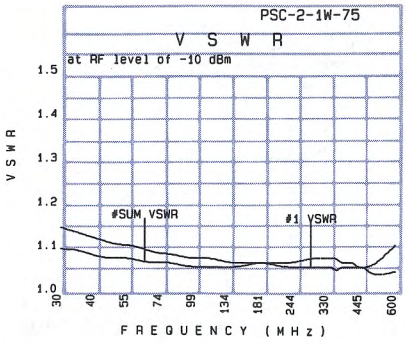
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1.00	1.02	1.09	1.09
2.07	1.02	1.07	1.07
3.38	1.01	1.05	1.05
8.90	1.01	1.04	1.04
11.29	1.00	1.04	1.04
29.69	1.01	1.04	1.04
79.13	1.03	1.04	1.04
100.44	1.04	1.04	1.04
110.20	1.05	1.04	1.04
120.90	1.05	1.04	1.04
139.87	1.06	1.04	1.04
159.67	1.07	1.04	1.04
179.89	1.08	1.05	1.05
194.77	1.09	1.05	1.05
200.00	1.10	1.05	1.05

PSC-2-1W-75

30 to 600 MHz







FREQUENCY (MHz)	ISOLATION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2
30.00	3.33	3.33	0.00	28.79
49.18	3.32	3.32	0.00	29.93
62.97	3.32	3.31	0.01	30.30
91.57	3.32	3.31	0.01	30.83
150.12	3.35	3.35	0.00	31.45
246.09	3.41	3.40	0.01	32.45
277.42	3.43	3.42	0.01	32.59
315.09	3.46	3.45	0.02	32.57
344.72	3.49	3.47	0.03	32.42
371.52	3.52	3.49	0.03	31.99
428.34	3.56	3.53	0.02	30.65
486.50	3.62	3.58	0.04	28.99
544.34	3.66	3.63	0.03	27.21
586.67	3.71	3.66	0.06	25.99
600.00	3.72	3.67	0.04	25.62

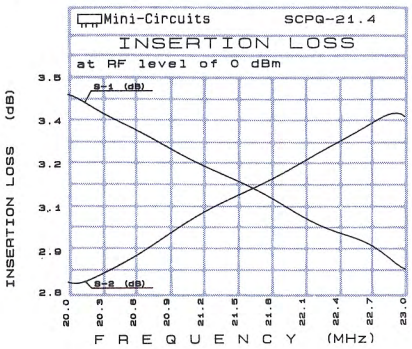
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
30.00	1.10	1.15	1.15
49.18	1.08	1.11	1.11
62.97	1.07	1.10	1.10
91.57	1.06	1.08	1.08
150.12	1.06	1.07	1.07
246.09	1.07	1.06	1.06
277.42	1.08	1.06	1.05
315.09	1.08	1.06	1.05
344.72	1.08	1.06	1.04
371.52	1.07	1.06	1.04
428.34	1.06	1.06	1.04
486.50	1.05	1.07	1.05
544.34	1.04	1.08	1.07
586.67	1.05	1.10	1.09
600.00	1.05	1.11	1.09

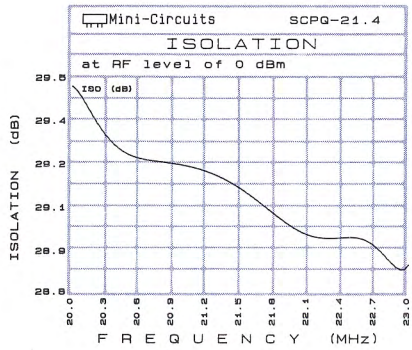
Power Splitter/Combiners

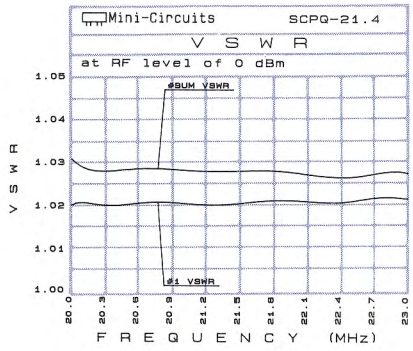
50 ohms

SYPQ-21.4

SCPQ-21.4 20 to 23 MHz

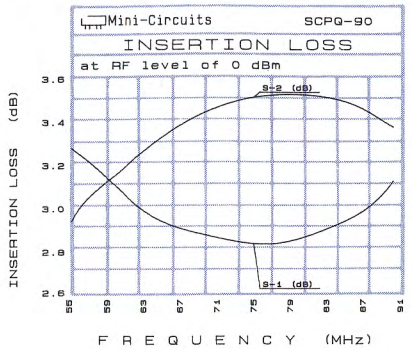


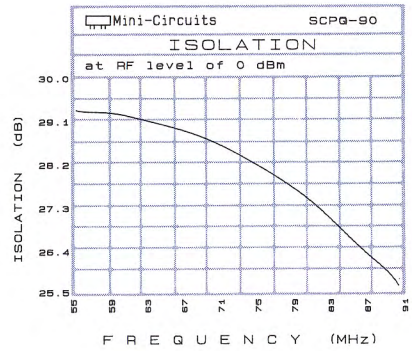


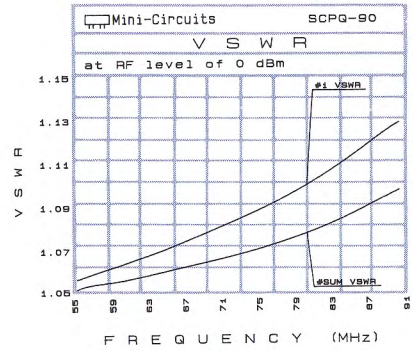


FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
20.000	3.45	2.80	0.65	89.81	29.39
20.075	3.43	2.79	0.64	90.10	29.50
20.150	3.40	2.77	0.63	89.89	29.40
20.225	3.40	2.83	0.57	90.00	29.29
20.300	3.39	2.84	0.55	89.76	29.40
20.375	3.38	2.83	0.55	89.65	29.12
20.450	3.33	2.83	0.50	89.62	29.27
20.550	3.32	2.87	0.45	89.88	29.20
20.625	3.34	2.91	0.43	89.73	29.31
20.700	3.28	2.90	0.38	89.46	29.24
20.775	3.27	2.92	0.35	89.83	29.16
20.850	3.29	2.96	0.33	89.78	29.24
20.925	3.25	2.95	0.30	89.89	29.22
21.000	3.23	2.98	0.25	89.61	29.09
23.000	2.83	3.37	0.54	89.82	28.77

SCPQ-90 55 to 90 MHz

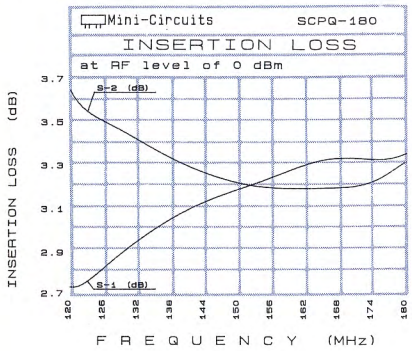


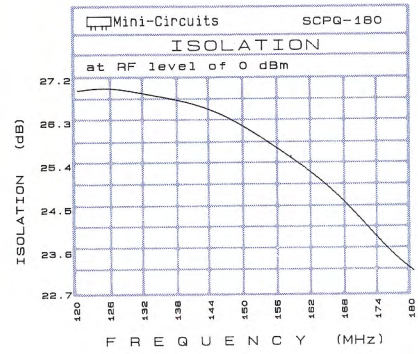


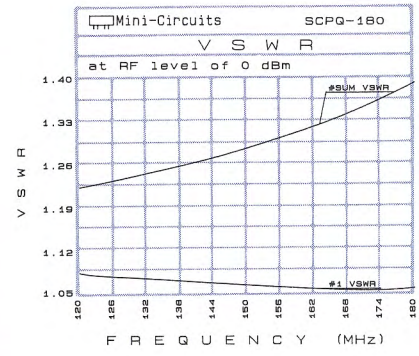


FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
55.000	3.28	2.95	0.33	90.07	29.35
56.000	3.25	3.01	0.24	90.14	29.30
57.000	3.21	3.05	0.16	90.25	29.30
57.692	3.18	3.08	0.10	90.09	29.26
58.590	3.16	3.13	0.03	90.12	29.39
61.282	3.05	3.19	0.14	90.20	29.17
63.974	2.94	3.29	0.35	90.36	29.11
66.667	2.92	3.39	0.47	90.27	28.88
70.000	2.87	3.46	0.59	90.49	28.80
72.051	2.85	3.49	0.64	90.50	28.47
75.000	2.84	3.52	0.68	90.69	28.21
78.333	2.85	3.53	0.68	90.75	27.75
81.026	2.87	3.53	0.66	91.09	27.38
83.718	2.92	3.52	0.60	91.11	26.89
90.000	3.12	3.38	0.26	91.82	25.71

SCPQ-180 120 to 180 MHz







FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
120.000	2.72	3.62	0.90	90.22	27.00
122.000	2.77	3.59	0.82	90.18	26.99
123.000	2.77	3.57	0.80	90.36	27.01
125.000	2.80	3.48	0.68	90.38	27.08
126.000	2.81	3.50	0.69	90.42	26.98
128.000	2.89	3.48	0.59	90.41	26.99
129.000	2.91	3.46	0.55	90.61	26.99
131.000	2.93	3.45	0.52	90.54	26.93
132.000	2.95	3.42	0.47	90.26	26.88
134.000	2.99	3.40	0.41	90.14	26.85
135.000	3.04	3.34	0.30	90.25	26.91
137.000	3.03	3.37	0.34	90.47	26.70
138.000	3.04	3.33	0.29	90.73	26.80
140.000	3.08	3.30	0.22	90.40	26.75
180.000	3.33	3.31	0.02	91.59	23.21

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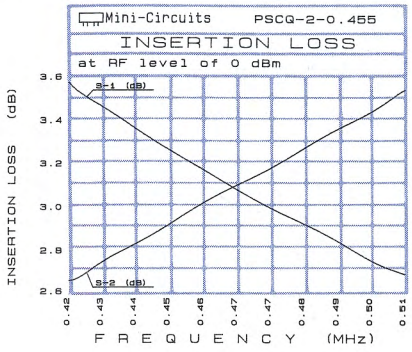
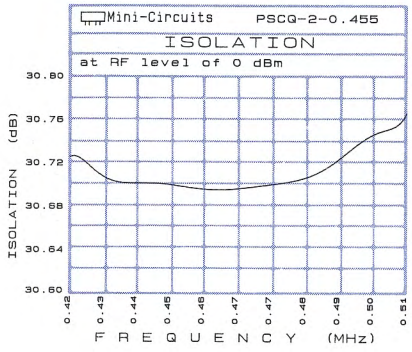
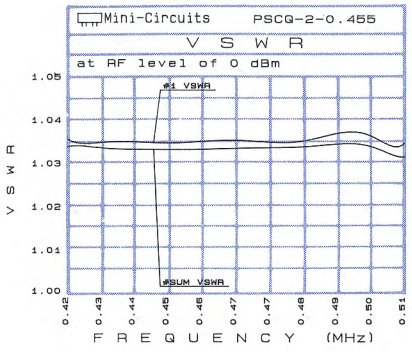
PSCQ-2-0.455 0.42 to 0.51 MHz

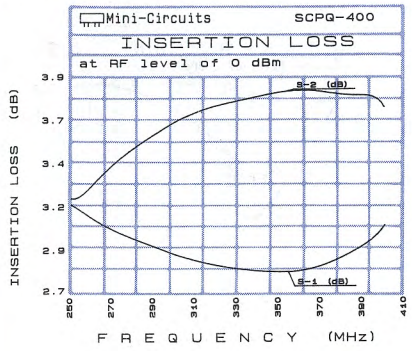


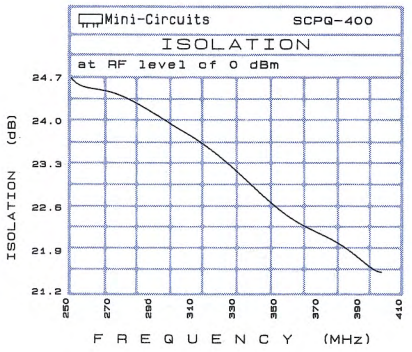


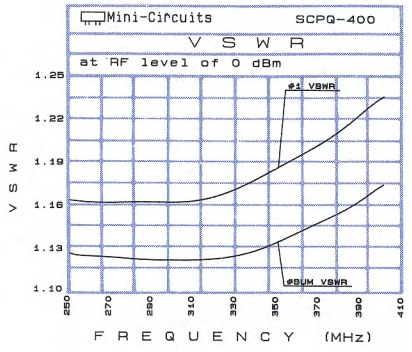


FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
0.420	3.52	2.65	0.87	89.97	30.73
0.427	3.43	2.72	0.71	89.96	30.70
0.434	3.37	2.78	0.59	90.00	30.71
0.441	3.29	2.84	0.45	89.94	30.69
0.448	3.22	2.91	0.31	89.99	30.69
0.455	3.16	2.97	0.19	89.93	30.68
0.462	3.08	3.05	0.03	89.91	30.70
0.468	3.03	3.10	0.07	89.98	30.70
0.475	2.97	3.16	0.19	90.02	30.68
0.482	2.90	3.22	0.32	89.95	30.72
0.501	2.73	3.37	0.64	90.27	30.75
0.503	2.73	3.43	0.70	89.97	30.74
0.505	2.72	3.45	0.73	90.01	30.75
0.508	2.70	3.47	0.77	89.98	30.76
0.510	2.68	3.49	0.81	89.99	30.76

SCPQ-400 250 to 400 MHz

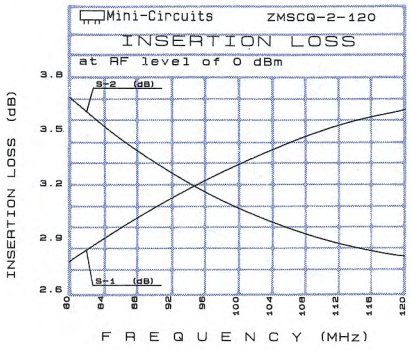


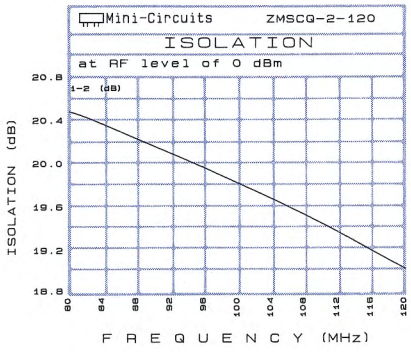


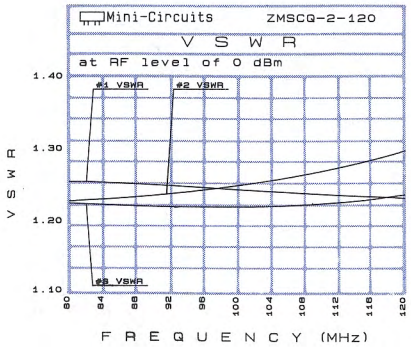


FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
250.000	3.18	3.20	0.02	89.39	24.67
254.000	3.12	3.20	0.08	89.40	24.65
258.000	3.10	3.25	0.15	89.38	24.56
262.000	3.07	3.29	0.22	89.48	24.53
265.000	3.04	3.32	0.28	89.52	24.44
269.000	3.04	3.39	0.35	89.31	24.51
273.000	3.01	3.43	0.42	89.31	24.41
277.000	2.97	3.45	0.48	89.41	24.39
281.000	2.95	3.50	0.55	89.47	24.38
285.000	2.94	3.52	0.58	89.39	24.31
288.000	2.92	3.53	0.61	89.27	24.17
292.000	2.91	3.58	0.67	89.41	24.04
296.000	2.88	3.62	0.74	89.45	24.10
308.000	2.86	3.68	0.82	89.57	23.79
400.000	3.03	3.75	0.72	89.01	21.52

ZMSCQ-2-120 80 to 120 MHz





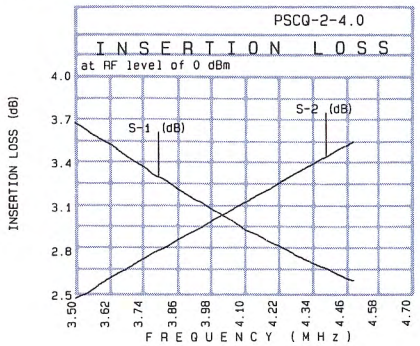


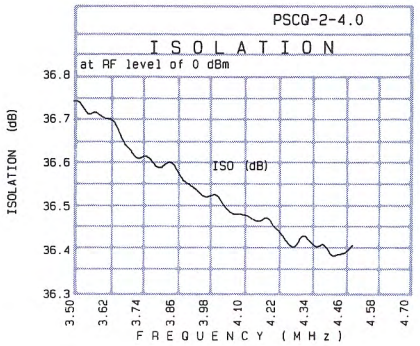
FREQ. (MHz)	INSERT. LOSS S-1 (dB)	INSERT. LOSS S-2 (dB)	AMP. UNBAL. (dB)	PHASE (Deg) 1-2	ISOL. (dB)
80.000	2.77	3.67	.90	87.45	20.48
82.000	2.83	3.59	.76	87.42	20.43
84.000	2.90	3.52	.62	87.46	20.38
86.000	2.95	3.45	.50	87.44	20.29
90.500	3.08	3.31	.23	87.54	20.15
92.500	3.13	3.25	.12	87.46	20.08
96.500	3.23	3.14	.09	87.34	19.96
100.500	3.32	3.06	.26	87.31	19.78
102.500	3.36	3.02	.34	87.34	19.73
107.500	3.46	2.93	.53	87.28	19.55
109.500	3.49	2.91	.58	87.36	19.47
114.000	3.55	2.85	.70	87.24	19.27
116.000	3.57	2.83	.74	87.48	19.21
118.000	3.59	2.81	.78	87.39	19.11
120.000	3.62	2.80	.82	87.33	19.03

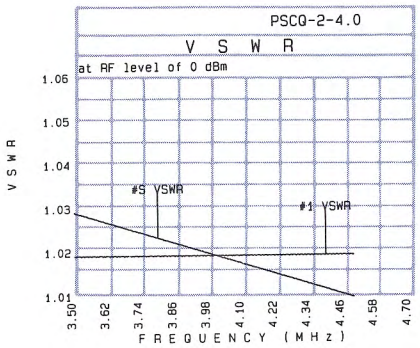
Power Splitter/Combiners

50 ohms

PSCQ-2-4.0 3.5 to 4.5 MHz

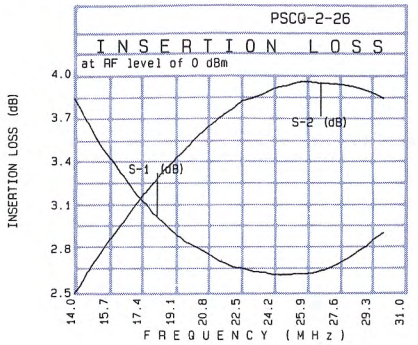


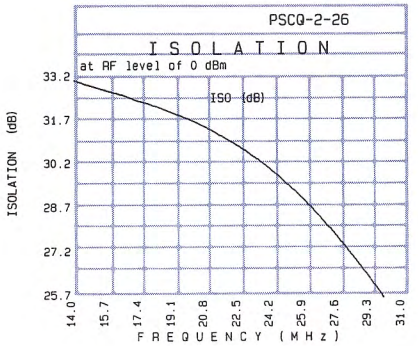


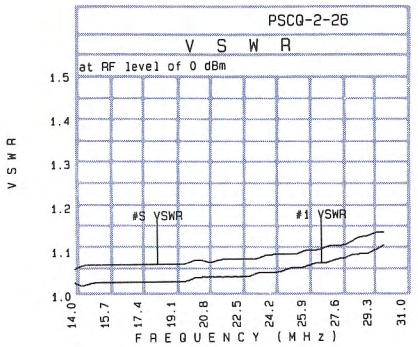


FREQ. (MHz)	INSERT. LOSS (dB) S-1	INSERT. LOSS (dB) S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
3.500	3.71	2.51	1.20	89.61	36.75
3.578	3.61	2.59	1.02	89.63	36.73
3.655	3.52	2.68	0.84	89.64	36.70
3.730	3.42	2.76	0.66	89.61	36.61
3.808	3.33	2.84	0.49	89.59	36.59
3.885	3.23	2.92	0.31	89.58	36.57
3.962	3.15	3.00	0.15	89.58	36.53
4.037	3.06	3.08	0.02	89.59	36.51
4.115	2.96	3.16	0.20	89.57	36.49
4.193	2.89	3.24	0.35	89.60	36.49
4.270	2.82	3.33	0.51	89.59	36.42
4.345	2.76	3.41	0.65	89.58	36.43
4.423	2.68	3.49	0.81	89.58	36.39
4.475	2.63	3.54	0.91	89.58	36.40
4.500	2.62	3.57	0.95	89.58	36.42

PSCQ-2-26 14 to 30 MHz

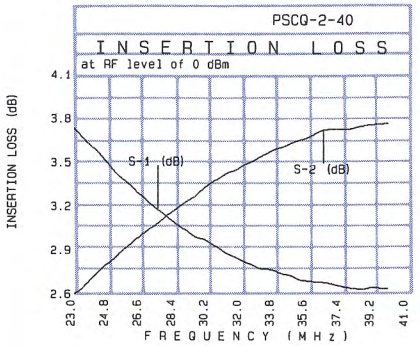


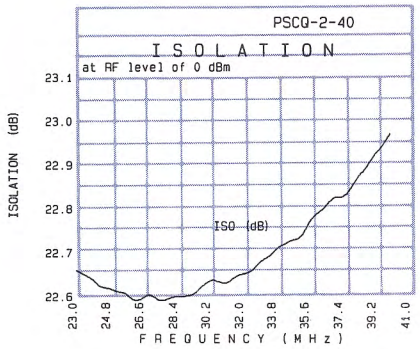


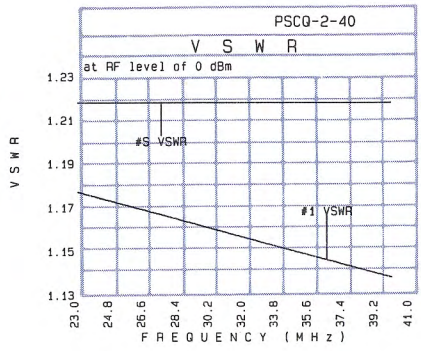


FREQ. (MHz)	INSERT. LOSS (dB) S-1	INSERT. LOSS (dB) S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
14.000	3.86	2.52	1.34	88.68	33.19
14.840	3.66	2.71	0.95	88.61	33.00
16.040	3.41	2.93	0.48	88.60	32.76
17.680	3.14	3.22	0.08	88.54	32.41
19.320	2.92	3.46	0.54	88.53	32.00
20.960	2.79	3.67	0.88	88.54	31.51
21.800	2.73	3.76	1.03	88.57	31.18
22.600	2.70	3.84	1.14	88.63	30.87
24.240	2.65	3.92	1.27	88.74	30.08
25.880	2.66	3.97	1.31	88.98	29.08
27.520	2.72	3.96	1.24	89.36	27.90
27.960	2.75	3.95	1.20	89.41	27.54
29.160	2.85	3.91	1.06	89.80	26.52
29.600	2.91	3.89	0.98	90.01	26.13
30.000	2.94	3.86	0.92	90.16	25.75

PSCQ-2-40 23 to 40 MHz







FREQ. (MHz)	INSERT. LOSS (dB) S-1	INSERT. LOSS (dB) S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
23.000	3.76	2.63	1.13	90.33	22.67
24.318	3.60	2.78	0.82	90.37	22.63
25.635	3.41	2.93	0.48	90.48	22.62
26.910	3.27	3.06	0.21	90.58	22.62
28.227	3.13	3.19	0.06	90.64	22.61
29.545	3.01	3.29	0.28	90.75	22.62
30.863	2.94	3.42	0.48	90.78	22.64
32.138	2.85	3.51	0.66	90.95	22.66
33.455	2.80	3.59	0.79	91.01	22.70
34.773	2.76	3.66	0.90	91.14	22.74
36.090	2.71	3.73	1.02	91.24	22.80
37.365	2.67	3.74	1.07	91.41	22.83
38.682	2.66	3.78	1.12	91.36	22.90
39.575	2.67	3.79	1.12	91.47	22.95
40.000	2.67	3.80	1.13	91.50	22.98

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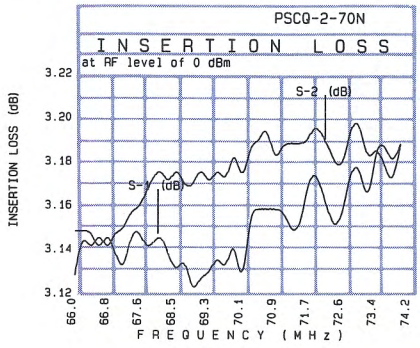
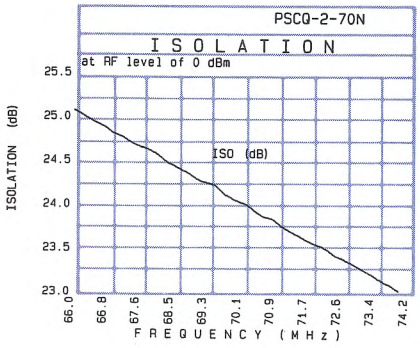
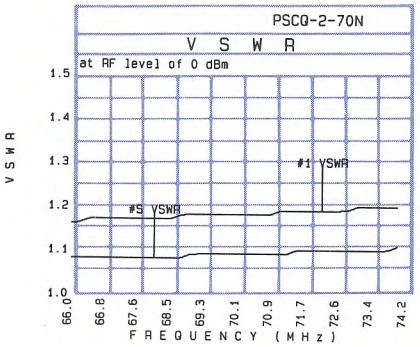
PSCQ-2-70N 66 to 74 MHz

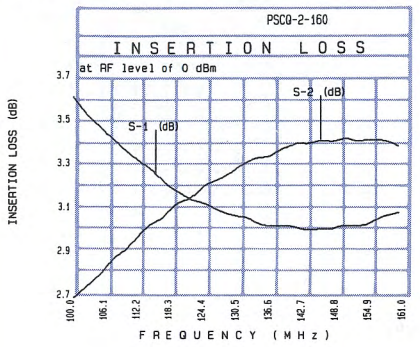


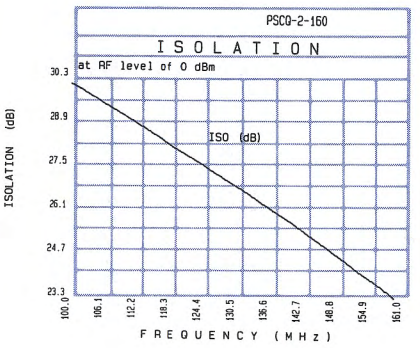


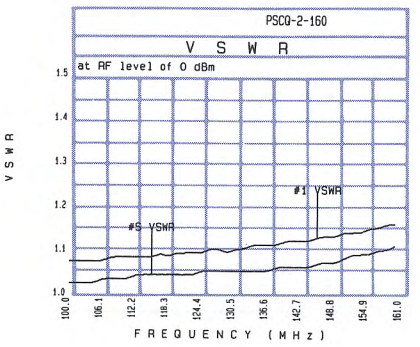


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
66.000	3.15	3.13	0.02	89.62	25.12
66.600	3.14	3.15	0.01	89.66	24.96
67.200	3.13	3.15	0.02	89.75	24.82
67.800	3.14	3.17	0.03	89.70	24.68
68.500	3.13	3.18	0.05	89.74	24.48
69.100	3.13	3.18	0.05	89.77	24.31
69.700	3.13	3.17	0.04	89.87	24.16
70.300	3.16	3.19	0.03	89.84	24.04
70.900	3.16	3.18	0.02	89.95	23.89
71.500	3.15	3.19	0.04	89.94	23.70
72.200	3.16	3.19	0.03	90.00	23.56
72.800	3.18	3.20	0.02	90.10	23.39
73.400	3.19	3.19	0.00	90.08	23.24
73.800	3.18	3.17	0.01	89.96	23.14
74.000	3.19	3.19	0.00	90.13	23.07

PSCQ-2-160 100 to 160 MHz

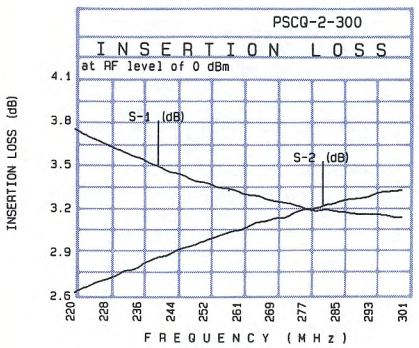


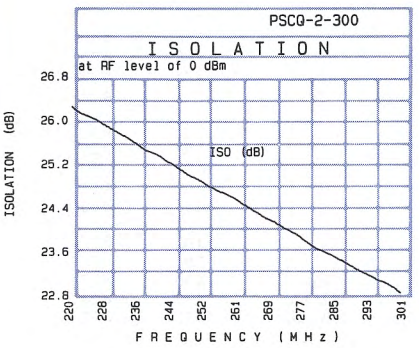


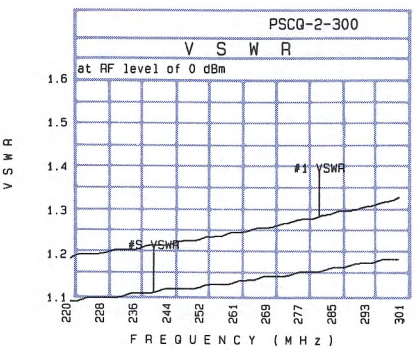


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
100.00	3.62	2.70	0.92	90.37	30.08
104.65	3.49	2.80	0.69	90.40	29.62
109.30	3.38	2.91	0.47	90.44	29.14
113.80	3.30	3.03	0.27	90.50	28.69
118.45	3.20	3.11	0.09	90.54	28.18
123.10	3.14	3.18	0.04	90.66	27.69
127.75	3.09	3.25	0.16	90.67	27.18
132.25	3.07	3.32	0.25	90.71	26.70
136.90	3.03	3.35	0.32	90.79	26.16
141.55	3.02	3.41	0.39	90.82	25.64
146.20	3.02	3.42	0.40	90.93	25.07
150.70	3.03	3.43	0.40	91.01	24.52
155.35	3.05	3.42	0.37	91.13	23.94
158.50	3.08	3.41	0.33	91.21	23.54
160.00	3.09	3.39	0.30	91.27	23.33

PSCQ-2-300 220 to 300 MHz







FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.) 1-2	ISOL. (dB) 1-2
220.00	3.77	2.65	1.12	89.82	26.33
226.00	3.69	2.73	0.96	89.85	26.08
232.50	3.61	2.81	0.80	89.82	25.79
238.50	3.53	2.87	0.66	89.83	25.49
244.50	3.47	2.94	0.53	89.66	25.26
251.00	3.41	3.00	0.41	89.80	24.98
257.00	3.37	3.06	0.31	89.79	24.73
263.00	3.32	3.12	0.20	89.67	24.47
269.00	3.28	3.17	0.11	89.60	24.23
275.50	3.24	3.22	0.02	89.58	23.95
281.50	3.23	3.26	0.03	89.59	23.67
287.50	3.20	3.29	0.09	89.51	23.44
294.00	3.19	3.34	0.15	89.41	23.16
298.00	3.17	3.35	0.18	89.51	23.03
300.00	3.17	3.36	0.19	89.56	22.90

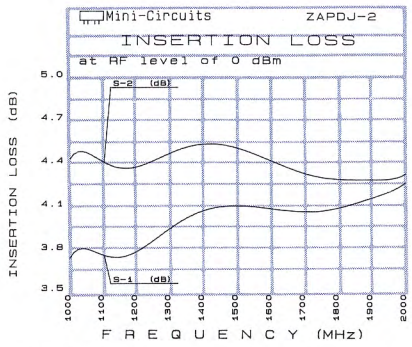
Power Splitter/Combiners

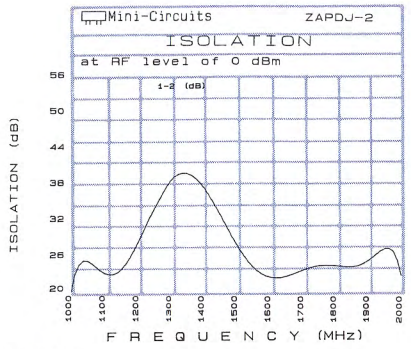
50 ohms

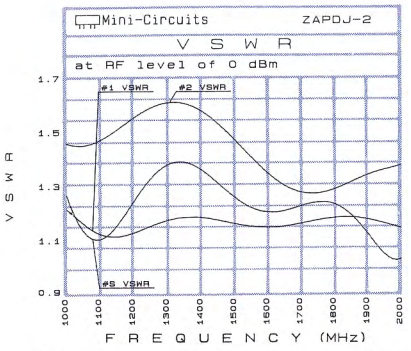
ZAPDJ-2

2 WAY-180°

1000 to 2000 MHz







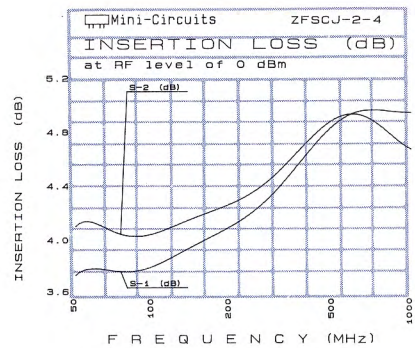
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2	PHASE (Degrees) 1-2
1000.000	3.73	4.44	0.71	23.25	177.00
1052.500	3.84	4.49	0.65	23.44	176.37
1102.500	3.68	4.36	0.68	24.00	176.19
1155.000	3.73	4.33	0.60	25.32	176.19
1205.000	3.79	4.34	0.55	27.46	175.69
1257.500	3.86	4.45	0.59	31.22	175.41
1307.500	3.88	4.40	0.52	38.36	175.79
1360.000	4.06	4.52	0.46	46.08	174.92
1410.000	4.02	4.53	0.51	33.69	175.04
1500.000	4.23	4.60	0.37	26.92	174.50
1615.000	4.06	4.33	0.27	23.53	174.82
1717.500	3.95	4.24	0.29	23.00	174.96
1795.000	4.10	4.27	0.17	23.88	174.29
1897.500	4.13	4.24	0.11	25.82	174.52
2000.000	4.23	4.29	0.06	25.37	174.36

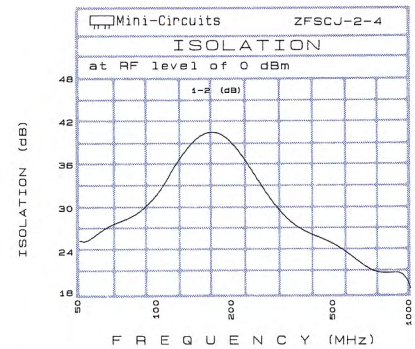
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
1000.000	1.25	1.22	1.46
1052.500	1.14	1.16	1.45
1102.500	1.09	1.12	1.47
1155.000	1.16	1.11	1.51
1205.000	1.26	1.13	1.56
1257.500	1.34	1.16	1.60
1307.500	1.38	1.18	1.61
1360.000	1.38	1.18	1.60
1410.000	1.36	1.18	1.57
1500.000	1.26	1.16	1.47
1615.000	1.20	1.15	1.33
1717.500	1.24	1.17	1.27
1795.000	1.23	1.18	1.29
1897.500	1.13	1.18	1.34
2000.000	1.04	1.14	1.37

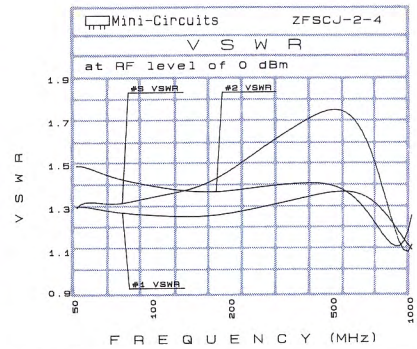
ZFSCJ-2-4

2 WAY-180°

50 to 1000 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB) 1-2	ISOLATION (dB) 1-2	PHASE (Degrees) 1-2
50.000	3.77	4.14	0.37	25.19	176.98
75.000	3.79	4.07	0.28	28.45	177.52
100.000	3.77	4.00	0.23	32.03	177.98
200.000	4.04	4.21	0.17	38.42	178.80
292.500	4.47	4.62	0.15	30.81	179.40
367.500	4.45	4.53	0.08	27.62	179.75
415.000	4.79	4.87	0.08	26.48	179.94
500.000	4.70	4.71	0.01	24.52	179.68
585.000	4.89	4.91	0.02	23.33	179.45
660.000	4.98	4.94	0.04	22.46	179.14
732.500	4.96	4.87	0.09	21.76	179.03
805.000	4.98	4.83	0.15	21.24	178.89
877.500	4.88	4.69	0.19	20.74	178.95
952.500	5.00	4.74	0.26	20.49	179.00
1000.000	4.90	4.66	0.24	20.27	179.39

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
50.000	1.32	1.31	1.50
75.000	1.33	1.28	1.44
100.000	1.35	1.27	1.40
200.000	1.48	1.28	1.38
292.500	1.61	1.32	1.40
367.500	1.70	1.35	1.42
415.000	1.73	1.36	1.42
500.000	1.75	1.37	1.39
585.000	1.71	1.37	1.35
660.000	1.62	1.35	1.29
732.500	1.49	1.31	1.22
805.000	1.33	1.26	1.14
877.500	1.15	1.19	1.11
952.500	1.07	1.13	1.18
1000.000	1.20	1.12	1.25

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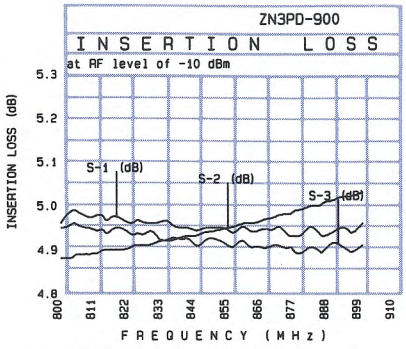
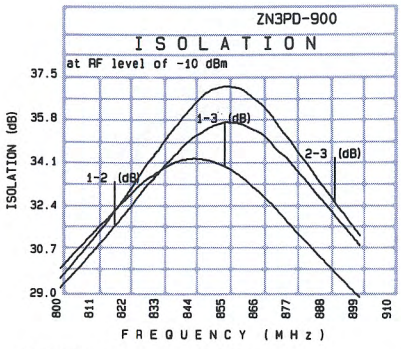
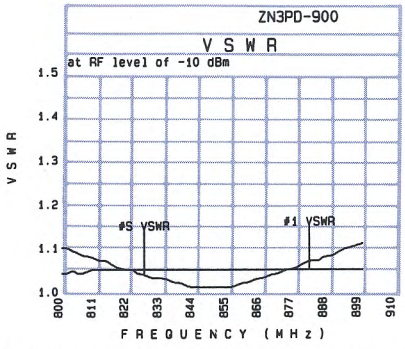
ZN3PD-900

3 WAY-0°

800 to 900 MHz





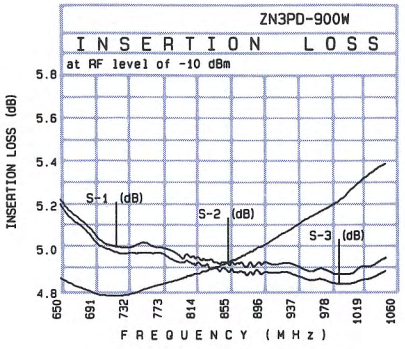


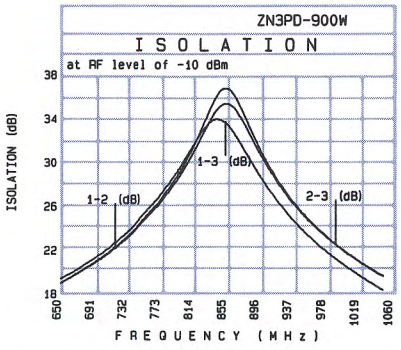
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
800.00	4.97	4.89	4.96	0.08	29.34	29.71	800.00	1.11	1.05	1.05	1.06
807.00	4.99	4.90	4.96	0.10	30.20	30.67	807.00	1.09	1.05	1.05	1.06
815.00	4.97	4.91	4.94	0.07	31.25	31.77	815.00	1.08	1.06	1.05	1.06
824.00	4.97	4.92	4.94	0.05	32.52	33.23	824.00	1.06	1.06	1.05	1.06
827.00	4.97	4.92	4.94	0.05	32.95	33.71	827.00	1.05	1.06	1.05	1.06
832.00	4.97	4.93	4.93	0.05	33.62	34.51	832.00	1.04	1.06	1.05	1.07
842.00	4.96	4.94	4.94	0.02	34.95	36.11	842.00	1.02	1.06	1.04	1.07
855.00	4.96	4.96	4.92	0.04	35.80	37.18	855.00	1.02	1.06	1.04	1.07
865.00	4.95	4.97	4.92	0.05	35.47	36.69	865.00	1.04	1.06	1.04	1.07
867.00	4.96	4.98	4.91	0.06	35.39	36.51	867.00	1.04	1.06	1.04	1.07
875.00	4.94	4.99	4.91	0.08	34.47	35.32	875.00	1.06	1.06	1.04	1.07
882.00	4.97	5.01	4.92	0.08	33.54	34.24	882.00	1.08	1.06	1.04	1.07
890.00	4.95	5.02	4.93	0.09	32.42	32.96	890.00	1.09	1.06	1.04	1.07
896.00	4.94	5.03	4.90	0.13	31.57	32.01	896.00	1.11	1.06	1.05	1.07
900.00	4.97	5.04	4.92	0.12	31.01	31.40	900.00	1.12	1.06	1.05	1.07

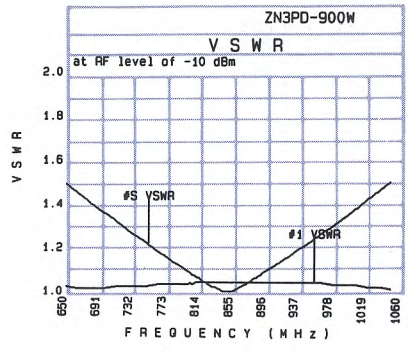
ZN3PD-900W

3 WAY-0°

650 to 1050 MHz







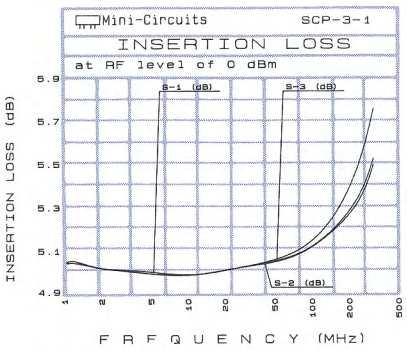
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
650.00	5.25	4.89	5.23	0.37	19.32	19.35	650.00	1.51	1.04	1.03	1.04
712.00	5.04	4.81	5.02	0.23	22.19	22.30	712.00	1.34	1.04	1.04	1.04
763.00	5.03	4.85	5.00	0.18	25.67	25.85	763.00	1.20	1.05	1.05	1.05
804.00	5.00	4.89	4.97	0.10	29.83	30.23	804.00	1.10	1.06	1.05	1.06
815.00	4.97	4.91	4.94	0.07	31.25	31.77	815.00	1.08	1.06	1.05	1.06
827.00	4.97	4.92	4.94	0.05	32.95	33.71	827.00	1.05	1.06	1.05	1.06
842.00	4.96	4.94	4.94	0.02	34.95	36.11	842.00	1.02	1.06	1.04	1.07
860.00	4.97	4.97	4.94	0.03	35.75	37.11	860.00	1.03	1.06	1.04	1.07
875.00	4.94	4.99	4.91	0.08	34.47	35.32	875.00	1.06	1.06	1.04	1.07
886.00	4.94	5.01	4.90	0.11	32.95	33.56	886.00	1.08	1.06	1.04	1.07
900.00	4.97	5.04	4.92	0.12	31.01	31.40	900.00	1.12	1.06	1.05	1.07
958.00	4.91	5.17	4.87	0.30	25.13	25.23	958.00	1.26	1.06	1.06	1.06
1019.00	4.95	5.33	4.88	0.44	21.46	21.49	1019.00	1.43	1.04	1.10	1.05
1040.00	4.96	5.39	4.90	0.49	20.45	20.50	1040.00	1.49	1.04	1.11	1.04
1050.00	4.98	5.41	4.92	0.50	20.06	20.07	1050.00	1.52	1.03	1.12	1.04

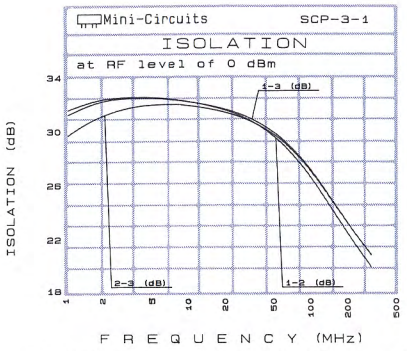
Power Splitter/Combiners

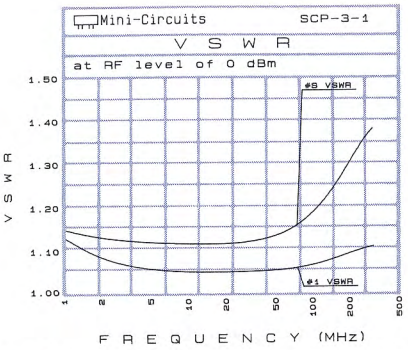
50 ohms

SCP-3-1

1 to 300 MHz





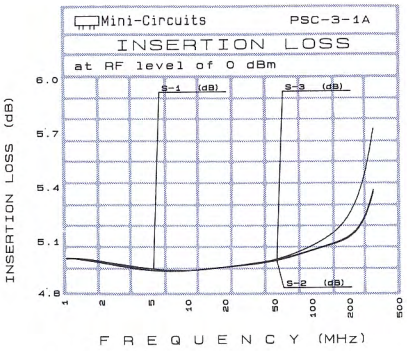


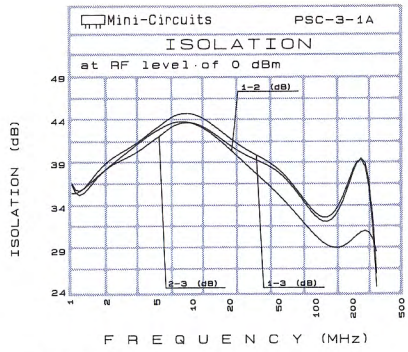
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3
1.000	5.06	5.05	5.05	0.01	31.61	29.75
2.000	5.02	5.02	5.02	0.00	32.47	31.32
5.000	5.00	4.99	4.99	0.01	32.54	32.07
10.000	4.99	4.99	4.99	0.00	32.21	31.92
20.000	5.01	5.01	5.01	0.00	31.54	31.38
40.000	5.05	5.04	5.05	0.01	30.23	30.28
50.000	5.06	5.06	5.07	0.01	29.55	29.71
80.000	5.09	5.09	5.11	0.02	27.56	27.94
100.000	5.10	5.10	5.13	0.03	26.37	26.86
150.000	5.25	5.24	5.31	0.07	24.01	24.66
182.000	5.26	5.25	5.36	0.11	22.79	23.54
200.000	5.27	5.25	5.39	0.14	22.25	22.98
221.000	5.29	5.27	5.44	0.17	21.64	22.41
269.000	5.50	5.47	5.69	0.22	20.60	21.44
300.000	5.44	5.42	5.68	0.26	20.00	20.92

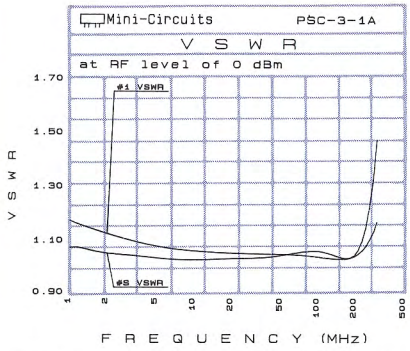
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.000	1.15	1.13	1.14	1.14
2.000	1.13	1.08	1.09	1.09
5.000	1.12	1.06	1.06	1.06
10.000	1.12	1.05	1.05	1.05
20.000	1.12	1.05	1.05	1.05
40.000	1.13	1.05	1.06	1.05
50.000	1.14	1.05	1.06	1.05
80.000	1.17	1.06	1.07	1.05
100.000	1.19	1.07	1.07	1.04
150.000	1.25	1.08	1.09	1.04
182.000	1.29	1.09	1.10	1.03
200.000	1.31	1.09	1.10	1.03
221.000	1.33	1.10	1.11	1.03
269.000	1.36	1.11	1.12	1.02
300.000	1.38	1.11	1.12	1.01

PSC-3-1A

1 to 300 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3
1.000	5.01	5.01	5.01	0.00	35.37	35.33
2.000	4.99	4.99	4.98	0.01	38.61	38.23
5.000	4.94	4.93	4.93	0.01	43.42	42.67
10.000	4.94	4.94	4.94	0.00	43.85	43.61
20.000	4.95	4.95	4.95	0.00	40.81	41.69
40.000	4.99	4.98	4.98	0.01	36.49	38.35
50.000	5.00	4.99	5.00	0.01	35.02	37.16
80.000	5.02	5.02	5.04	0.02	32.05	34.78
100.000	5.04	5.04	5.07	0.03	30.81	33.78
127.000	5.09	5.08	5.13	0.05	29.74	33.17
150.000	5.08	5.08	5.15	0.07	29.29	33.26
174.000	5.10	5.10	5.19	0.09	29.34	34.19
200.000	5.15	5.14	5.29	0.15	30.01	36.72
253.000	5.21	5.20	5.44	0.24	32.47	39.79
300.000	5.45	5.43	5.80	0.37	27.11	26.82

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
1.000	1.08	1.17	1.17	1.17
2.000	1.05	1.12	1.12	1.12
5.000	1.03	1.08	1.08	1.08
10.000	1.03	1.06	1.06	1.06
20.000	1.03	1.05	1.05	1.05
40.000	1.04	1.05	1.05	1.05
50.000	1.04	1.04	1.05	1.05
80.000	1.05	1.04	1.04	1.05
100.000	1.06	1.04	1.03	1.05
127.000	1.05	1.03	1.03	1.06
150.000	1.04	1.03	1.03	1.07
174.000	1.02	1.03	1.03	1.09
200.000	1.04	1.04	1.05	1.12
253.000	1.19	1.09	1.10	1.19
300.000	1.47	1.16	1.17	1.28

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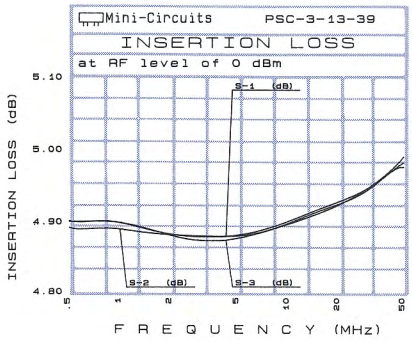
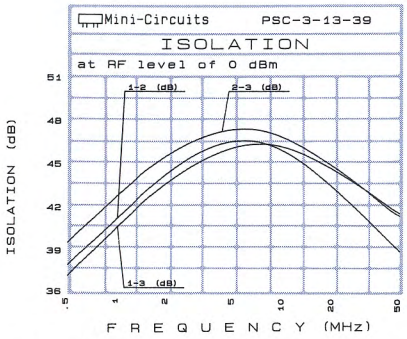
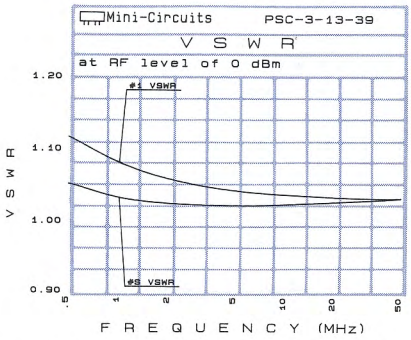
PSC-3-13-39

0.5 to 50 MHz





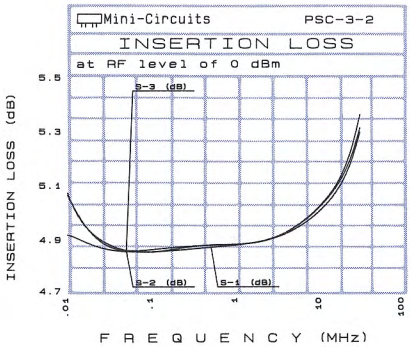


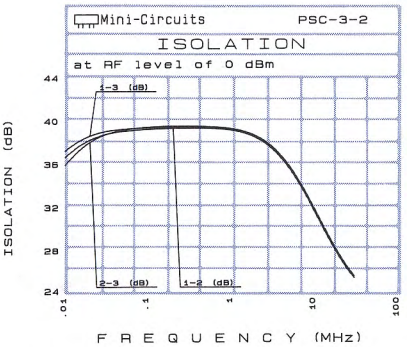
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3
0.500	4.90	4.89	4.90	0.01	38.07	39.60
1.000	4.90	4.89	4.90	0.01	41.26	42.85
2.000	4.88	4.88	4.88	0.00	44.51	45.78
4.250	4.88	4.88	4.87	0.01	46.59	47.35
5.000	4.88	4.88	4.88	0.00	46.70	47.55
6.750	4.88	4.88	4.88	0.00	46.59	47.43
10.000	4.90	4.90	4.90	0.00	45.97	46.78
14.500	4.91	4.91	4.91	0.00	44.72	45.93
20.000	4.93	4.92	4.92	0.01	43.33	44.91
25.000	4.94	4.93	4.93	0.01	42.34	44.10
29.750	4.95	4.94	4.95	0.01	41.51	43.45
34.750	4.95	4.95	4.96	0.01	40.80	42.79
39.750	4.96	4.96	4.96	0.00	40.13	42.27
45.000	4.97	4.97	4.98	0.01	39.51	41.78
50.000	4.98	4.97	4.99	0.02	38.96	41.42

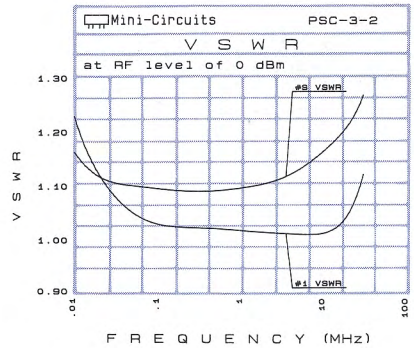
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
0.500	1.05	1.12	1.11	1.11
1.000	1.03	1.08	1.08	1.08
2.000	1.02	1.06	1.05	1.06
4.250	1.02	1.04	1.04	1.04
5.000	1.02	1.04	1.04	1.04
6.750	1.02	1.04	1.04	1.04
10.000	1.02	1.04	1.04	1.04
14.500	1.03	1.03	1.03	1.03
20.000	1.03	1.03	1.03	1.03
25.000	1.03	1.03	1.03	1.03
29.750	1.03	1.03	1.03	1.03
34.750	1.03	1.03	1.03	1.04
39.750	1.03	1.03	1.03	1.04
45.000	1.03	1.03	1.03	1.04
50.000	1.03	1.03	1.03	1.04

PSC-3-2

0.01 to 30 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3
0.010	4.92	5.06	5.06	0.14	36.72	36.00
0.020	4.88	4.91	4.91	0.03	38.38	38.19
0.050	4.85	4.85	4.86	0.01	39.13	39.26
0.100	4.86	4.87	4.85	0.02	39.28	39.47
0.201	4.86	4.87	4.87	0.01	39.36	39.54
0.498	4.87	4.88	4.88	0.01	39.38	39.56
0.998	4.89	4.89	4.89	0.00	39.21	39.33
1.982	4.88	4.88	4.88	0.00	38.56	38.74
4.952	4.94	4.93	4.95	0.02	35.69	35.93
10.027	5.03	5.01	5.03	0.02	31.70	31.93
14.964	5.09	5.07	5.09	0.02	29.11	29.37
17.915	5.12	5.11	5.14	0.03	28.03	28.27
20.103	5.16	5.14	5.17	0.03	27.29	27.53
25.102	5.23	5.21	5.26	0.05	26.21	26.42
30.000	5.32	5.30	5.36	0.06	25.52	25.69

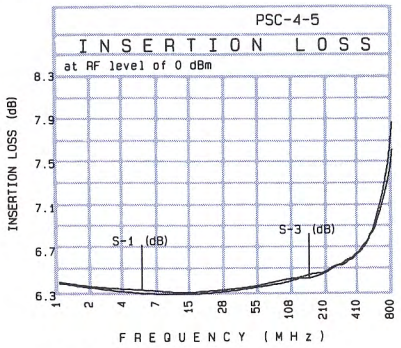
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3
0.010	1.16	1.22	1.22	1.25
0.020	1.11	1.11	1.12	1.12
0.050	1.10	1.05	1.05	1.05
0.100	1.09	1.03	1.03	1.03
0.201	1.09	1.02	1.02	1.02
0.498	1.09	1.02	1.02	1.02
0.998	1.10	1.02	1.02	1.02
1.982	1.11	1.01	1.01	1.01
4.952	1.13	1.01	1.01	1.01
10.027	1.16	1.01	1.01	1.01
14.964	1.19	1.02	1.02	1.02
17.915	1.20	1.04	1.04	1.04
20.103	1.22	1.05	1.05	1.05
25.102	1.24	1.08	1.08	1.08
30.000	1.27	1.12	1.12	1.12

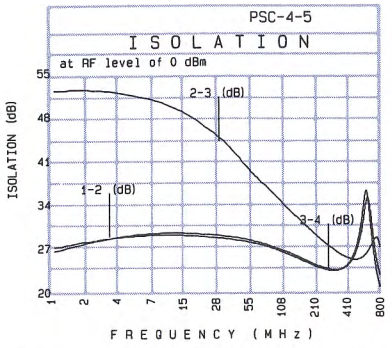
Power Splitter/Combiners

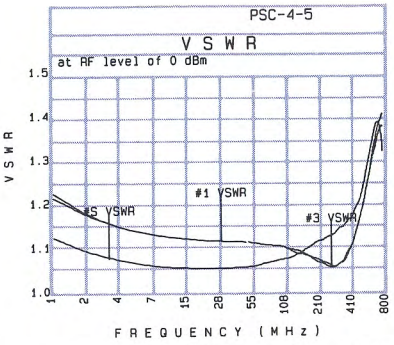
50 ohms

PSC-4-5

1 to 800 MHz





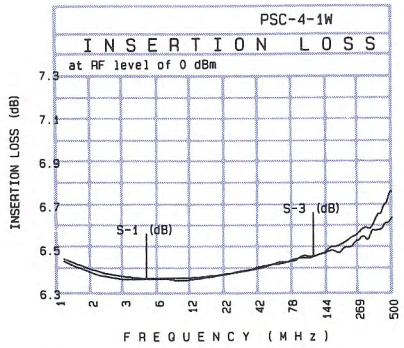


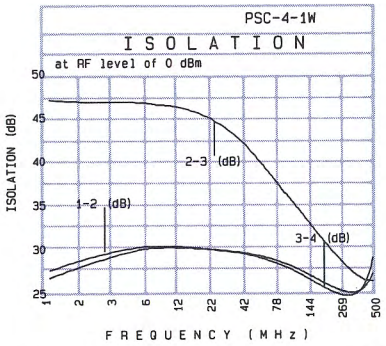
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4
1.0	6.46	6.44	6.45	6.46	0.02	27.74	52.72	27.19
2.0	6.40	6.38	6.39	6.39	0.02	28.98	53.04	28.83
5.0	6.39	6.36	6.35	6.36	0.04	29.67	51.87	29.94
10.0	6.35	6.34	6.34	6.34	0.01	29.78	50.48	30.10
20.0	6.37	6.36	6.35	6.35	0.02	29.50	47.13	29.91
50.0	6.41	6.41	6.40	6.40	0.01	28.65	40.22	29.02
100.0	6.48	6.45	6.45	6.46	0.03	27.08	35.01	27.31
200.0	6.53	6.52	6.52	6.54	0.02	24.70	29.75	24.96
267.0	6.60	6.61	6.60	6.62	0.02	24.06	27.88	24.25
400.0	6.71	6.73	6.71	6.81	0.10	25.29	25.96	25.05
467.0	6.80	6.83	6.78	6.94	0.16	27.97	25.73	27.25
500.0	6.84	6.89	6.84	6.95	0.11	30.36	25.86	29.12
667.0	7.28	7.35	7.20	7.32	0.15	26.13	28.98	28.19
778.0	7.78	7.85	7.53	7.56	0.32	20.67	26.01	22.67
800.0	7.90	8.00	7.65	7.64	0.36	20.29	24.44	22.44

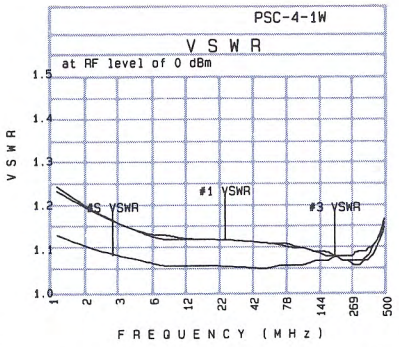
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1.0	1.13	1.22	1.22	1.23	1.23
2.0	1.09	1.17	1.17	1.17	1.17
5.0	1.07	1.14	1.14	1.14	1.14
10.0	1.06	1.13	1.13	1.13	1.13
20.0	1.06	1.12	1.13	1.12	1.12
50.0	1.06	1.12	1.12	1.12	1.12
100.0	1.08	1.11	1.11	1.11	1.11
200.0	1.12	1.08	1.08	1.07	1.08
267.0	1.13	1.06	1.07	1.06	1.07
400.0	1.17	1.11	1.12	1.11	1.11
467.0	1.21	1.17	1.18	1.17	1.16
500.0	1.24	1.20	1.21	1.20	1.20
667.0	1.39	1.37	1.38	1.35	1.35
778.0	1.25	1.41	1.42	1.37	1.38
800.0	1.16	1.42	1.42	1.37	1.38

PSC-4-1W

1 to 500 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4
1.0	6.48	6.47	6.47	6.46	0.02	28.08	47.42	27.23
2.0	6.40	6.40	6.38	6.38	0.02	29.74	47.13	29.07
5.0	6.39	6.39	6.39	6.38	0.01	30.71	47.21	30.45
10.0	6.39	6.39	6.38	6.39	0.01	30.77	46.85	30.64
20.0	6.41	6.40	6.41	6.39	0.02	30.43	45.46	30.41
50.0	6.45	6.45	6.46	6.43	0.03	29.74	40.71	29.60
100.0	6.48	6.47	6.48	6.49	0.02	28.37	35.55	27.96
120.0	6.50	6.50	6.50	6.50	0.00	27.84	34.22	27.36
200.0	6.53	6.55	6.56	6.59	0.06	26.20	30.39	25.65
220.0	6.53	6.55	6.58	6.61	0.08	25.96	29.76	25.44
250.0	6.56	6.56	6.60	6.63	0.07	25.65	28.94	25.15
320.0	6.62	6.59	6.63	6.73	0.14	25.50	27.53	25.29
400.0	6.64	6.63	6.72	6.80	0.17	26.40	26.77	26.91
486.0	6.70	6.70	6.82	6.95	0.25	28.81	26.92	31.71
500.0	6.74	6.73	6.88	6.97	0.24	29.31	27.06	32.84

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
1.0	1.14	1.24	1.24	1.25	1.25
2.0	1.10	1.18	1.17	1.18	1.18
5.0	1.08	1.14	1.14	1.14	1.14
10.0	1.07	1.13	1.13	1.13	1.13
20.0	1.07	1.13	1.12	1.13	1.12
50.0	1.06	1.12	1.12	1.12	1.12
100.0	1.07	1.11	1.11	1.11	1.11
120.0	1.08	1.10	1.10	1.10	1.10
200.0	1.09	1.08	1.09	1.08	1.08
220.0	1.09	1.08	1.08	1.08	1.08
250.0	1.09	1.07	1.08	1.08	1.08
320.0	1.10	1.08	1.09	1.09	1.09
400.0	1.13	1.12	1.13	1.13	1.13
486.0	1.20	1.19	1.20	1.21	1.20
500.0	1.22	1.20	1.22	1.22	1.21

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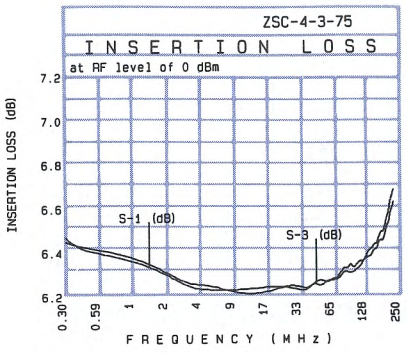
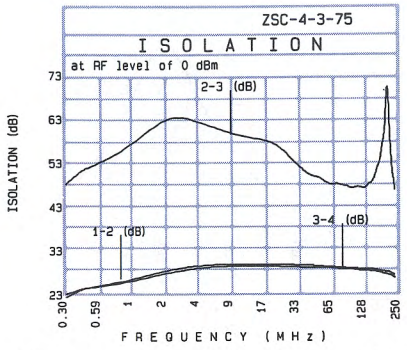
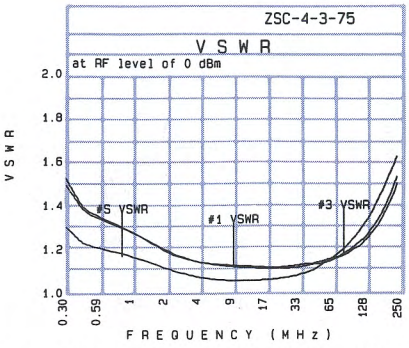
EUROPE 44-252-835094 Fax 44-252-837010

ZSC-4-3-75

0.25 to 250 MHz





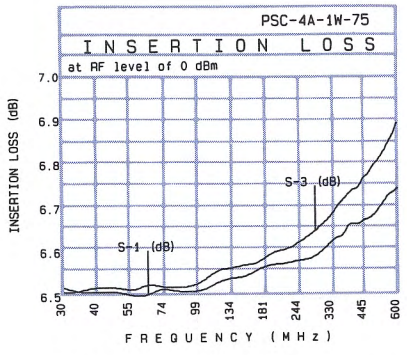


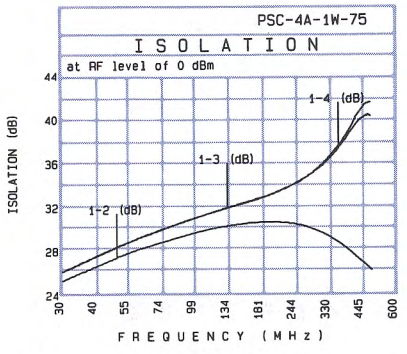
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4
0.3	6.47	6.49	6.49	6.48	0.02	23.39	49.10	24.07
0.5	6.44	6.43	6.42	6.42	0.02	26.02	53.54	25.82
2.0	6.34	6.32	6.33	6.31	0.03	29.34	64.57	28.72
3.5	6.27	6.29	6.26	6.25	0.04	30.29	64.41	29.64
5.0	6.28	6.25	6.25	6.24	0.04	30.72	62.70	30.25
10.0	6.22	6.23	6.25	6.24	0.03	30.99	59.64	30.56
20.0	6.25	6.25	6.27	6.24	0.03	30.83	59.19	30.49
50.0	6.30	6.28	6.26	6.29	0.04	30.54	50.86	30.09
95.1	6.33	6.33	6.38	6.37	0.05	30.04	48.19	29.81
100.0	6.33	6.32	6.34	6.36	0.04	29.94	48.20	29.75
125.0	6.39	6.35	6.38	6.38	0.04	29.88	48.21	29.41
183.6	6.47	6.46	6.51	6.54	0.08	29.31	59.37	28.82
200.0	6.55	6.53	6.59	6.61	0.08	29.08	72.18	28.53
243.7	6.73	6.70	6.79	6.83	0.13	28.13	44.95	27.49
250.0	6.72	6.71	6.81	6.85	0.14	27.86	43.93	27.36

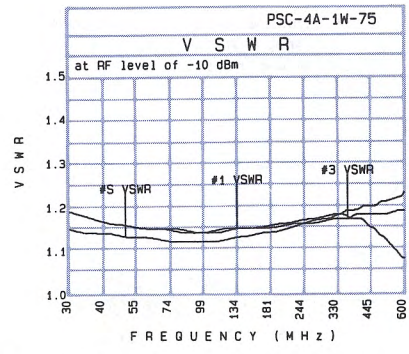
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
0.3	1.32	1.54	1.54	1.51	1.51
0.5	1.22	1.36	1.36	1.35	1.35
2.0	1.13	1.20	1.20	1.21	1.21
3.5	1.10	1.17	1.17	1.17	1.17
5.0	1.08	1.15	1.15	1.15	1.15
10.0	1.07	1.13	1.13	1.14	1.14
20.0	1.08	1.13	1.13	1.13	1.14
50.0	1.14	1.15	1.15	1.16	1.16
95.1	1.26	1.21	1.21	1.22	1.22
100.0	1.27	1.22	1.21	1.23	1.23
125.0	1.34	1.26	1.26	1.27	1.28
183.6	1.51	1.39	1.38	1.41	1.42
200.0	1.56	1.43	1.42	1.46	1.46
243.7	1.66	1.54	1.54	1.58	1.58
250.0	1.68	1.56	1.56	1.59	1.60

PSC-4A-1W-75

30 to 600 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4
30.00	6.53	6.54	6.52	6.54	0.02	25.70	26.49	25.82
49.18	6.52	6.52	6.53	6.53	0.02	27.77	28.75	27.79
62.97	6.51	6.52	6.54	6.54	0.03	28.64	29.72	28.61
91.57	6.52	6.54	6.53	6.55	0.03	29.79	31.08	29.65
150.12	6.55	6.56	6.58	6.58	0.03	30.82	32.62	30.48
246.09	6.59	6.58	6.63	6.61	0.05	30.84	34.44	30.18
277.42	6.59	6.60	6.65	6.62	0.05	30.51	35.15	29.78
315.09	6.62	6.62	6.68	6.64	0.06	29.96	36.14	29.19
344.72	6.64	6.64	6.71	6.66	0.07	29.43	37.09	28.60
371.52	6.65	6.65	6.73	6.68	0.08	28.94	38.12	28.02
428.34	6.67	6.66	6.76	6.70	0.11	27.70	40.10	26.75
486.50	6.69	6.68	6.81	6.73	0.13	26.55	41.14	25.53
544.34	6.73	6.70	6.85	6.74	0.14	25.47	39.06	24.42
586.67	6.75	6.73	6.88	6.77	0.15	24.81	36.88	23.73
600.00	6.75	6.72	6.90	6.78	0.18	24.64	36.12	23.56

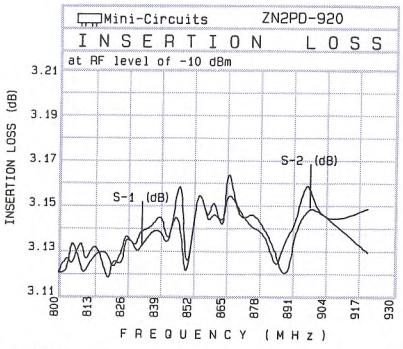
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
30.00	1.16	1.20	1.20	1.20	1.20
49.18	1.14	1.17	1.17	1.17	1.17
62.97	1.14	1.16	1.16	1.16	1.16
91.57	1.13	1.15	1.15	1.15	1.15
150.12	1.14	1.16	1.16	1.16	1.16
246.09	1.17	1.18	1.17	1.17	1.17
277.42	1.18	1.18	1.17	1.17	1.17
315.09	1.18	1.19	1.18	1.18	1.18
344.72	1.19	1.19	1.18	1.18	1.18
371.52	1.18	1.20	1.19	1.18	1.19
428.34	1.17	1.21	1.19	1.19	1.19
486.50	1.14	1.22	1.20	1.19	1.20
544.34	1.11	1.22	1.21	1.20	1.21
586.67	1.09	1.23	1.22	1.20	1.22
600.00	1.09	1.24	1.22	1.20	1.23

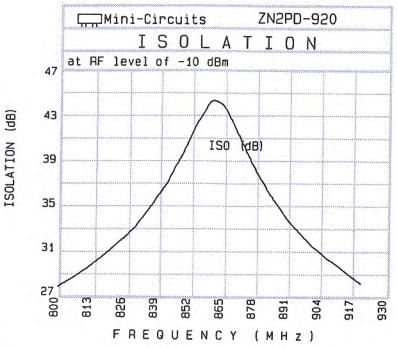
2 way
Power Splitter/Combiners

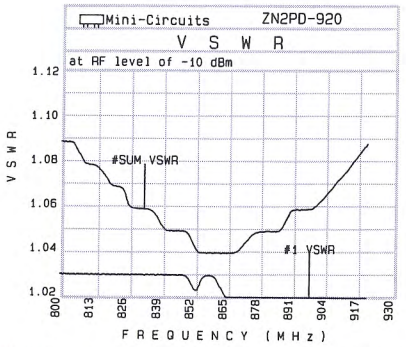
ZN2PD-920

2 way - 0°

800 to 920 MHz







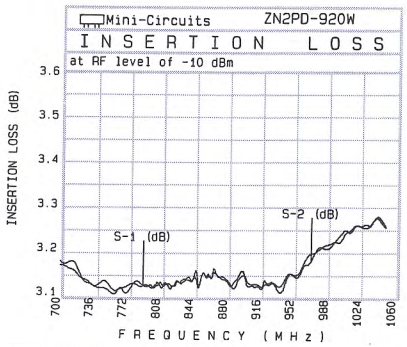
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2
800.00	3.12	3.12	0.00	27.79
809.38	3.12	3.14	0.02	29.21
819.88	3.13	3.11	0.02	31.09
826.00	3.14	3.14	0.00	32.45
831.25	3.13	3.14	0.01	33.71
836.50	3.14	3.14	0.01	35.17
845.25	3.15	3.15	0.00	38.51
853.13	3.15	3.15	0.00	42.19
860.13	3.15	3.16	0.01	45.00
865.38	3.16	3.18	0.02	44.13
869.75	3.15	3.14	0.01	42.38
884.63	3.12	3.13	0.02	35.88
891.63	3.14	3.14	0.00	33.77
900.00	3.14	3.15	0.00	31.65
920.00	3.15	3.13	0.02	28.29

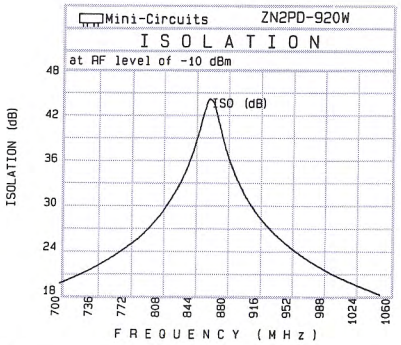
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
800.00	1.09	1.03	1.02
809.38	1.08	1.03	1.02
819.88	1.07	1.03	1.02
826.00	1.06	1.03	1.02
831.25	1.06	1.03	1.02
836.50	1.06	1.03	1.03
845.25	1.05	1.03	1.02
853.13	1.04	1.02	1.02
860.13	1.04	1.03	1.02
865.38	1.04	1.02	1.02
869.75	1.04	1.02	1.02
884.63	1.05	1.02	1.02
891.63	1.06	1.02	1.02
900.00	1.06	1.02	1.02
920.00	1.09	1.02	1.02

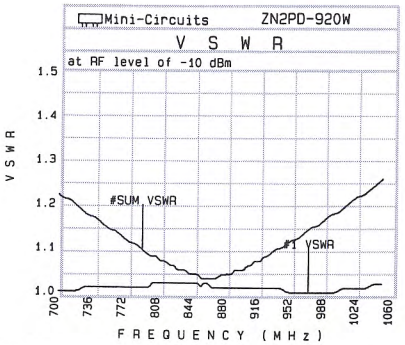
ZN2PD-920W

2 way - 0°

700 to 1050 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2
700.00	3.17	3.18	0.01	19.51
738.50	3.12	3.12	0.01	21.84
777.00	3.12	3.13	0.01	25.07
805.00	3.14	3.12	0.02	28.48
826.00	3.14	3.14	0.00	32.45
847.88	3.17	3.14	0.03	39.57
860.13	3.15	3.16	0.01	45.00
865.38	3.16	3.18	0.02	44.13
891.63	3.14	3.14	0.00	33.77
918.75	3.11	3.12	0.01	28.40
952.00	3.15	3.15	0.00	24.51
989.63	3.22	3.21	0.01	21.49
1028.13	3.27	3.26	0.01	19.27
1044.75	3.27	3.28	0.00	18.46
1050.00	3.26	3.26	0.00	18.20

FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
700.00	1.23	1.01	1.01
738.50	1.18	1.02	1.02
777.00	1.12	1.02	1.02
805.00	1.09	1.03	1.02
826.00	1.06	1.03	1.02
847.88	1.05	1.03	1.02
860.13	1.04	1.03	1.02
865.38	1.04	1.02	1.02
891.63	1.06	1.02	1.02
918.75	1.08	1.02	1.02
952.00	1.13	1.01	1.01
989.63	1.18	1.01	1.01
1028.13	1.23	1.02	1.02
1044.75	1.26	1.03	1.03
1050.00	1.27	1.03	1.03

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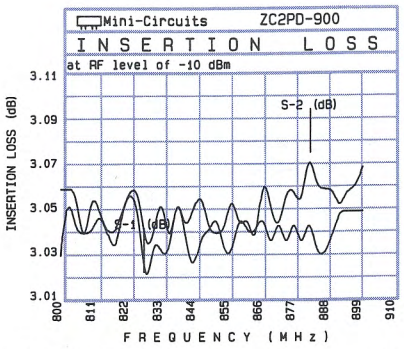
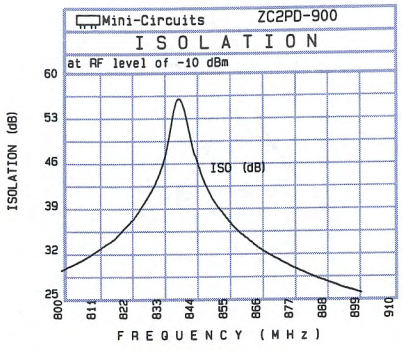
Mini-Circuits

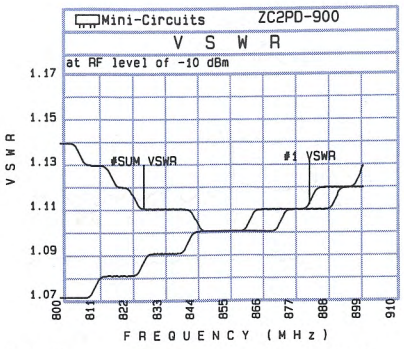
ZC2PD-900

2 way - 0°

800 to 900 MHz







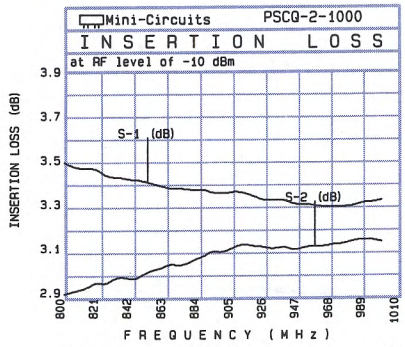
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2
800.00	3.03	3.06	0.02	29.24
807.75	3.04	3.03	0.01	31.07
815.50	3.04	3.04	0.00	33.52
823.00	3.06	3.06	0.00	36.73
830.75	3.04	3.04	0.00	42.26
838.50	3.06	3.06	0.00	57.44
846.25	3.04	3.06	0.02	44.99
853.75	3.03	3.04	0.01	38.44
861.50	3.04	3.05	0.00	34.51
869.25	3.03	3.05	0.02	31.81
877.00	3.05	3.06	0.02	29.79
884.50	3.03	3.06	0.03	28.19
892.25	3.05	3.05	0.00	26.82
897.50	3.05	3.06	0.01	26.03
900.00	3.05	3.07	0.02	25.61

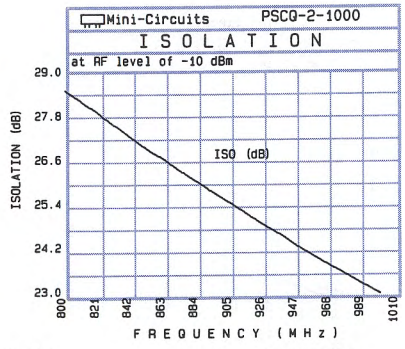
FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
800.00	1.14	1.07	1.06
807.75	1.13	1.07	1.07
815.50	1.13	1.08	1.07
823.00	1.12	1.08	1.08
830.75	1.11	1.09	1.08
838.50	1.11	1.09	1.09
846.25	1.10	1.10	1.09
853.75	1.10	1.10	1.09
861.50	1.10	1.10	1.10
869.25	1.10	1.11	1.10
877.00	1.11	1.11	1.11
884.50	1.11	1.12	1.11
892.25	1.12	1.12	1.11
897.50	1.12	1.12	1.12
900.00	1.13	1.12	1.12

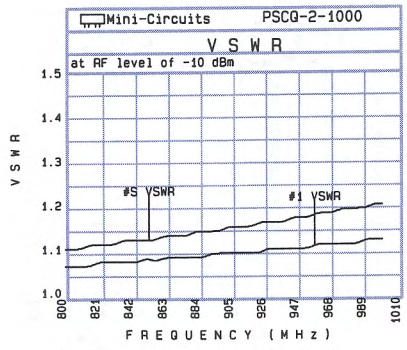
PSCQ-2-1000

2 way - 90°

800 to 1000 MHz





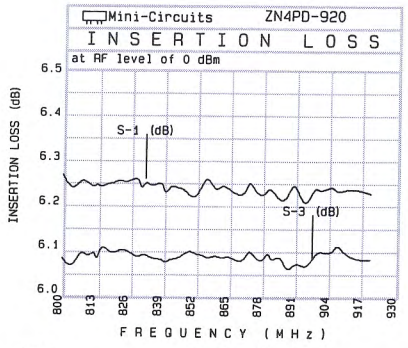


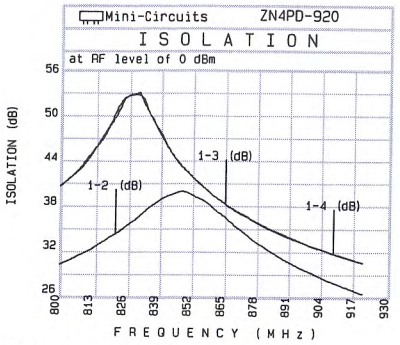
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	INSERTION LOSS (dB) S-2	AMPLITUDE UNBALANCE (dB)	PHASE (DEGREE)	ISOLATION (dB) 1-2
800.00	3.51	2.91	0.61	88.85	28.60
815.50	3.48	2.94	0.54	88.84	28.12
831.00	3.44	2.98	0.46	88.96	27.64
846.00	3.43	2.98	0.45	88.95	27.20
861.50	3.40	3.03	0.37	88.83	26.77
877.00	3.39	3.05	0.33	88.94	26.31
892.50	3.37	3.11	0.27	88.90	25.87
907.50	3.38	3.13	0.25	88.82	25.46
923.00	3.34	3.13	0.22	88.91	25.01
938.50	3.34	3.13	0.21	89.04	24.63
954.00	3.32	3.13	0.19	88.96	24.19
969.00	3.31	3.14	0.17	89.00	23.80
984.50	3.32	3.16	0.16	88.96	23.43
995.00	3.33	3.16	0.18	88.98	23.19
1000.00	3.34	3.15	0.19	89.20	23.06

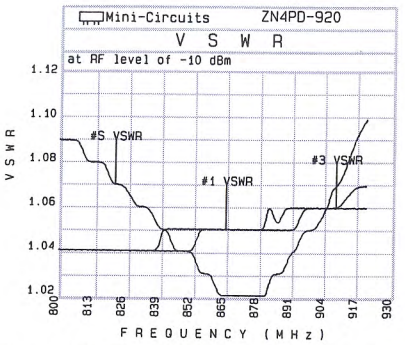
Power Splitter/Combiners

ZN4PD-920

800 to 920 MHz



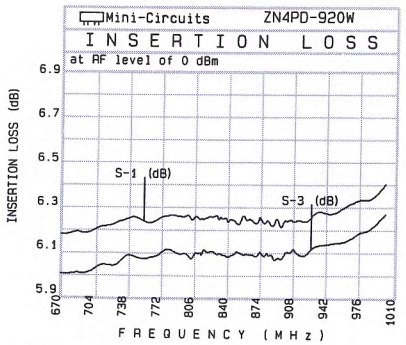


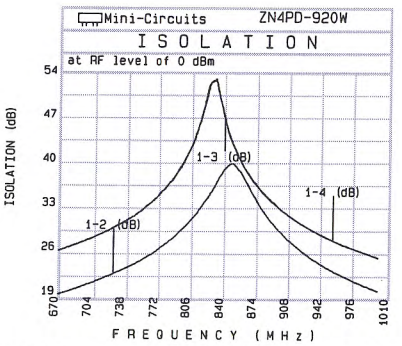


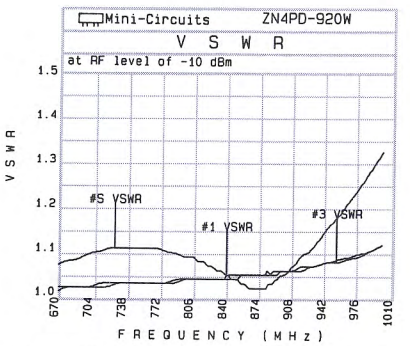
FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQ. (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
800.00	6.27	6.10	6.08	6.22	0.19	29.94	40.73	30.18	800.00	1.09	1.04	1.04	1.04	1.04
810.25	6.25	6.12	6.08	6.21	0.17	31.71	44.37	32.09	810.25	1.08	1.04	1.05	1.04	1.04
817.68	6.25	6.10	6.10	6.23	0.15	33.27	48.28	33.71	817.68	1.08	1.04	1.05	1.04	1.04
830.05	6.27	6.12	6.08	6.22	0.19	36.26	53.67	37.10	830.05	1.06	1.04	1.05	1.04	1.04
839.13	6.26	6.12	6.08	6.21	0.18	38.65	47.70	39.59	839.13	1.05	1.04	1.05	1.04	1.04
847.38	6.24	6.10	6.09	6.21	0.15	40.05	43.62	40.44	847.38	1.04	1.05	1.05	1.04	1.04
854.80	6.25	6.10	6.09	6.22	0.16	39.01	40.90	39.41	854.80	1.03	1.05	1.05	1.05	1.04
856.45	6.27	6.13	6.08	6.21	0.19	38.82	40.23	39.13	856.45	1.03	1.05	1.05	1.05	1.05
869.65	6.22	6.10	6.07	6.23	0.16	35.12	37.25	35.05	869.65	1.02	1.05	1.06	1.05	1.05
877.90	6.22	6.07	6.07	6.19	0.16	33.01	35.69	32.93	877.90	1.02	1.05	1.06	1.05	1.05
885.33	6.21	6.11	6.09	6.20	0.12	31.54	34.51	31.27	885.33	1.03	1.05	1.06	1.05	1.05
895.23	6.20	6.09	6.06	6.21	0.15	29.68	33.15	29.54	895.23	1.05	1.06	1.06	1.06	1.06
906.78	6.23	6.11	6.12	6.23	0.12	27.94	31.79	27.79	906.78	1.07	1.06	1.07	1.06	1.06
915.03	6.24	6.11	6.08	6.21	0.17	26.87	30.93	26.72	915.03	1.09	1.07	1.07	1.06	1.06
920.00	6.23	6.12	6.08	6.21	0.15	26.22	30.46	26.11	920.00	1.10	1.07	1.07	1.06	1.06

ZN4PD-920W

670 to 1000 MHz







FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQ. (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
670.00	6.17	6.02	5.99	6.15	0.18	19.09	26.01	19.10	670.00	1.07	1.02	1.02	1.01	1.01
721.15	6.21	6.06	6.03	6.17	0.18	22.02	29.36	22.08	721.15	1.11	1.03	1.03	1.02	1.02
771.48	6.25	6.11	6.08	6.22	0.16	26.13	34.77	26.29	771.48	1.11	1.03	1.04	1.03	1.03
805.30	6.24	6.09	6.07	6.21	0.16	30.79	42.50	31.05	805.30	1.09	1.04	1.04	1.04	1.04
817.68	6.25	6.10	6.10	6.23	0.15	33.27	48.28	33.71	817.68	1.08	1.04	1.05	1.04	1.04
832.53	6.26	6.11	6.09	6.23	0.17	37.05	52.53	37.74	832.53	1.06	1.04	1.05	1.04	1.04
847.38	6.24	6.10	6.09	6.21	0.15	40.05	43.62	40.44	847.38	1.04	1.05	1.05	1.04	1.04
862.23	6.25	6.11	6.08	6.23	0.17	37.20	38.99	37.17	862.23	1.02	1.05	1.06	1.05	1.05
877.90	6.22	6.07	6.07	6.19	0.16	33.01	35.69	32.93	877.90	1.02	1.05	1.06	1.05	1.05
890.28	6.26	6.12	6.07	6.22	0.19	30.58	33.71	30.42	890.28	1.04	1.06	1.06	1.05	1.05
906.78	6.23	6.11	6.12	6.23	0.12	27.94	31.79	27.79	906.78	1.07	1.06	1.07	1.06	1.06
940.60	6.27	6.13	6.13	6.27	0.14	24.11	28.71	23.96	940.60	1.15	1.08	1.08	1.08	1.07
982.68	6.33	6.21	6.19	6.32	0.13	20.91	26.00	20.79	982.68	1.27	1.10	1.11	1.10	1.10
991.75	6.36	6.25	6.23	6.34	0.13	20.35	25.54	20.25	991.75	1.30	1.11	1.12	1.11	1.11
1000.00	6.41	6.28	6.27	6.38	0.14	19.87	25.10	19.76	1000.00	1.33	1.12	1.12	1.12	1.11

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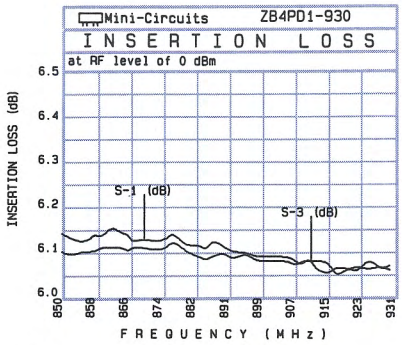
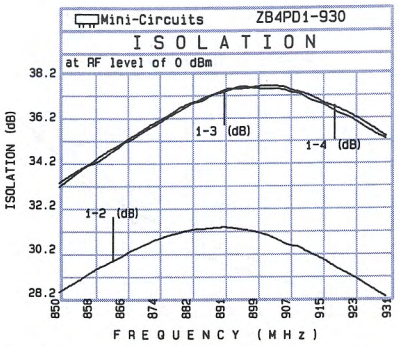
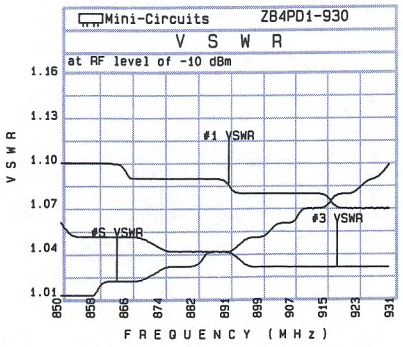
Mini-Circuits

ZB4PD1-930

850 to 930 MHz



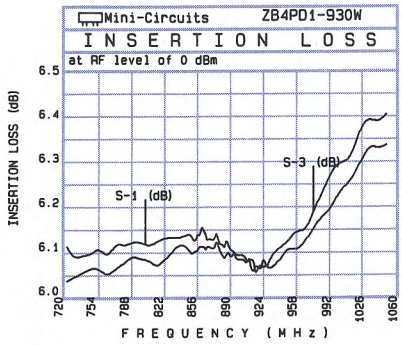


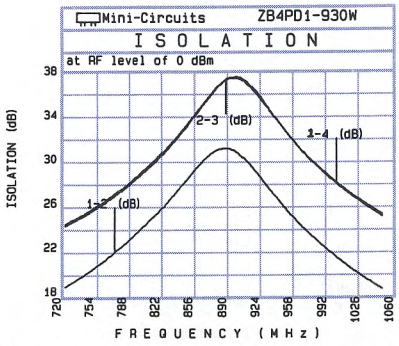


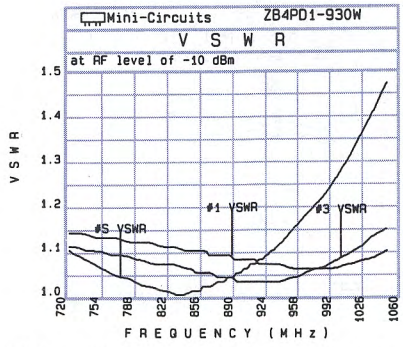
FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQ. (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
850.00	6.14	6.11	6.10	6.13	0.04	28.39	33.26	27.78	850.00	1.01	1.10	1.06	1.06	1.10
857.44	6.13	6.09	6.10	6.09	0.04	29.23	34.16	28.57	857.44	1.01	1.10	1.06	1.05	1.10
862.31	6.16	6.12	6.11	6.12	0.05	29.70	34.73	28.96	862.31	1.02	1.10	1.06	1.05	1.10
867.19	6.12	6.10	6.11	6.09	0.04	30.23	35.31	29.44	867.19	1.02	1.09	1.06	1.05	1.09
876.94	6.15	6.12	6.13	6.11	0.03	30.97	36.38	30.21	876.94	1.03	1.09	1.05	1.04	1.09
885.06	6.10	6.09	6.08	6.08	0.03	31.29	36.88	30.57	885.06	1.04	1.09	1.05	1.04	1.09
886.69	6.13	6.10	6.09	6.09	0.04	31.31	37.08	30.60	886.69	1.04	1.09	1.05	1.04	1.09
891.56	6.10	6.09	6.08	6.07	0.03	31.38	37.36	30.70	891.56	1.04	1.08	1.04	1.04	1.08
899.69	6.09	6.08	6.08	6.06	0.03	31.11	37.41	30.49	899.69	1.05	1.08	1.04	1.03	1.08
907.00	6.08	6.08	6.07	6.05	0.03	30.52	37.21	30.02	907.00	1.06	1.08	1.04	1.03	1.08
911.88	6.06	6.06	6.08	6.06	0.02	30.19	36.93	29.68	911.88	1.07	1.08	1.03	1.03	1.08
920.00	6.06	6.07	6.07	6.04	0.03	29.34	36.13	28.90	920.00	1.08	1.07	1.03	1.03	1.07
924.88	6.06	6.07	6.09	6.04	0.05	28.82	35.64	28.37	924.88	1.09	1.07	1.03	1.03	1.07
927.31	6.07	6.05	6.06	6.03	0.04	28.52	35.30	28.12	927.31	1.09	1.07	1.03	1.03	1.07
930.00	6.06	6.07	6.07	6.03	0.05	28.22	35.11	27.88	930.00	1.10	1.07	1.03	1.03	1.07

ZB4PD1-930W

725 to 1050 MHz





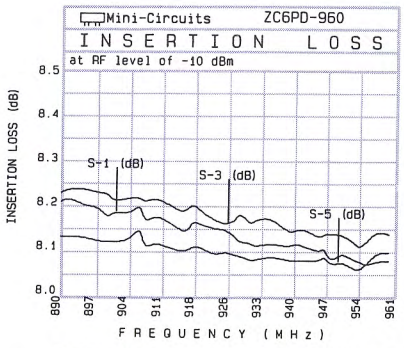


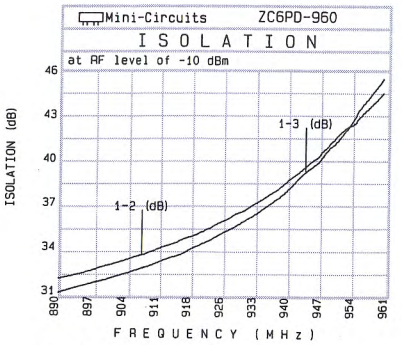
FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQ. (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
725.00	6.11	6.00	6.03	6.07	0.11	18.72	24.23	18.34	725.00	1.10	1.14	1.12	1.11	1.14
766.44	6.08	6.01	6.04	6.07	0.07	21.15	26.43	20.76	766.44	1.05	1.13	1.10	1.09	1.13
808.69	6.11	6.08	6.08	6.08	0.03	24.33	29.29	23.82	808.69	1.02	1.12	1.08	1.07	1.12
850.13	6.14	6.11	6.10	6.13	0.04	28.39	33.26	27.78	850.13	1.01	1.10	1.06	1.06	1.10
859.88	6.13	6.09	6.11	6.11	0.04	29.51	34.40	28.76	859.88	1.02	1.10	1.06	1.05	1.10
869.63	6.13	6.11	6.11	6.09	0.04	30.41	35.56	29.66	869.63	1.02	1.09	1.05	1.05	1.09
885.06	6.10	6.09	6.08	6.08	0.03	31.29	36.88	30.57	885.06	1.04	1.09	1.05	1.04	1.09
897.25	6.09	6.08	6.08	6.08	0.02	31.21	37.59	30.51	897.25	1.05	1.08	1.04	1.03	1.08
908.63	6.07	6.09	6.08	6.05	0.04	30.55	37.27	29.97	908.63	1.07	1.08	1.04	1.03	1.08
920.00	6.06	6.07	6.07	6.04	0.03	29.34	36.13	28.90	920.00	1.08	1.07	1.03	1.03	1.07
933.00	6.06	6.08	6.09	6.05	0.04	27.89	34.72	27.50	933.00	1.10	1.07	1.03	1.03	1.07
975.25	6.15	6.19	6.19	6.14	0.06	23.64	30.27	23.41	975.25	1.20	1.06	1.05	1.06	1.06
1016.69	6.27	6.33	6.33	6.26	0.07	20.57	27.21	20.33	1016.69	1.33	1.07	1.10	1.10	1.06
1041.88	6.33	6.40	6.39	6.30	0.10	19.07	25.70	18.81	1041.88	1.44	1.09	1.13	1.14	1.08
1050.00	6.34	6.42	6.41	6.32	0.09	18.59	25.29	18.35	1050.00	1.48	1.10	1.15	1.15	1.09

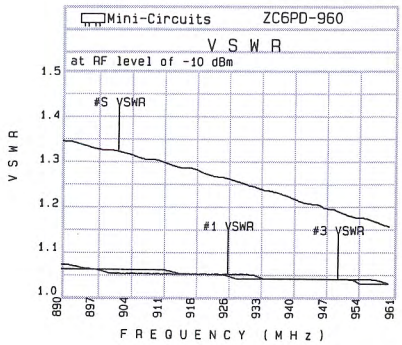
Power Splitter/Combiners

ZC6PD-960

890 to 960 MHz



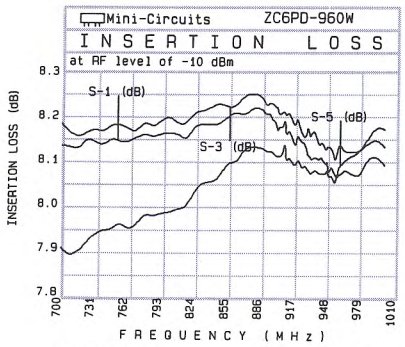


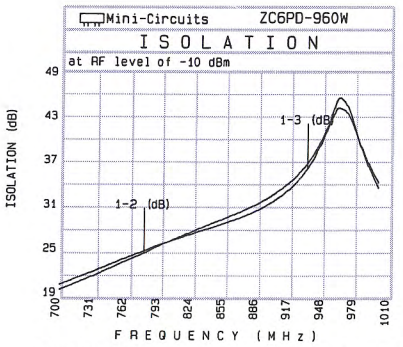


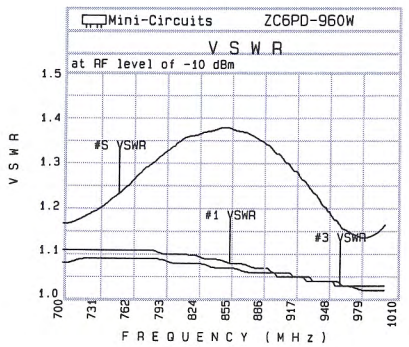
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
890.00	8.21	0.10	32.09	30.06	1.35	1.07
898.00	8.20	0.11	32.76	30.38	1.33	1.06
904.75	8.18	0.10	33.45	30.69	1.32	1.06
910.00	8.18	0.10	33.98	30.91	1.31	1.06
915.25	8.15	0.10	34.56	31.10	1.29	1.05
916.75	8.14	0.09	34.85	31.10	1.29	1.05
922.75	8.15	0.07	35.60	31.26	1.27	1.05
928.00	8.12	0.10	36.55	31.44	1.26	1.05
934.75	8.12	0.09	37.70	31.56	1.24	1.04
942.25	8.11	0.07	39.43	31.72	1.21	1.04
945.25	8.10	0.06	40.32	31.71	1.21	1.04
948.25	8.08	0.07	41.14	31.78	1.20	1.04
953.50	8.08	0.06	42.52	31.72	1.18	1.04
957.25	8.08	0.08	43.89	31.72	1.17	1.04
960.00	8.08	0.07	44.82	31.67	1.16	1.03

ZC6PD-960W

700 to 1000 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
700.00	8.14	0.34	19.90	24.61	1.17	1.11
738.25	8.14	0.28	22.31	25.11	1.21	1.11
777.25	8.17	0.25	24.93	25.88	1.30	1.11
815.50	8.15	0.21	27.42	27.02	1.37	1.10
853.75	8.21	0.15	29.67	28.45	1.39	1.08
889.75	8.21	0.10	32.09	30.06	1.35	1.07
901.00	8.19	0.09	33.03	30.54	1.33	1.06
912.25	8.17	0.10	34.30	30.92	1.30	1.06
922.75	8.15	0.07	35.60	31.26	1.27	1.05
931.00	8.11	0.09	37.01	31.52	1.25	1.05
946.00	8.11	0.05	40.35	31.67	1.20	1.04
953.50	8.08	0.06	42.52	31.72	1.18	1.04
969.25	8.08	0.09	44.62	31.48	1.15	1.03
992.50	8.12	0.12	36.53	30.72	1.15	1.03
1000.00	8.10	0.14	34.64	30.33	1.17	1.03

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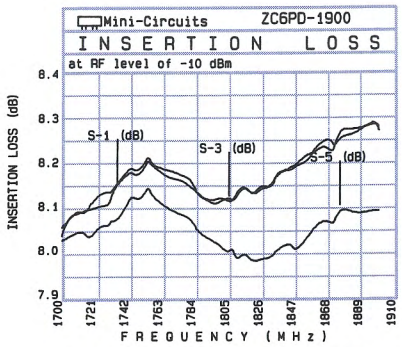
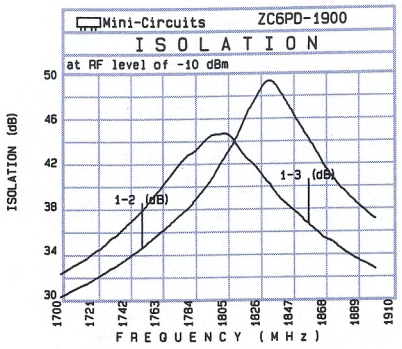
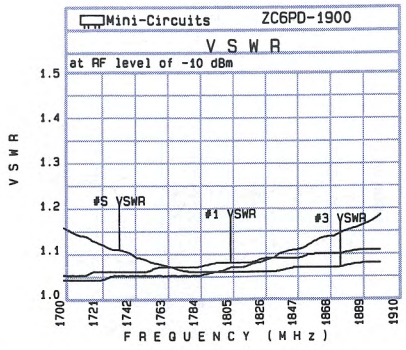
Mini-Circuits

ZC6PD-1900

1700 to 1900 MHz



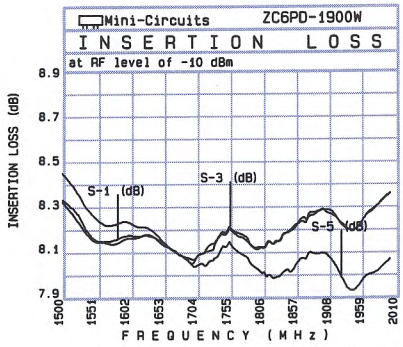


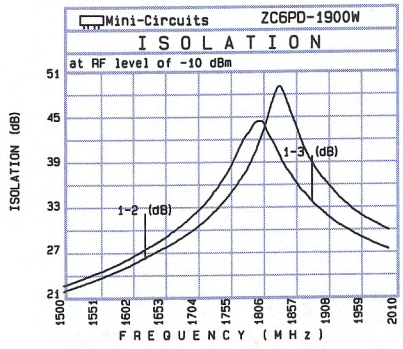


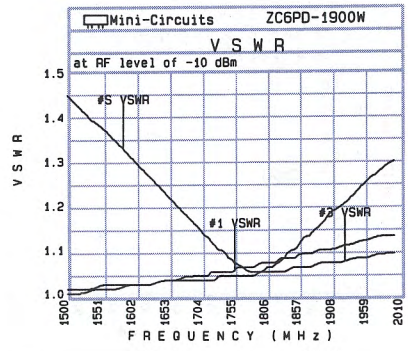
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
1700.00	8.06	0.09	30.11	34.33	1.16	1.05
1715.00	8.09	0.08	31.20	34.89	1.14	1.05
1730.00	8.14	0.11	32.44	35.60	1.11	1.06
1743.75	8.20	0.10	33.74	36.24	1.10	1.06
1755.00	8.23	0.11	34.80	36.89	1.08	1.06
1775.00	8.18	0.10	37.43	38.08	1.06	1.07
1795.00	8.12	0.10	40.51	39.64	1.06	1.08
1807.50	8.12	0.13	43.58	40.43	1.07	1.08
1820.00	8.13	0.18	47.36	41.31	1.08	1.08
1833.75	8.16	0.19	49.71	42.74	1.09	1.09
1855.00	8.21	0.21	45.06	44.76	1.12	1.10
1870.00	8.26	0.19	41.39	46.72	1.14	1.10
1885.00	8.27	0.20	39.06	48.61	1.16	1.11
1897.50	8.31	0.21	37.34	49.94	1.18	1.11
1900.00	8.28	0.22	37.20	50.18	1.19	1.11

ZC6PD-1900W

1500 to 2000 MHz







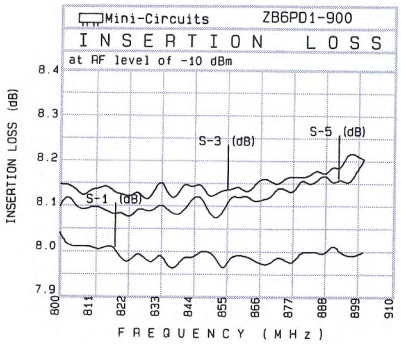
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
1500.00	8.33	0.13	21.76	28.98	1.46	1.01
1563.75	8.15	0.10	23.80	30.46	1.37	1.02
1628.75	8.18	0.08	26.36	31.93	1.27	1.03
1692.50	8.08	0.09	29.66	33.96	1.17	1.05
1717.50	8.11	0.12	31.32	35.14	1.13	1.06
1743.75	8.20	0.10	33.74	36.24	1.10	1.06
1768.75	8.19	0.10	36.47	37.82	1.07	1.07
1800.00	8.13	0.13	41.82	39.76	1.06	1.08
1820.00	8.13	0.18	47.36	41.31	1.08	1.08
1845.00	8.19	0.17	47.51	43.75	1.11	1.09
1871.25	8.24	0.17	41.31	46.86	1.14	1.10
1910.00	8.28	0.23	36.09	50.09	1.20	1.11
1973.75	8.30	0.30	31.43	45.35	1.28	1.14
1987.50	8.33	0.31	30.78	44.26	1.30	1.14
2000.00	8.37	0.30	30.19	43.33	1.31	1.14

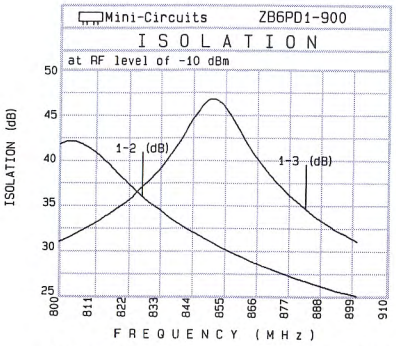
Power Splitter/Combiners

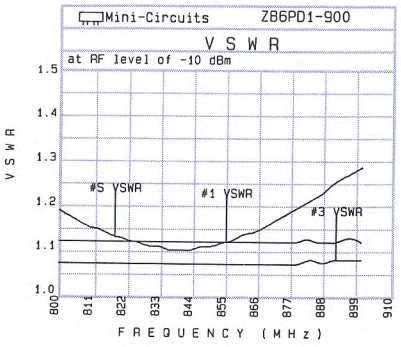
ZB6PD1-900

6 way - 0°

800 to 900 MHz





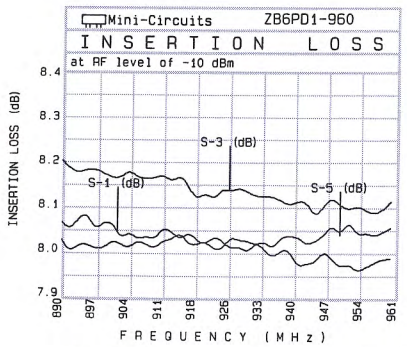


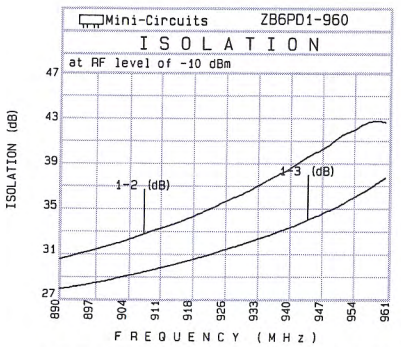
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
800.00	8.04	0.12	42.10	49.24	1.19	1.12
807.75	8.01	0.12	42.14	45.32	1.16	1.12
815.50	8.01	0.14	40.16	42.91	1.14	1.12
823.00	7.97	0.15	37.60	41.02	1.12	1.12
830.75	7.97	0.16	35.28	39.30	1.11	1.12
838.50	7.96	0.16	33.43	37.90	1.10	1.12
846.25	8.00	0.15	31.90	36.84	1.11	1.12
853.75	7.95	0.19	30.50	35.69	1.12	1.12
861.50	7.99	0.15	29.38	34.84	1.14	1.12
869.25	7.97	0.19	28.28	34.07	1.16	1.12
877.00	7.97	0.20	27.37	33.23	1.19	1.12
884.50	8.00	0.19	26.54	32.57	1.22	1.12
892.25	8.00	0.18	25.73	31.95	1.26	1.12
897.50	7.99	0.23	25.32	31.50	1.28	1.13
900.00	8.00	0.21	25.07	31.28	1.29	1.12

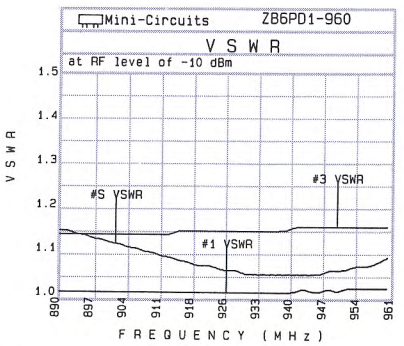
ZB6PD1-960

6 way - 0°

890 to 960 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
890.00	8.07	0.24	30.53	46.44	1.15	1.01
895.43	8.09	0.20	31.16	44.51	1.14	1.01
900.85	8.07	0.20	31.83	43.25	1.12	1.01
906.10	8.03	0.19	32.60	42.02	1.11	1.01
911.53	8.06	0.20	33.34	40.77	1.09	1.01
916.95	8.05	0.16	34.20	39.88	1.08	1.01
922.38	8.04	0.13	35.20	39.01	1.07	1.01
927.63	8.02	0.17	36.23	38.14	1.06	1.01
933.05	8.01	0.14	37.42	37.51	1.05	1.01
938.48	8.01	0.11	38.58	36.70	1.05	1.01
943.90	7.98	0.10	40.13	36.12	1.05	1.01
949.15	7.97	0.14	41.47	35.60	1.06	1.01
954.58	7.97	0.13	42.72	34.97	1.07	1.02
958.25	7.99	0.10	43.21	34.68	1.08	1.02
960.00	7.99	0.13	43.06	34.50	1.09	1.02

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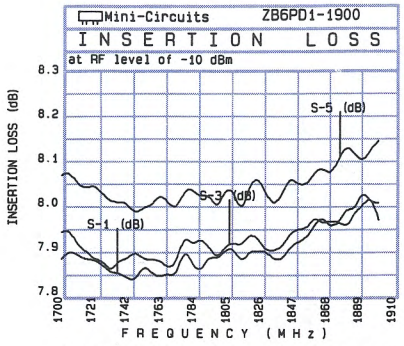
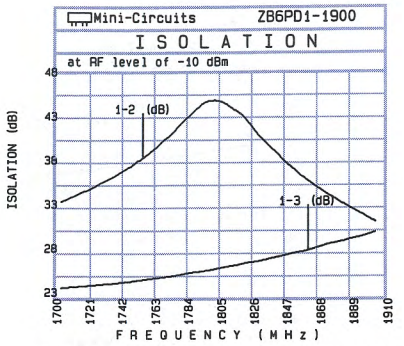
Mini-Circuits

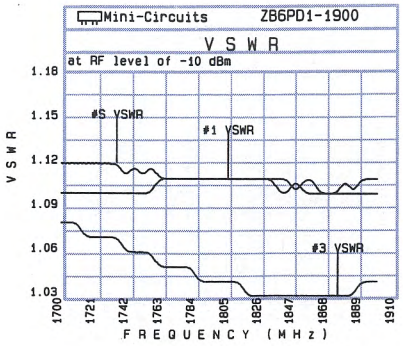
ZB6PD1-1900

6 way - 0°

1700 to 1900 MHz





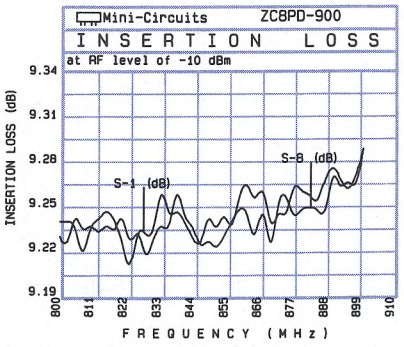


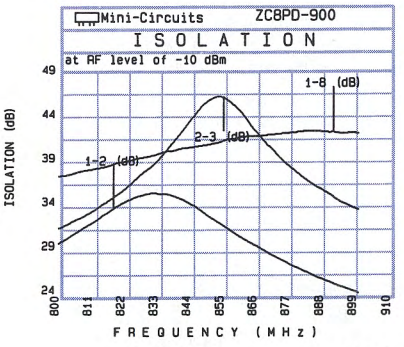
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-4	VSWR S	VSWR 1
1700.00	7.88	0.21	33.71	33.10	1.12	1.10
1715.50	7.88	0.20	34.95	33.70	1.12	1.10
1731.00	7.85	0.20	36.27	34.13	1.12	1.10
1746.00	7.83	0.17	37.81	34.76	1.12	1.10
1761.50	7.84	0.20	40.02	35.34	1.11	1.11
1777.00	7.91	0.17	42.84	36.27	1.11	1.11
1792.50	7.89	0.13	45.17	36.97	1.11	1.11
1807.50	7.91	0.13	44.54	37.90	1.11	1.11
1823.00	7.90	0.17	41.92	38.94	1.11	1.11
1838.50	7.88	0.15	39.17	39.91	1.11	1.10
1854.00	7.93	0.13	36.55	41.27	1.11	1.10
1869.00	7.95	0.12	34.68	43.01	1.10	1.10
1884.50	7.99	0.13	33.06	44.69	1.10	1.10
1895.00	8.03	0.12	32.02	46.45	1.11	1.10
1900.00	7.97	0.18	31.53	47.29	1.11	1.10

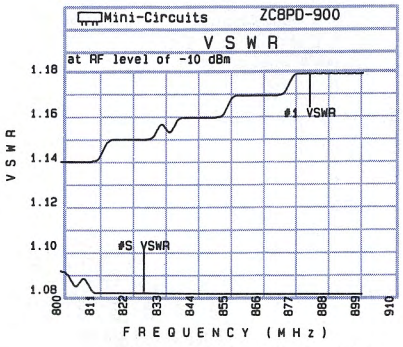
ZC8PD-900

8 way - 0°

800 to 900 MHz





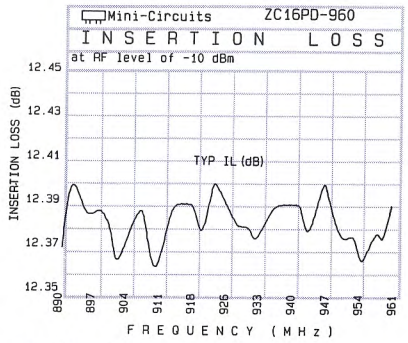


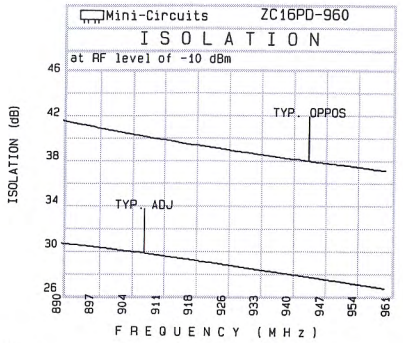
FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	(dB) S-6	(dB) S-8	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 1-8	(dB) 3-4	(dB) 6-7	FREQ. (MHz)	VSWR S	VSWR 7	VSWR 8
800.00	9.24	9.26	9.22	9.24	9.20	9.23	0.07	29.65	37.33	28.76	30.42	800.00	1.09	1.14	1.16
807.75	9.21	9.25	9.19	9.24	9.23	9.23	0.10	31.28	37.95	30.26	31.63	807.75	1.09	1.15	1.17
815.50	9.25	9.27	9.23	9.24	9.24	9.24	0.07	33.05	38.37	31.79	33.09	815.50	1.08	1.15	1.17
823.00	9.20	9.24	9.18	9.21	9.21	9.22	0.07	34.54	39.04	33.30	34.45	823.00	1.08	1.15	1.18
830.75	9.23	9.27	9.19	9.21	9.24	9.23	0.09	35.46	39.66	34.49	36.49	830.75	1.08	1.16	1.18
838.50	9.25	9.27	9.20	9.22	9.23	9.27	0.08	35.09	40.23	35.02	38.80	838.50	1.08	1.16	1.19
846.25	9.22	9.27	9.20	9.23	9.23	9.22	0.07	33.80	40.80	34.13	41.46	846.25	1.08	1.17	1.19
853.75	9.25	9.28	9.19	9.22	9.23	9.23	0.09	32.04	41.24	32.83	44.17	853.75	1.08	1.17	1.19
861.50	9.27	9.29	9.21	9.22	9.22	9.25	0.08	30.33	41.95	31.18	45.14	861.50	1.08	1.17	1.20
869.25	9.23	9.27	9.20	9.23	9.23	9.21	0.07	28.80	42.10	29.64	42.88	869.25	1.08	1.18	1.20
877.00	9.27	9.27	9.20	9.21	9.24	9.24	0.07	27.43	42.35	28.27	40.21	877.00	1.08	1.18	1.21
884.50	9.25	9.28	9.22	9.27	9.26	9.25	0.07	26.24	42.53	27.01	38.03	884.50	1.08	1.19	1.21
892.25	9.27	9.31	9.22	9.24	9.27	9.26	0.09	25.11	42.51	25.89	36.07	892.25	1.08	1.19	1.22
897.50	9.27	9.32	9.25	9.25	9.28	9.26	0.08	24.47	42.48	25.11	35.08	897.50	1.08	1.19	1.22
900.00	9.29	9.30	9.22	9.25	9.30	9.29	0.09	24.12	42.28	24.85	34.50	900.00	1.08	1.19	1.22

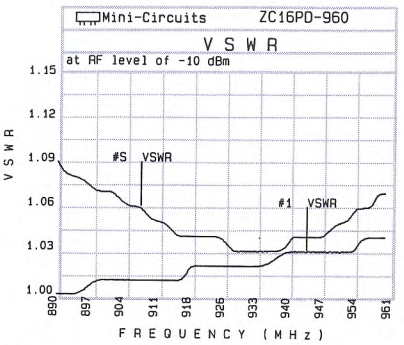
Power Splitter/Combiners

ZC16PD-960

890 to 960 MHz



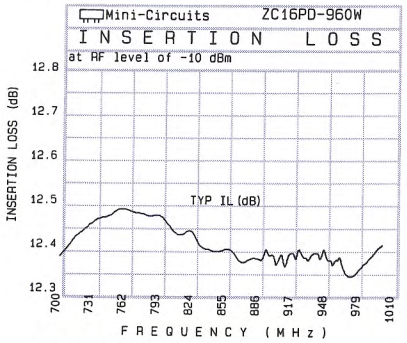


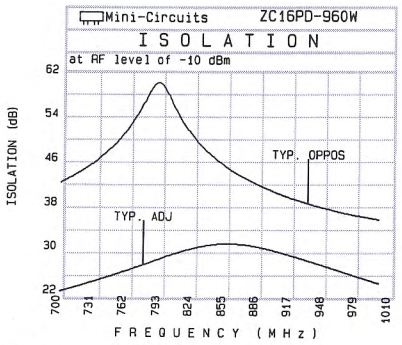


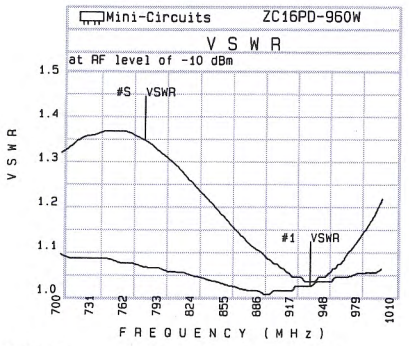
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-9	FREQUENCY (MHz)	VSWR S	VSWR 1
890.00	12.37	0.24	30.43	41.59	890.00	1.09	1.00
898.00	12.39	0.24	30.07	40.94	898.00	1.07	1.01
901.75	12.36	0.22	29.88	40.62	901.75	1.07	1.01
907.75	12.38	0.25	29.58	40.17	907.75	1.06	1.01
915.25	12.39	0.23	29.16	39.64	915.25	1.04	1.01
919.75	12.37	0.25	28.89	39.39	919.75	1.04	1.02
925.00	12.39	0.24	28.61	39.06	925.00	1.04	1.02
930.25	12.38	0.25	28.30	38.77	930.25	1.03	1.02
938.50	12.39	0.26	27.83	38.25	938.50	1.03	1.03
942.25	12.37	0.24	27.60	38.08	942.25	1.04	1.03
946.75	12.39	0.25	27.29	37.83	946.75	1.04	1.03
953.50	12.36	0.26	26.89	37.51	953.50	1.06	1.03
957.25	12.38	0.24	26.68	37.30	957.25	1.06	1.04
958.00	12.37	0.26	26.63	37.28	958.00	1.07	1.04
960.00	12.39	0.25	26.51	37.19	960.00	1.07	1.04

ZC16PD-960W

700 to 1000 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-9	FREQUENCY (MHz)	VSWR S	VSWR 1
700.00	12.38	0.24	22.43	42.27	700.00	1.32	1.09
746.50	12.47	0.26	25.21	48.38	746.50	1.37	1.08
792.25	12.48	0.24	28.34	60.92	792.25	1.32	1.06
838.75	12.40	0.24	30.89	47.70	838.75	1.21	1.03
884.50	12.38	0.23	30.67	42.07	884.50	1.10	1.01
901.00	12.37	0.25	29.93	40.69	901.00	1.07	1.01
907.75	12.38	0.25	29.58	40.17	907.75	1.06	1.01
913.00	12.39	0.25	29.29	39.85	913.00	1.05	1.01
922.75	12.40	0.23	28.75	39.19	922.75	1.04	1.02
934.75	12.39	0.25	28.03	38.49	934.75	1.03	1.02
946.00	12.40	0.23	27.37	37.88	946.00	1.04	1.03
957.25	12.38	0.24	26.68	37.30	957.25	1.06	1.04
984.25	12.37	0.26	25.01	36.25	984.25	1.15	1.05
994.00	12.40	0.30	24.41	35.89	994.00	1.19	1.05
1000.00	12.41	0.30	24.04	35.71	1000.00	1.22	1.06

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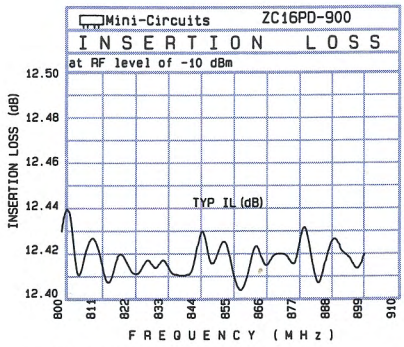
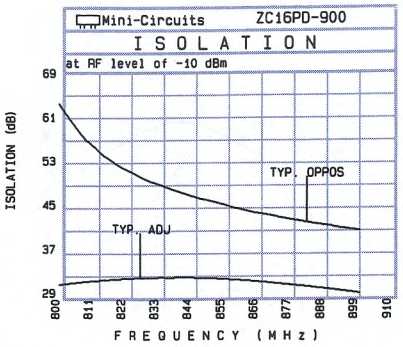
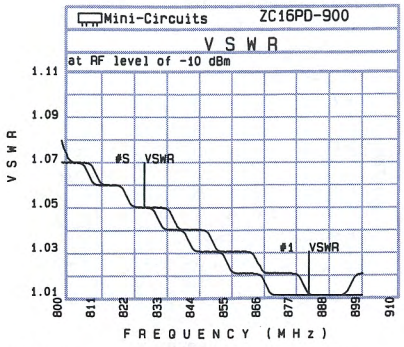
Mini-Circuits

ZC16PD-900

800 to 900 MHz



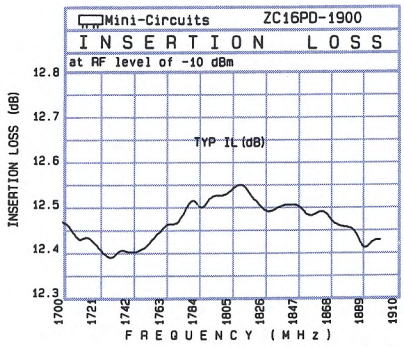


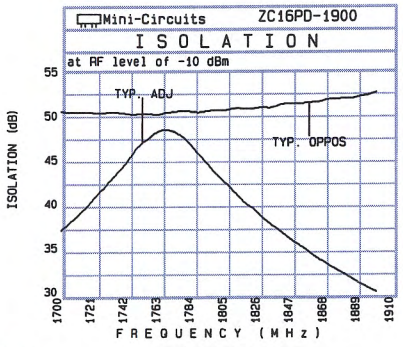


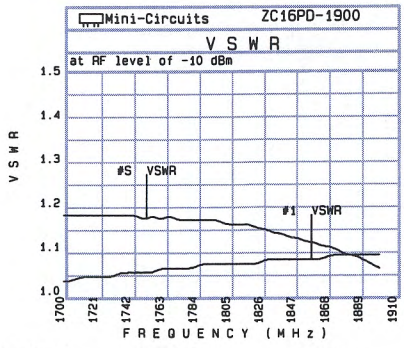
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-9	FREQUENCY (MHz)	VSWR S	VSWR 1
800.00	12.43	0.20	31.27	64.26	800.00	1.08	1.07
807.75	12.42	0.20	31.75	58.34	807.75	1.07	1.07
815.50	12.40	0.21	32.12	54.41	815.50	1.06	1.06
823.00	12.41	0.21	32.38	52.04	823.00	1.05	1.05
830.75	12.41	0.19	32.54	49.87	830.75	1.05	1.05
838.50	12.41	0.19	32.58	48.45	838.50	1.04	1.04
846.25	12.44	0.21	32.57	46.96	846.25	1.03	1.04
853.75	12.43	0.20	32.41	46.07	853.75	1.03	1.03
861.50	12.41	0.21	32.14	44.92	861.50	1.02	1.03
869.25	12.42	0.21	31.78	44.07	869.25	1.01	1.02
877.00	12.41	0.20	31.33	43.18	877.00	1.01	1.02
884.50	12.40	0.21	30.88	42.47	884.50	1.01	1.01
892.25	12.42	0.21	30.37	41.75	892.25	1.01	1.01
897.50	12.41	0.25	29.98	41.34	897.50	1.02	1.01
900.00	12.42	0.24	29.77	41.20	900.00	1.02	1.01

ZC16PD-1900

1700 to 1900 MHz







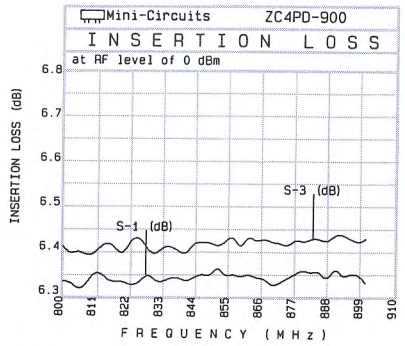
FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	ISOLATION (dB) 1-9	FREQUENCY (MHz)	VSWR S	VSWR 1
1700.00	12.47	0.34	37.37	50.92	1700.00	1.18	1.03
1715.50	12.44	0.36	39.87	50.79	1715.50	1.18	1.04
1731.00	12.38	0.37	43.00	50.90	1731.00	1.18	1.04
1746.00	12.40	0.37	46.25	50.55	1746.00	1.18	1.05
1761.50	12.45	0.38	48.81	50.47	1761.50	1.17	1.06
1777.00	12.50	0.37	48.09	51.06	1777.00	1.17	1.06
1792.50	12.53	0.37	45.23	50.96	1792.50	1.17	1.07
1807.50	12.55	0.35	42.40	51.21	1807.50	1.16	1.07
1823.00	12.51	0.36	39.90	51.28	1823.00	1.15	1.07
1838.50	12.51	0.40	37.48	51.74	1838.50	1.14	1.08
1854.00	12.48	0.39	35.52	51.89	1854.00	1.12	1.08
1869.00	12.47	0.36	33.64	52.39	1869.00	1.11	1.09
1884.50	12.45	0.38	31.94	52.35	1884.50	1.09	1.09
1895.00	12.43	0.38	30.91	52.78	1895.00	1.07	1.09
1900.00	12.43	0.37	30.48	53.15	1900.00	1.06	1.09

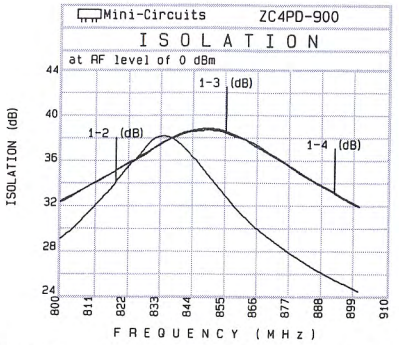
Power Splitter/Combiners 50 ohms

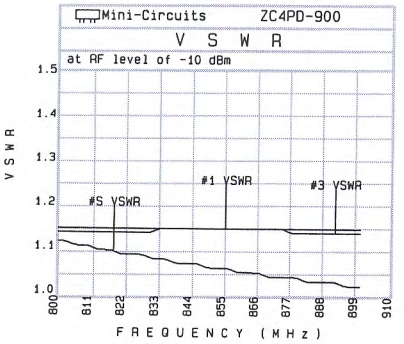
ZC4PD-900

4 way - 0°

800 to 900 MHz





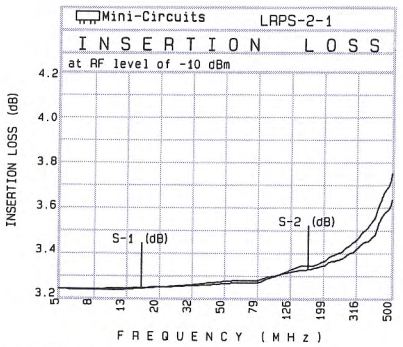


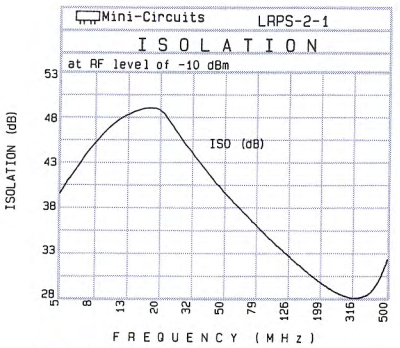
FREQ. (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	(dB) S-3	(dB) S-4	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	(dB) 2-3	(dB) 3-4	FREQ. (MHz)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
800.00	6.33	6.33	6.41	6.35	0.08	29.04	32.46	23.52	800.00	1.12	1.14	1.16	1.15	1.16
807.75	6.32	6.31	6.39	6.35	0.08	31.00	33.62	24.53	807.75	1.11	1.14	1.16	1.15	1.16
815.50	6.33	6.32	6.42	6.35	0.10	33.18	34.82	25.58	815.50	1.10	1.14	1.16	1.15	1.16
823.00	6.32	6.32	6.43	6.36	0.12	35.88	36.07	26.79	823.00	1.09	1.14	1.16	1.15	1.16
830.75	6.33	6.31	6.39	6.33	0.08	38.20	37.33	28.14	830.75	1.08	1.14	1.16	1.15	1.16
838.50	6.34	6.33	6.40	6.37	0.08	38.06	38.59	29.81	838.50	1.07	1.15	1.16	1.15	1.16
846.25	6.35	6.34	6.42	6.36	0.08	35.88	39.20	31.54	846.25	1.07	1.15	1.16	1.15	1.16
853.75	6.34	6.31	6.42	6.35	0.10	33.38	39.14	33.64	853.75	1.06	1.15	1.17	1.15	1.16
861.50	6.35	6.33	6.44	6.38	0.11	31.18	38.36	35.93	861.50	1.05	1.15	1.17	1.15	1.16
869.25	6.32	6.32	6.42	6.36	0.10	29.37	37.20	37.83	869.25	1.04	1.15	1.17	1.15	1.16
877.00	6.35	6.33	6.43	6.37	0.10	27.89	35.90	37.64	877.00	1.04	1.15	1.17	1.14	1.16
884.50	6.36	6.32	6.43	6.37	0.11	26.60	34.58	36.01	884.50	1.03	1.15	1.17	1.14	1.15
892.25	6.34	6.35	6.44	6.40	0.10	25.47	33.40	33.87	892.25	1.03	1.15	1.17	1.14	1.15
897.50	6.35	6.33	6.42	6.39	0.08	24.79	32.58	32.59	897.50	1.02	1.15	1.17	1.14	1.15
900.00	6.33	6.32	6.43	6.38	0.12	24.48	32.25	31.86	900.00	1.02	1.15	1.17	1.14	1.15

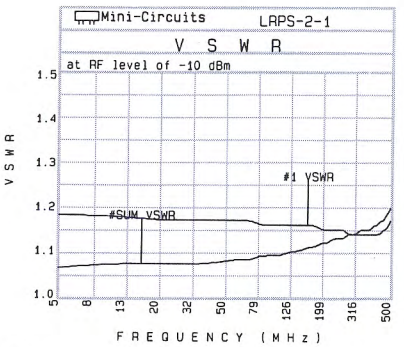
LRPS-2-1

2 way - 0°

5 to 500 MHz







FREQUENCY (MHz)	INSERTION LOSS (dB) S-1	(dB) S-2	AMPLITUDE UNBALANCE (dB)	ISOLATION (dB) 1-2	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
5.000	3.24	3.24	0.00	39.91	5.000	1.07	1.19	1.19
9.950	3.24	3.23	0.01	48.64	9.950	1.08	1.19	1.18
55.738	3.28	3.27	0.01	39.25	55.738	1.09	1.18	1.17
59.450	3.28	3.27	0.01	38.76	59.450	1.09	1.18	1.17
100.288	3.30	3.30	0.00	34.57	100.288	1.10	1.17	1.17
158.450	3.35	3.33	0.02	31.32	158.450	1.12	1.17	1.17
210.425	3.39	3.37	0.02	29.61	210.425	1.13	1.16	1.16
226.513	3.40	3.37	0.02	29.20	226.513	1.14	1.16	1.16
250.025	3.41	3.38	0.03	28.76	250.025	1.14	1.16	1.16
278.488	3.44	3.41	0.03	28.42	278.488	1.15	1.15	1.16
329.225	3.50	3.45	0.05	28.21	329.225	1.16	1.15	1.16
397.288	3.57	3.49	0.08	28.88	397.288	1.17	1.15	1.16
449.263	3.69	3.59	0.09	30.36	449.263	1.18	1.16	1.16
482.675	3.72	3.61	0.11	31.81	482.675	1.20	1.17	1.17
500.000	3.77	3.65	0.12	32.62	500.000	1.21	1.18	1.18

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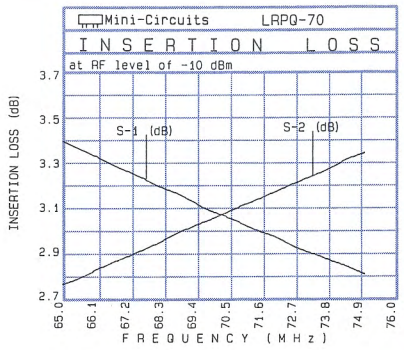
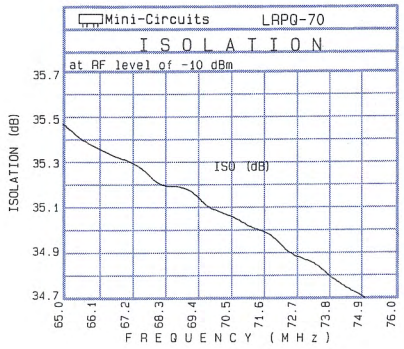
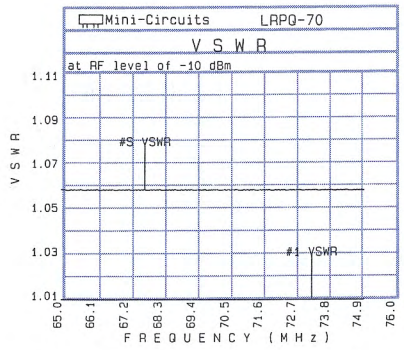
Mini-Circuits

LRPQ-70 65 to 75 MHz

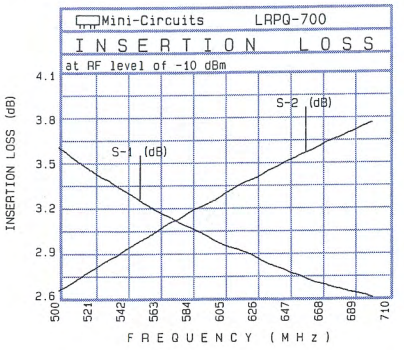


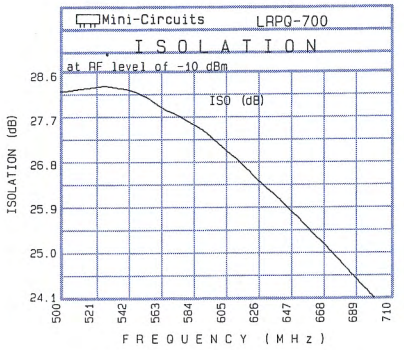


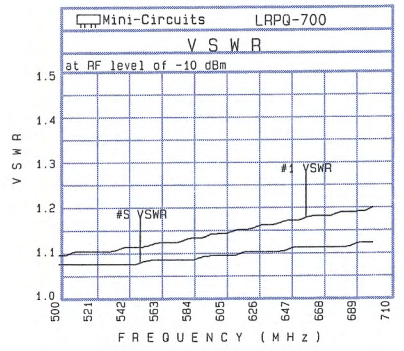


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
65.00	3.42	2.77	0.65	90.54	35.50
66.15	3.35	2.84	0.51	90.54	35.39
67.20	3.28	2.90	0.38	90.57	35.33
67.70	3.25	2.93	0.32	90.55	35.29
68.20	3.21	2.96	0.25	90.54	35.21
69.25	3.15	3.03	0.12	90.58	35.20
70.00	3.10	3.07	0.03	90.62	35.11
70.75	3.06	3.12	0.06	90.63	35.07
71.30	3.02	3.15	0.13	90.59	35.02
72.30	2.97	3.21	0.24	90.58	34.93
72.80	2.93	3.24	0.31	90.66	34.89
73.35	2.91	3.27	0.36	90.59	34.87
73.85	2.88	3.30	0.42	90.63	34.80
74.35	2.86	3.34	0.48	90.63	34.76
75.00	2.82	3.37	0.55	90.62	34.71

LRPQ-700 500 to 700 MHz

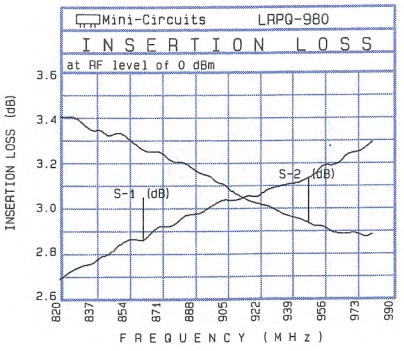


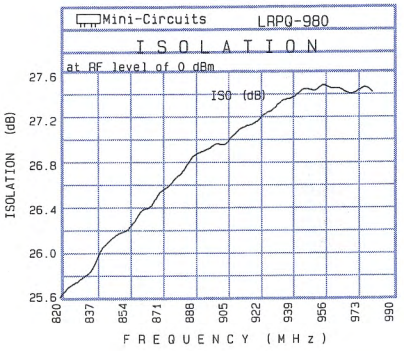


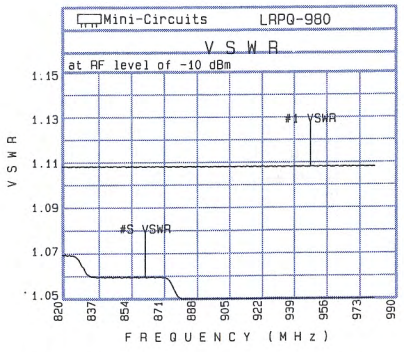


FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
500.00	3.64	2.66	0.98	88.52	28.37
515.00	3.52	2.76	0.76	88.49	28.43
531.00	3.42	2.87	0.55	88.60	28.48
546.00	3.32	2.96	0.36	88.59	28.39
562.00	3.21	3.06	0.15	88.64	28.10
577.00	3.12	3.15	0.03	88.54	27.85
592.00	3.05	3.24	0.19	88.55	27.56
608.00	2.96	3.34	0.38	88.56	27.12
623.00	2.91	3.42	0.51	88.58	26.67
638.00	2.83	3.50	0.67	88.54	26.25
654.00	2.77	3.59	0.82	88.58	25.73
669.00	2.71	3.67	0.96	88.55	25.24
685.00	2.66	3.74	1.08	88.54	24.69
695.00	2.64	3.79	1.15	88.60	24.35
700.00	2.62	3.81	1.19	88.60	24.18

LRPQ-980 820 to 980 MHz







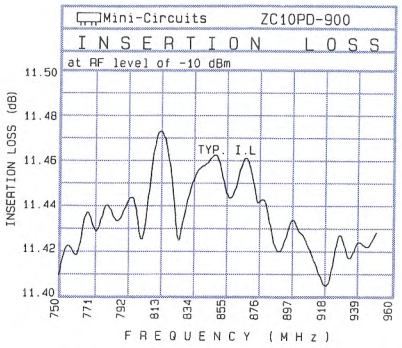
FREQ. (MHz)	INSERT. LOSS (dB) S-1	S-2	AMP. UNBAL. (dB)	PHASE (Deg.)	ISOL. (dB)
820.000	2.69	3.43	0.74	89.05	25.63
833.000	2.76	3.39	0.63	88.93	25.83
845.000	2.80	3.33	0.53	89.09	26.13
858.000	2.88	3.31	0.43	89.16	26.32
871.000	2.94	3.28	0.34	89.24	26.62
883.000	2.98	3.23	0.25	89.12	26.77
896.000	3.02	3.17	0.15	88.97	26.98
908.000	3.05	3.09	0.04	89.18	27.10
921.000	3.06	3.04	0.02	89.17	27.22
934.000	3.12	2.99	0.13	89.26	27.44
946.000	3.15	2.96	0.19	89.25	27.55
959.000	3.21	2.91	0.30	89.36	27.52
972.000	3.27	2.91	0.36	89.35	27.49
976.000	3.29	2.88	0.41	89.45	27.57
980.000	3.32	2.90	0.42	89.36	27.50

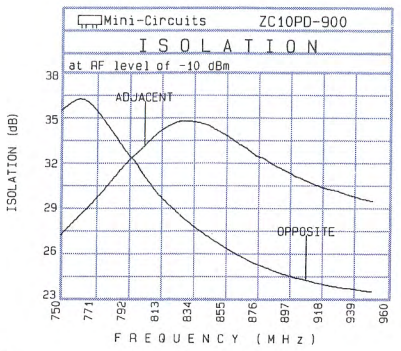
Power Splitter/Combiners 50 ohms

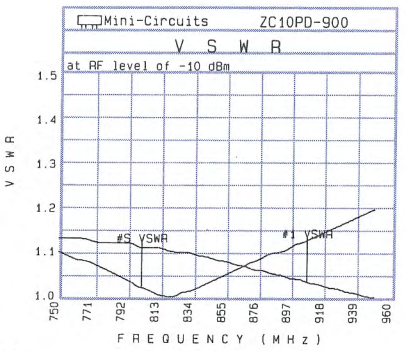
ZC10PD-900

10 way - 0°

750 to 950 MHz





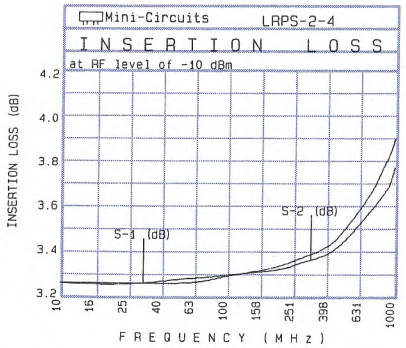


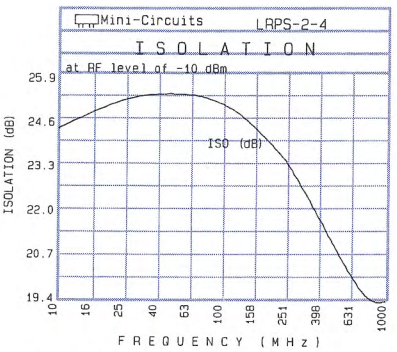
FREQ. (MHz)	INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	ISOLATION ADJACENT	ISOLATION OPPOSITE	FREQ. (MHz)	VSWR S	VSWR OUTPUT
750.000	11.41	0.37	27.37	35.92	750.000	1.11	1.17
767.500	11.45	0.31	29.27	36.54	767.500	1.09	1.17
785.500	11.43	0.29	31.56	34.08	785.500	1.06	1.16
800.000	11.43	0.27	33.26	31.85	800.000	1.03	1.15
814.500	11.48	0.28	34.67	29.97	814.500	1.01	1.15
826.500	11.43	0.30	35.21	28.75	826.500	1.02	1.14
844.000	11.46	0.25	34.99	27.33	844.000	1.04	1.13
862.000	11.45	0.25	33.76	26.17	862.000	1.07	1.12
875.000	11.44	0.27	32.81	25.49	875.000	1.09	1.11
891.000	11.42	0.32	32.01	24.85	891.000	1.11	1.10
903.000	11.43	0.33	31.41	24.52	903.000	1.13	1.09
920.500	11.40	0.41	30.62	24.07	920.500	1.16	1.08
938.000	11.43	0.40	30.15	23.81	938.000	1.19	1.06
944.000	11.42	0.40	29.95	23.70	944.000	1.20	1.06
950.000	11.43	0.39	29.85	23.63	950.000	1.21	1.06

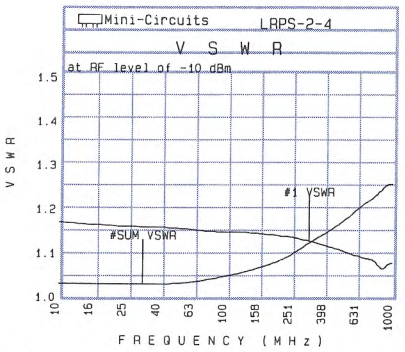
LRPS-2-4

2 way - 0°

10 to 1000 MHz







FREQ. (MHz)	INSERTION LOSS (dB) S-1	INSERTION UNBALANCE S-2	AMPLITUDE LOSS (dB) (dB)	ISOLATION (dB)	FREQUENCY (MHz)	VSWR S	VSWR 1	VSWR 2
10.000	3.27	3.27	0.00	24.54	10.000	1.04	1.18	1.18
25.313	3.26	3.27	0.01	25.52	25.313	1.04	1.17	1.17
49.758	3.29	3.27	0.02	25.62	49.758	1.04	1.17	1.17
75.913	3.30	3.28	0.02	25.52	75.913	1.05	1.16	1.17
99.899	3.31	3.31	0.00	25.29	99.899	1.06	1.16	1.16
134.269	3.32	3.32	0.00	24.96	134.269	1.07	1.16	1.16
232.522	3.36	3.34	0.02	23.74	232.522	1.10	1.15	1.16
247.731	3.38	3.36	0.02	23.57	247.731	1.11	1.15	1.15
402.670	3.43	3.40	0.03	21.85	402.670	1.16	1.13	1.15
497.364	3.51	3.46	0.05	20.96	497.364	1.18	1.12	1.14
697.324	3.66	3.59	0.07	19.78	697.324	1.23	1.10	1.12
791.534	3.74	3.64	0.10	19.53	791.534	1.24	1.10	1.11
879.696	3.82	3.69	0.13	19.43	879.696	1.26	1.07	1.10
937.238	3.86	3.72	0.14	19.44	937.238	1.27	1.09	1.10
1000.000	3.93	3.80	0.13	19.46	1000.000	1.27	1.09	1.10

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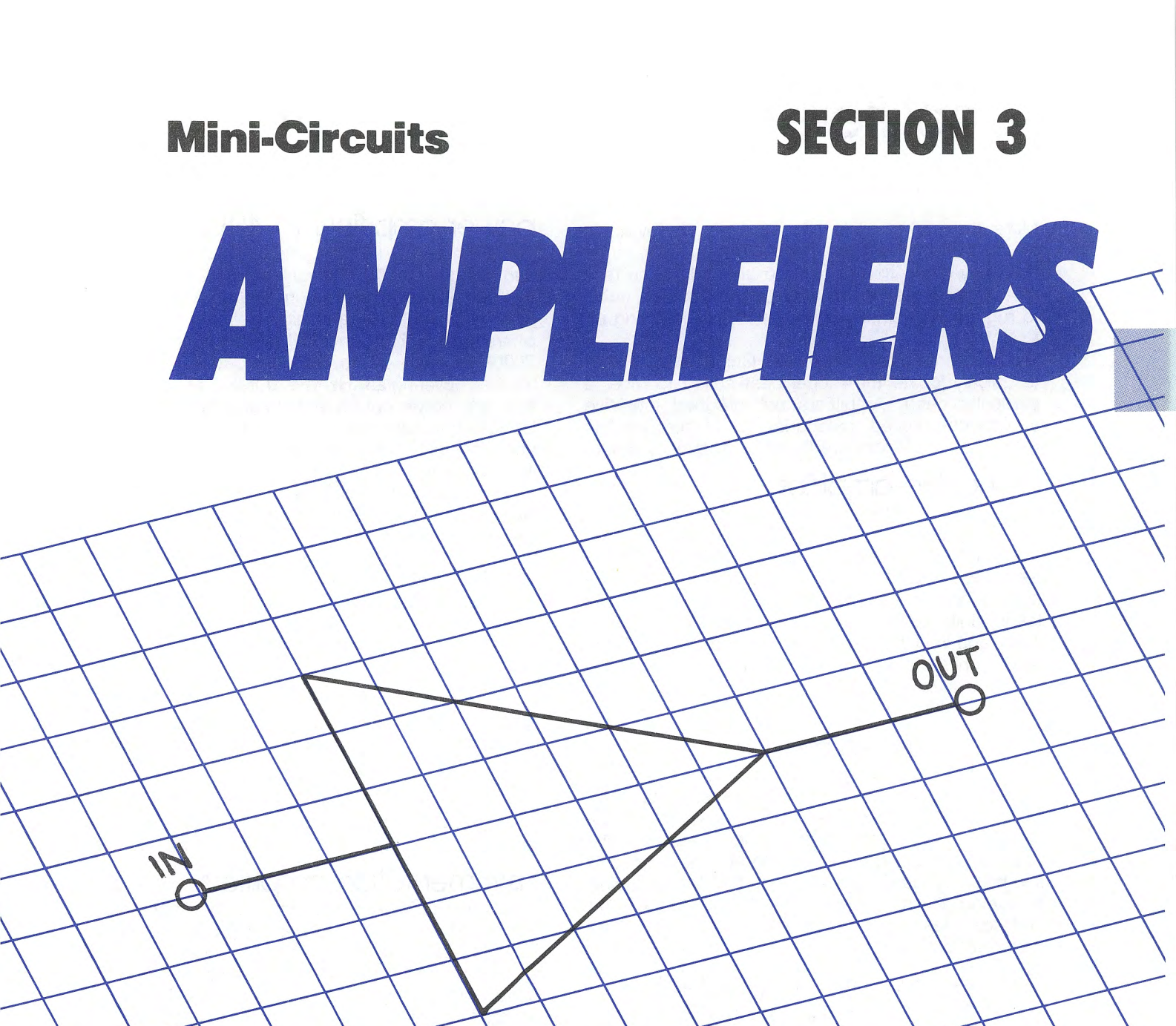
SECTION 3

AMPLIFIERS



contents of this section

technical

introduction 3-2
definition of terms 3-4, 3-5
most often asked questions . . . . . 3-6 thru 3-8
monolithic amplifiers application notes . . . . . 3-9 thru 3-11
selection guide/environmental table 3-12, 3-13
specifications check list
a guide form for requirements 3-3

product specifications

monolithic 3-14, 3-15
low-noise 3-16, 3-17
variable gain, high isolation 3-18
low power 3-19
low distortion, high power 3-19
medium power 3-20
high power 3-21

computer data and curves

CAPD information . . . . . 3-22 thru 3-48

Amplifiers

More than 50 models of amplifiers are available as off-the-shelf catalog items. The models range from tiny monolithic devices to plug-in and surface mount packages, to miniature connectorized units, to rugged heat-sinked units capable of handling up to IOW output.
A convenient Amplifier Selection Guide makes it easy to quickly locate the model best suited to meet a particular need. Amplifiers are grouped into five application-oriented categories and then models within each category are listed by frequency range.

monolithic amplifiers

The tiny and rugged wideband MAR-, VAM-, and MAV- monolithic series are priced as low as 99 cents each (in small quantity), are unconditionally stable regardless of load, and are easily cascadable. Available in both straight leads and surface-mountable leads, units cover frequencies form DC to 2 GHz. Tape and reel packaging is standard for surface-mount units. For design convenience, kits of monolithic amplifiers and chip coupling capacitors for multi-stage operation are also available.

rugged plug-in models

Another popular series for pc board designs is the MAN-, which consist of two stages complete with coupling capacitors housed in a compact 0.8 by 0.4 by 0.25 in. EMI shielded, hermetically-sealed metal case. Broadband models include high isolation and low-noise types. Prices start at $13.95, including screening, thermal shock −55°C to +100°C, fine and gross leak, and burn-in for 96 hours at 100°C under normal operating voltage and current.

WJ and Avantek equivalent

Hermetically-sealed TO-8 amplifiers, with the same pinouts and specs as Watkins-Johnson and Avantek models, are available from Mini-Circuits' factory stock with guaranteed 1 week shipment. Offered at considerably lower cost, the AMP-series span 5 to 1000 MHz with gain up to 27dB, and output power level to +15.5dBm. Additional model equivalents are available; please contact our Applications Department.

low-noise models

For applications where low noise is a critical factor, Mini-Circuits LN- and HLN-series boast a noise level of less than 1.5dB along with up to +27dBm power output, operating up to 2.4GHz.

power amplifiers to 10W

A full line of low (10mW), medium (up to 500mW), and high (up to 10W) power amplifiers are available from Mini-Circuits, priced from $69.95. Variable gain, high gain, low noise, and high isolation models are offered in the ZFL- and ZHL-series, spanning 2 to 2000MHz with up to 500mW output. Additional models, covering 25KHz to 4200MHz, are also available with power output as high as 10W.
Using ultra-linear Class A design, these amplifiers are unconditionally stable, can be connected to any load impedance without amplifier damage or oscillation, and include overvoltage protection.
Applications include low-distortion IM testing, broadband isolation in production and lab test setups, and higher signal output level from signal/sweep generators and frequency synthesizers.

RF Instrumentation Amplifiers, available now!

Model	Freq. Range (MHz)	Gain dB min	Power min. out (1 dB comp) dBm	Power min. out (1 dB comp) W	NF dB	Price $ ea.
TIA-900-10	100-900	28	+40	10	13	3695.00
TIA-1000-4	100-1000	19	+36	4	12	1995.00
TIA-1000-1R8	0.5-1000	35	+32	1.6	8	1495.00

All models operate from 110/220V ac.

instrumentation amplifiers

A new line of instrumentation amplifiers have been introduced with built-in power supply for operation from 110-220V ac. The TIA-series include models with up to 38dB gain reverse isolation as high as 80dB, and bandwidth as wide as 0.5 to l000MHz. All models are in a self-enclosed instrumentation cabinet, contain LED indicator, and are thermally protected.

Our guaranteed one-week shipment policy applies to all Mini-Circuits' amplifiers.

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Amplifiers

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency Range _____ MHz
Gain (min.) _____ dB
Gain flatness ± _____ dB over _____ MHz
Isolation (out-in) min. _____ dB
Power output, 1 dB compression, _____ dBm
Noise Figure, typical _____ dB
Supply voltage _____ volts DC
Current,max. _____ mA
Intercept point 2-tone, 3rd order___ dBm typ
2-tone, ___ order___ dBm typ
VSWR or return loss (dB) ☐ 50 ohms ☐ 75 ohms
Input _____ output _____
Max RF input without damage
with load _____ dBm, no load _____ dBm
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC ☐ Other
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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Modern Amplifier Terms Defined

1 dB compression point defines the output level at which the amplifier's gain is 1 dB less than the small-signal gain, or is compressed by 1 dB.

Conditionally stable amplifier refers to an amplifier which will oscillate under particular load or source impedance (VSWR) conditions, an undesirable situation.

Cp (Process capability) Process capability is broadly defined as the specification width (S) divided by the Process width (P) and is an indication of the spread of the process. Specification width "S" is the difference between the upper specification limit (USL) and the lower specification limit (LSL). Assuming the process to be Gaussian, its standard deviation can be denoted by sigma (σ). Process width is defined as 6 times sigma (3 sigma on each side of mean). For example, if the USL and LSL of noise figure of an amplifier are 6.9 and 6.0 dB, then S is 0.9 dB. If the standard deviation (σ) is 0.1 dB, then P is 0.6 dB. Cp, the process capability, is 0.9/0.6 and is 1.5.

When Cp is 1, then 99.73% of the units pass specs and the process produces 0.27% rejects. When the value of Cp increases, the number of rejects reduce dramatically. Percent defects are no longer used at higher values of Cp, instead parts per million (ppm) is used to describe the number of rejects. For example, when Cp is 1.5, rejects are 5 ppm and when Cp is 2 the rejects are 0.002 ppm (In this case process width is $\pm 6\ \sigma$ and the process is called a 6 σ process). All the above numbers are based on the assumption that the center of the spec limits and the center of the process are the same. When this is not true, Cp does not provide complete information.

Cpk (Process capability of a non-centered process) Cp does not take into account non centering of the process and hence is of minimal value in practice. In this case another term, called Cpk, is used and takes into account any non-centering of the process and is defined as

$Cpk = Cp(1-K)$, where:

$$K = \left|\frac{D - \bar{X}}{S/2}\right| \text{ and } D = \text{design center}$$

Cpk is also defined as:

$$CpK = \left|\frac{NSL - \bar{x}}{3\sigma}\right|$$

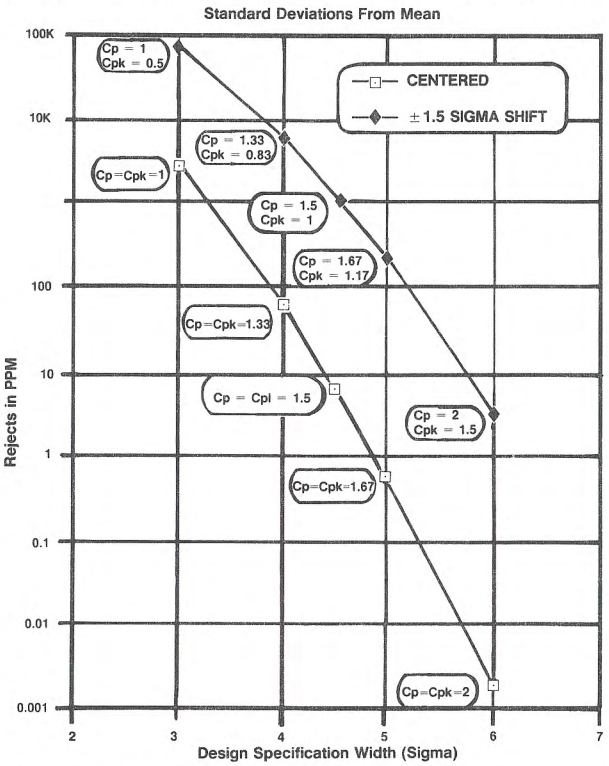
where NSL is the nearest spec limit, $\bar{X}$ is the mean of the process, and the vertical lines indicate that Cpk is always a positive number. Cp and Cpk are equal for a centered process. Cpk is also useful for defining processes with single-sided specs. For example, noise figure of an amplifier has only an upper spec limit and active directivity a lower spec limit. In deriving Cpk, one should make sure that $\bar{X}$ has a meaningful value, such as between spec limits when both spec limits are present. For single-sided specs, $\bar{X}$ should be below the upper spec limit or above the lower spec limit. The graph below shows the number of rejects for various values of Cpk.

Directivity (active) is defined as the difference between isolation and forward gain in dB. It is an indication of the isolation of the source from the load, or how much the load impedance affects the input impedance and the source impedance affects the output impedance. The higher the active directivity (in dB), the better the isolation.

Dynamic range is the power range over which an amplifier provides useful linear operation, with the lower limit dependent on the noise figure and the upper level a function of the 1 dB compression point.

Gain flatness indicates the variation of an amplifier's gain characteristic over the full frequency response range at a given temperature, expressed in dB.

Gain (forward gain, G) for RF amplifiers is the ratio of output power to input power, specified in the small-signal, linear gain region, with a signal applied at the input. Gain in dB is defined as, $G_{dB} = 10 \log_{10} G$.



Harmonic distortion is produced by nonlinear amplifier operation and appears in the form of output signal frequencies at integral multiples of the input signal frequency. Since harmonic distortion is influenced by input power level, it is generally specified in terms of the relative level of the harmonics to the fundamental signal power level.

Isolation is the ratio of the power applied to the output of the amplifier to that measured at the input of the amplifier.

Linearity of an amplifier signifies its output power is a linear function of the input power. A linear amplifier produces at its output an amplified replica of the input signal with negligible or no harmonic generation.

Maximum signal level refers to the largest CW or pulse RF signal that can be safely applied to an amplifier's input. Exceeding the specified limit can result in noise figure degradation, increased distortion, gain reduction, and/or amplifier burnout.

Noise factor is the ratio of signal-to-noise power ratio at an amplifier's input to the signal-to-noise power ratio at the output. Noise figure NF in dB is related to noise factor F by

$$NF = 10 \log_{10} F \text{ in dB}$$

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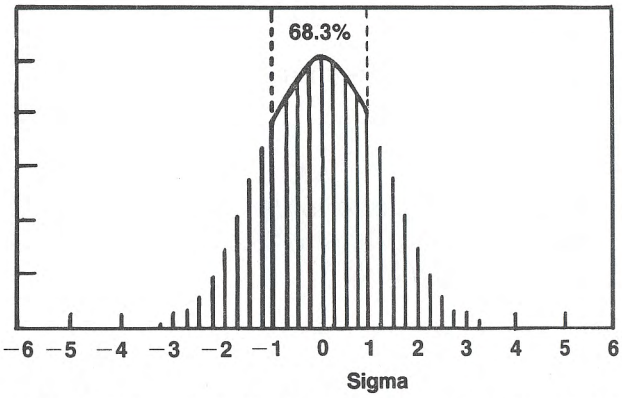
Return loss (RL) is the ratio of reflected power to incident power at the RF port of an amplifier, expressed in dB by return loss (RL = $-20 \log |\rho|$, where ρ = reflection coefficient.

Reverse gain is the ratio of power measured at the input of an amplifier to the applied power at the output of an amplifier, also known as isolation.

Sigma is the statistical term for the Standard Deviation of a distribution. All things differ one from another to a greater or lesser degree. The measure of how much a distribution varies around the average or middle value X is a measure of its standard deviation. Most distributions take a bell-shaped curve appearance, called a normal distribution. The distance from the center of a normal distribution curve to where the curve changes direction, or its point of inflection, is called the standard deviation or the Greek letter sigma; one sigma denotes one standard deviation.



Sigma performance, SP, tells how far the nearest spec limit is from the average, compared with the sigma value. For example, if the spec limit is 6 sigma away, the process has SP = 6. Thus, 5P equals 3 times the CpK value.

"Skinny" sigma refers to a small deviation. The relationship between the process standard deviation and the width of the specification reflects the sigma. For example, in a well-controlled process the nature of deviation from one unit to the next is small and most units thus fall well within the spec limits; the narrow variation indicate a "skinny" sigma. In a process that is not tightly controlled, units will vary from one spec extreme to the other or even exceed the spec limits; here the standard deviation and sigma are wide. What causes some confusion is the fact that 6 sigma is skinny while 2 sigma is wide; 6 sigma means the spec limits are much further away from the distribution.

Stability of an amplifier is an indication of its tendency to oscillate or generate a signal at its output without an applied input.

Two-Tone Third-order intercept point Two-tone third-order intercept point is a measure of third-order products generated by a second signal arriving at the input of a device such as an amplifier. If F1 and F2 are the frequencies of the two signals arriving at the input, the amplifier generates intermod products at its output due to inherent nonlinearity, in the form $\pm m*F1 \pm n*F2$ where m and n are positive integers which can assume any value from 1 to infinity. The order of the intermod is defined as m + n. Hence 2*F1−F2, 2*F2−F1, 3*F1 and 3*F2 are third-order products by definition. The first two products are called two-tone third-order products as they are generated when two tones are applied simultaneously at the input and the latter two are called single-tone third-order products.

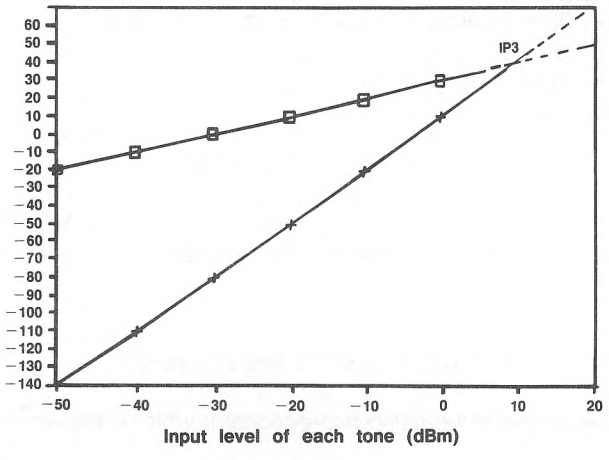
For example, if 100 and 101 MHz are the frequencies of two applied signals, then 99 and 102 MHz are the two-tone third-order products and 300 and 303 MHz are single-tone third-order products. Two-tone third-order products are very close to the desired signals and are very difficult to filter out. Hence they are of great importance in system design.

In the linear region, third-order products decrease/increase by 3 dB for every 1 dB decrease/increase of input power, and output signal power decreases/increases by a dB for every dB of input power. When drawn on a X-Y graph, with input power on X-axis and output power on the Y-axis, third-order products fall on a straight line with a slope of 3 and signal power on a straight line with a slope 1 as shown below. By extending the linear portions the two lines, they intercept at a point. The X co-ordinate and the Y co-ordinate of this point are called the input and output intercept point, and the two differ by an amount equal to the small-signal gain of the amplifier. Output intercept point, IP3(dBm) can also be calculated using a simple formula.

$$IP3(dBm)out = Pout(dBm) + A/2$$

where Pout(dBm) is the output power of each tone in dBm and "A" is the difference of output power and intermod level in dB. Input intercept point is obtained by substituting Pin(dBm) for Pout(dBm) in the above formula. Single-tone and two-tone third-order intercept points differ by a fixed amount but have the same slope.

Amplifier Third-Order Intercept Point



Unconditionally stable refers to an amplifier that will not oscillate regardless of load or source impedance.

VSWR (voltage standing wave ratio) is related to return loss(RL) by the following:

$$VSWR = \frac{1 + 10^{-RL/20}}{1 - 10^{-RL/20}}$$

14 often-asked questions about amplifiers

Q. *What is the effect of using a 50-ohm amplifier in a 75-ohm system?*

A. When a 75-ohm load is seen from an ideal 50-ohm amplifier or vice-versa, a 1.5:1 VSWR results which alters gain, output return loss, and gain flatness in real-life amplifiers. If active directivity (defined as isolation minus gain) is low, a change in load impedance will result in a change of input impedance and a change in source impedance will result in a change in output impedance. Hence, a 75-ohm load on an amplifier with low directivity will affect the input impedance of an amplifier. Maximum transfer of power may not occur.

However, in many applications, the mismatch may not be objectionable. For specific performance details, the 50-ohm amplifier should be tested under 75-ohm conditions. Contact the factory or sales rep. for computer automated performance data (CAPD) on the amplifier you are considering.

Q. *What is output VSWR and what is its significance?*

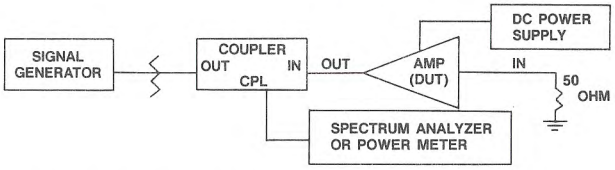
A. Output VSWR is a measure of how much power is reflected back from the amplifier's output port when an external signal is applied to that port. VSWR varies from a theoretical value of 1:1 for a perfect match to greater than 20:1 for total mismatch. Since loads in practical applications vary with frequency, maximum power and gain flatness also will deviate from what is specified. If the amplifier is connected to its load by a cable and all three have different impedance, then multiple reflections between the amplifier and its load can occur resulting in greater variation in frequency response. In general, the output impedance (characterized by output VSWR) is the source impedance of the following device.

Q. *How is output VSWR measured?*

A. A simple setup using a directional coupler is shown below.

First establish the 0 dB reference as follows. Apply the input signal to the directional coupler output port as shown. Apply a short circuit to the coupler's input port and measure the power at the coupled port. Then replace the short with an open circuit and note the reading at the coupled port. The average of the two readings is the 0 dB reference. Next substitute the open circuit with a 50 ohm load. Note the reading; this will give you the measurement range of the setup. Remove the 50 ohm load and replace it with the DUT. Measure how far the reflected signal is from the 0 dB reference; this is the output return loss (R.L.). To convert output return loss to VSWR, use the formula:

$$VSWR = \frac{1 + 10^{(-R.L./20)}}{1 - 10^{(-R.L./20)}}$$



For more accurate measurements, use a scalar or vector network analyzer.

Q. *What is the relationship between reflection coefficient, VSWR, and output return loss?*

A. The voltage reflection coefficient (ρ) is the ratio of the reflected to incident voltage in an amplifier or device. The theoretical reflection coefficient varies from zero for a perfect match to one for a total mismatch. Magnitude of reflection coefficient and VSWR are related by

$$|\rho| = \frac{VSWR - 1}{VSWR + 1}$$

Return loss is related to the magnitude of reflection coefficient by

$$R.L. = -20 \log_{10} |\rho| \quad \text{or}$$

$$R.L. = -20 \log_{10} \frac{VSWR - 1}{VSWR + 1}$$

Q. *To improve matching, can I use a resistive pad between amplifier stages?*

A. Of course. But at the expense of overall gain, noise figure, and/or output power. The higher the gain of the first stage and the lower the value of the attenuator, the less the degradation of noise figure. Overall noise figure is calculated as follows:

$$F = F1 + \left(\frac{L - 1}{G1}\right) + \frac{(F2 - 1)L}{G1} = F1 + \frac{F2L - 1}{G1}$$

Where F1, F2 are noise factors of first, and second amplifiers, and L is the loss of the pad.

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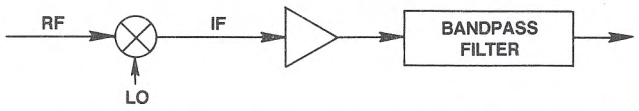
Noise figure in dB = 10 $\log_{10}$ F, where F is noise factor

Loss in dB = 10 $\log_{10}$ L, where L is loss factor

Gain in dB = 10 $\log_{10}$ G, where G is gain factor

Q. *What is the significance of an amplifier's directivity characteristic in a system design?*

A. Directivity is the difference between isolation and gain. Directivity is an indication of how the impedance mismatch at the amplifier's output affects the input.



In receiver applications, a filter following a wideband amplifier reflects undesired signals back to the amplifier and then to the mixer stage. If the amplifier provides high directivity, the reflected signals reaching the mixer will be much lower in magnitude and thus have little interaction at the mixer stage.

Another common application is two-tone, third-order IM testing, where the two-tone signals must be well isolated; amplifiers with high directivity are used between source and combiner.

For relatively high RF frequencies, isolators can be used but they are expensive; for frequencies below 1 GHz, they are difficult to find.



MAN

High-directivity amplifiers, such as Mini-Circuits' MAN-AD series, are recommended for such applications.

Q. *Can I obtain higher power output by paralleling amplifiers?*

A. Yes, but it's not as simple as merely connecting the two inputs and the two outputs in parallel. It involves judicious use of power hybrids with proper amplitude and phase balance and power levels, as well as amplifiers well matched for gain and phase characteristics. Quite candidly, it's generally advisable to specify an amplifier that meets the high-power requirements.

Q. *I want to vary an amplifier's gain. Can I adjust the amplifier's supply voltage to achieve an AGC effect?*

A. It's not recommended. An amplifier is designed to operate at a given supply voltage and its performance specifications (gain, power output, saturation, frequency response, etc.) are based on the stated supply voltage. Boost the supply voltage too much and gamble on the amplifier burning up; reduce the supply voltage too low and expect the performance specs to deviate considerably.

Variable-gain amplifiers are available, such as Mini- Circuits' ZFL-1000G and ZFL-1000GH, to accomplish your objective.

Q. *I'm working with a 12-volt system and am considering your +30 dBm ZHL-series amplifiers. The specs indicate a +15 volt supply is required. How will performance be affected with 12- rather than 15-volt DC input?*

A. Mini-Circuits' RF Signal-Processing Handbook, Vol. 3 on Amplifiers provides performance figures for three DC power input levels: +15, +16, and +12 volts. Need a copy? Ask your local Mini-Circuits' sales representative or contact the factory for a free copy.

ZHL-42W

FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	34.97	37.07	37.10	1.13	29.8	24.9	32.9	1.27	.05	1.86	.17	10.35	27.85
21.4	35.54	37.56	37.57	1.18	33.7	20.6	45.0	1.26	.05	1.90	.18	10.07	28.46
67.0	35.09	37.04	37.06	1.28	43.1	24.6	32.2	1.26	.05	1.91	.16	8.96	28.48
209.9	35.15	37.07	37.06	1.32	35.5	39.3	31.2	1.26	.05	1.90	.14	7.51	28.43
657.2	35.83	37.51	37.49	1.43	26.9	25.5	33.1	1.22	.04	1.90	.07	7.10	28.93
1514.1	36.00	37.68	37.68	1.54	23.2	21.1	25.6	1.56	.09	1.79	.18	7.14	29.83
1836.4	35.56	37.53	37.56	1.54	34.5	22.1	23.8	1.49	.11	1.54	.10	7.35	30.08
2158.7	35.54	37.51	37.53	1.55	20.6	26.1	26.1	1.35	.09	1.49	.15	7.23	29.98
2373.6	35.73	37.62	37.61	1.37	18.7	39.5	21.0	1.27	.08	1.55	.16	7.14	29.32
2588.5	35.92	37.53	37.51	1.14	18.1	24.0	27.0	1.23	.07	1.69	.16	7.08	29.09
2910.8	35.39	36.89	36.92	1.07	31.3	28.5	26.1	1.10	.07	1.90	.13	6.99	28.79
3233.1	35.41	37.14	37.16	1.11	23.1	36.0	17.8	1.37	.08	1.84	.15	7.05	28.87
3555.4	36.69	38.23	38.23	1.49	26.3	25.3	24.3	2.00	.15	1.62	.12	6.87	28.82
3877.7	36.70	37.58	37.55	1.81	27.8	19.0	18.9	1.93	.24	1.21	.15	6.91	28.42
4200.0	36.96	38.09	38.07	1.70	30.2	19.8	35.4	1.40	.25	1.39	.34	6.97	28.13

σ equals standard deviation, see Amplifier terms

Q. *Is there a simple way to estimate second- and third-order intercept point for an amplifier?*

A. As a general rule, the second-order point is 18 to 20 dB above the 1 dB compression point while the third-order intercept point is 10 dB above the 1 dB compression point.

Q. *My application involves injecting sharp RF pulses to an amplifier. How can I tell whether the amplifier's peak power limits will be exceeded?*

A. Here's a conservative rule-of-thumb estimate for a 50-ohm amplifier. (1) Take the amplifier's maximum power spec. (2) Convert from dBm to W. (3) Multiply by 100. (4) Take the square root, and use this figure as the maximum peak voltage that can be applied.

Q. *When an amplifier is used in a test setup, is there such a thing as a safe sequence to connect the amplifier's input, output, and supply voltage to avoid damage?*

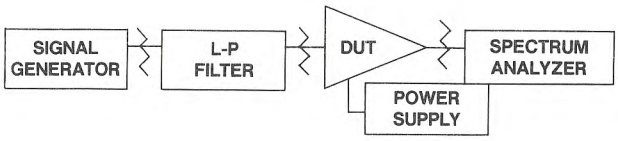
A. Yes, there is a recommended procedure. Begin by connecting the load, then the DC supply, and finally the RF input signal. When finished, first disconnect the RF input, then the DC power, and finally the load.

Q. *Please sketch the test setup and describe the test procedure used to measure an amplifier's second-order intercept point.*

A. Block diagram of a set up for measuring amplifier harmonics is shown below. Second harmonic of an amplifier is quantified and specified as second order intercept point (IP2). In the linear region of the amplifier, if second harmonic is A2 dB below fundamental, this IP2 is given by

$$IP2(dBm) = Pout\ (dBm) + A2$$

In the block diagram, a low-pass filter is provided to attenuate second harmonics of the generator 10 to 20 dB below that generated by the amplifier. Sufficient attenuation should be provided at the amplifier output to prevent spectrum analyzer from generating harmonics.



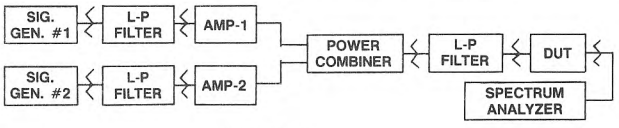
SECOND-ORDER INTERCEPT TEST

Q. *Describe the procedure for measuring 2-tone 3-order intercept point of an amplifier.*

A. Block diagram of a setup for measuring two-tone third- order intercept point is shown below.

If F1 & F2 are the frequencies of the two tones, then 2F1 − F2 and 2F2 − F1 are the third-order products. The set up should ensure that second harmonic of F1 & F2 are at least 10 to 20 dB below the third-order products to be measured. Care also should be taken to prevent F1 & F2 interaction and generation of third-order products. Amplifiers 1 and 2 are selected such that they have high directivity. This provides the desired isolation of the generators. If A3 is the level of the third-order product below the desired signal, then the output third-order intercept point is given as

$$IP3(dBm) = Pout\ (dBm) + A3/2$$



2-TONE TEST

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Monolithic Amplifiers

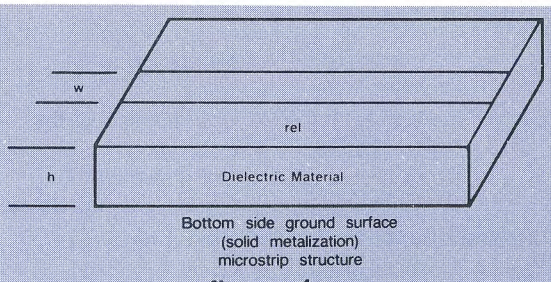
The MAR-cascadable amplifier series is a family of silicon bipolar monolithic integrated circuits fabricated with nitride self-alignment, ion-implantation for precise control of doping and passivation to achieve high reliability. These devices, priced from below one dollar in volume quantity, exhibit excellent unit-to-unit uniformity and are ideally suited as 50-ohm amplifier building blocks. The MAR devices are simple to use if you follow the suggestions given for board layout, proper grounding and steps to minimize parasitics, and correct biasing.

board layout suggestions

In a typical microstrip structure, Fig. 1(a), line impedances are determined by strip width (w), board dielectric material (E_r), and dielectric thickness (h). Since the impedances of the MAR-units are prematched to operate in a 50 ohm system, microstrip lines should be as close to 50 ohms as possible to realize full specified performance. For various board materials, line width dimensions for a 50-ohm line are given in Fig. 1(b). Operation in systems with characteristic impedances other than 50 ohms is possible with somewhat reduced performance. MAR amplifiers offer very good return loss in a 50-ohm system.

The board material for the microstrip structure should be selected to suit the intended frequency of operation. PTFE woven-glass performs well to frequencies in excess of 2 GHz, is a fairly rugged material that can tolerate substantial rework, and is not particularly sensitive to heat or humidity.

Duroid is the favored material of microwave designers because of its high dielectric consistency and low dielectric dissipation. RT/duroid is a somewhat fragile material which crushes fairly easily; glues do not adhere well to its substrate so thin metallization patterns are subject to lifting if abused with repeated rework. Some versions can also be quite hydroscopic, and can show substantial dielectric shifts with variations in humidity. Because of these factors, care should be taken when working with the material.



Bottom side ground surface
(solid metalization)
microstrip structure

figure 1a

Line Widths for 50 ohm line for various board materials.

Board material	ϵ	Thick	w/h for 50Ω	w for 50Ω
RT/Duroid 5870[1]	2.3	.015″	2.90	.044″
PTFE-Woven Glass Fiber (Typ.)	2.55	.010″	2.55	.025″
		.031″	2.55	.079″
		.062″	2.55	.158″
Epoxy-Glass (G10)	4.8	.062″	1.75	.108″
Alumina/E10[2]	10.0	.025″	0.95	.024″
		.050″	0.95	.048″

[1] Trademark of Rogers Corp. for its PTFE nonwoven glass PC material. (RT is reinforced teflon and PTFE is polytetraflourethylene)
[2] E-10 and Epsilam-10 are trademarks of 3M for its ceramic filled PTFE substrate.

figure 1b

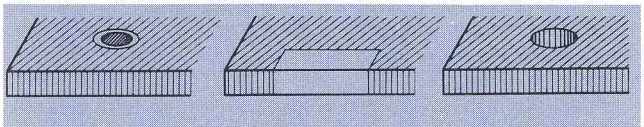
parasitics and grounds

During board layout, care should be taken to minimize all parasitics. Remember that extra lead length equals extra inductance added to the design. This is particularly important if the circuit is to be operated above 1 GHz. Transmission lines should, whenever possible, run flush to the package. This requires that a hole be made in the board so that the MAR-amplifier leads are in the same plane as the transmission line. MAR-amplifiers should be mounted on the etched side of the board to minimize the inductance of feedthrough connections. Abrupt changes in transmission line width also create parasitic effects, called step discontinuities. Although the complete model for such a discontinuity can become quite complicated, the overall effect of the step from an MAR-amplifier lead to a 50 ohm transmission line is typically .05 to .2 nH of extra series inductance. Tapering the transmission lines from 50 ohms down to the amplifier lead width helps minimize this effect. Bends in transmission lines also create parasitic effects and should be avoided when possible; when they must be used, the corners should be chamfered to prevent the bends from acting as extra shunt capacitance. (Reference: K.C. Kupta et all, "Microstrip lines and slot lines," Artech, 1979, p 140-142). The effects of parasitics on gain loss and VSWR, is shown in Table 1.

Ground planes should be kept as large and as solid as possible. Return paths for high frequency circulating currents must be kept as short as possible, especially at the emitter leads (MAR ground lead connections). If plated through holes are used as ground returns, they should be placed directly under the ground leads of the MAR and be located as near as possible to the body of the package .050 inches. Any additional path length acts as series inductance, which translates into unwanted emitter resistance at operating frequencies. Gain, power compression, and high frequency rolloff will all be degraded if proper grounding techniques are not used. A gain decrease of more than 1 dB can be expected at 1 GHz for approximately 2nH of lead inductance. Fig. 2 shows good return paths between topside ground connections and the bottom ground plane. The effects of parasitic emitter inductance due to poor RF grounding is shown in Fig. 3, with emitter inductance of zero to 4nH.

table 1 **Effects of Parasitics on VSWR and Gain**

Freq. MHz	MAR-2, No Parasitics		≈0.9 nH Parasitics Only		MAR-2, + Parasitics	
	VSWR	Loss, dB	VSWR	Loss, dB	VSWR	Loss, dB
500	1.09:1	0.0	1.01:1	0.0	1.18:1	.03
1000	1.23:1	.04	1.12:1	.01	1.39:1	.11
1500	1.29:1	.07	1.22:1	.04	1.46:1	.15
2000	1.29:1	.07	1.30:1	.07	1.45:1	.15
2500	1.26:1	.05	1.38:1	.11	1.45:1	.15
3000	1.26:1	.05	1.45:1	.15	1.53:1	.19



a. Wire "feed through" soldered in place in hole drilled through board.
b. "Wrap around" of copper foil (may be used with slit in board).
c. Plated through hole (side walls of hole metalized).

figure 2

Methods of realizing minimal length return paths to ground.

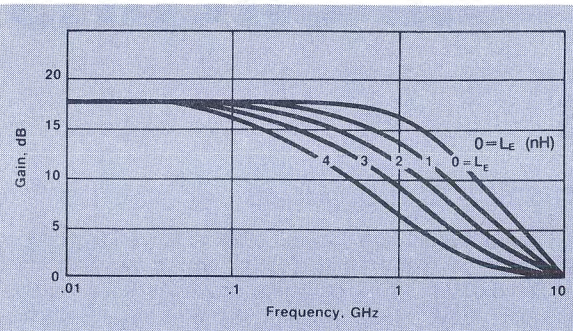


figure 3
Gain vs. frequency as a function of emitter inductance (L_E) for the MAR-1.

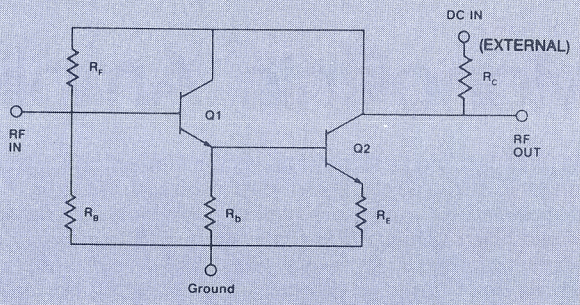


figure 4
General MAR AMP schematic.

for 75-ohm systems

When an ideal 50-ohm unit is used in a 75-ohm system, return loss will drop to 14 dB (VSWR 1.5:1) and mismatch loss will be 0.18 dB at each port. In practice, the return loss change may be higher due to finite isolation. Table 2 shows the gain and return loss of a MAR-3 amplifier in a 75-ohm test system. Gain is about the same as in the 50 ohm system. Input and output return loss (75 ohm) is better than 9 dB over most of the range. At high frequencies there is some improvement in input return loss probably due to the tuning effect of parasitics.

table 2 75-ohm Gain and Return Loss

Frequency (MHz)	Pin (dBm)	Gain (dB)	RL#IN (dB)	RL#OUT (dB)
.30	−32.99	11.72	− 9.78	−11.61
1.	−33.15	11.62	− 9.72	−11.62
12.	−33.54	11.64	− 9.86	−11.69
102.	−33.88	11.57	− 9.75	−11.67
254.	−34.18	11.45	−10.18	−11.63
495.	−34.59	11.29	−11.06	−11.23
1009.	−35.25	10.85	−16.01	−10.38
1507.	−35.50	9.94	−21.23	− 9.99
2200.	−36.17	8.32	−13.50	− 8.72

proper biasing calculations

In order to deliver full performance, MAR-amplifiers must be biased correctly. The internal resistive networks determine individual transistor operating points; all the user needs to do is present the proper voltage at the DC input terminal. For the purpose of bias stability over temperature, the internal transistors should have their bias supplied through a collector resistor (labeled R_C in Fig. 4). This resistor compensates for increases in device β (beta) with temperature by dropping the transistor's collector voltages whenever they try to draw more collector current. Coupled with this effect is the fact that the collector resistor will itself be changing in value over temperature.

Resistors with positive temperature coefficients such as the common carbon composite (+.0001% per degree C°) do an excellent job of compensating for the temperature drift of the negative coefficient on-chip resistors.

For bias stabilization over a temperature range of −10° to +100°C, a drop of at least 1.5 volts across the collector resistor is necessary. The larger this voltage drop, the more stable the bias will be.

For a fixed bias (constant quiescent current vs. temperature), gain will decrease as temperature increases. A voltage drop of about 2V across the collector resistor allows the bias swing over temperature to compensate for this gain change, yielding best gain flatness over temperature. The effect of bias stabilization resistor R_C on performance over a temperature range is shown in Table 3. Notice that the amplifier may self-destruct at high temperatures if no bias resistor is used.

table 3 Effects of R_C on performance over temperature.

MAR-1 Operating Voltage = 5.07 V

Voltage Drop, volts	Resistor Value, ohms	Temperature degrees C	Bias Current, mA	Power Gain @100 MHz, dB
0	0	−10	9.5	−0.5
		25	18.4	18.8
		100	**	**
1.5	82	−10	14.2	17.0
		25	17.3	18.3
		100	24.1	19.0
2.0	100	−10	16.3	18.5
		25	18.9	18.9
		100	24.6	19.0
7.0	412	−10	16.1	18.3
		25	18.8	18.1
		100	18.3	17.5

** Device destroyed due to excessive current draw.

the value of the bias stabilization resistor R_C is given by:

$$R_C = \frac{V_{cc} - V_d}{I_d} \text{ ohms}$$

where

V_{cc} = the power supply voltage applied to R_C (in volts)

V_d = the voltage at the DC input terminal of the MMIC (in volts)

I_d = the quiescent bias current drawn by the MMIC (in amps)

The dissipation of this resistor is given by:

$$P_{diss} = I_d^2 \times R_C \text{ watts}$$

Table 4 shows the recommended bias resistor values for MAR amplifiers.

table 4 bias resistor values for MAR amplifiers

Amplifier	Bias Current	Bias Voltage	Approximate Bias Resistor (Ohms)				Resistor Dissipation (Watts)
	I_B (mA)	$+V_O$	+5V	+9V	+12V	+15V	$+V_{CC}$=12V
MAR-1	17	~5	—	235	412	588	.12
MAR-2	25	~5	—	160	280	400	.18
MAR-3	35	~5	—	114	200	286	.25
MAR-4	50	~6	—	60	120	180	.30
MAR-6	16	~3.5	98	344	531	719	.14
MAR-7	22	~4	45	227	364	500	.18
MAR-8	36	~8	—	—	111	194	.14

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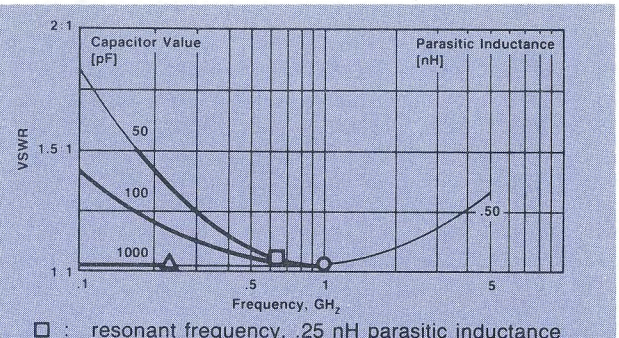
DC blocking capacitors are used in both the RF input and output lines to isolate the resistive bias circuits from the source and load resistances. These capacitors will also put limits on the frequency response of the finished amplifier. Low frequency response will be determined by the capacitor's value; it must be high enough to be a reasonable RF "short" at the lowest frequency of operation. High frequency response will be limited to the frequency at which the capacitor's associated parasitic inductance becomes resonant with the blocking capacitor. Operation above the frequency may lead to highly unpredictable circuit behavior. Blocking capacitors with high Qs (Q defined as ratio of capacitive reactance to parasitic resistance) should always be used to minimize insertion losses. Fig. 5 illustrates the variations in VSWR as a function of frequency and value of blocking capacitor.

An RF choke (Dale IM-2 or equivalent) should be used in series with the bias stabilization resistor. Although the choke is not generally needed to keep the RF out of the DC, it is needed to keep the stabilization resistor from appearing in parallel with the load circuit, and thus degrading the output match. A good rule-of-thumb is that the impedance of the choke at the lowest frequency of operation plus the value of the stabilization resistor should be at least 500 ohms. A 10 uH inductor works well as a choke at frequencies as low as 10 MHz; it can be either a molded inductor (for low-cost applications) or a chip inductor (in cases where space is at a premium). At higher frequencies, several turns of wire on a high permeability ferrite bead should be used. If the choke is omitted, expect a gain loss of between 0.5 and 1 dB and a decrease in $P_{1\ dB}$ of as much as 2 dB from the guaranteed performance due to load impedance mismatch.

A large value bypass capacitor (1 uF or so) should be used in conjunction with the choke to present a low impedance path to ground for any signal that does manage to get past the choke. This capacitor should be attached between the supply side of the RF choke and ground.



□ : resonant frequency, .25 nH parasitic inductance
○ : resonant frequency, 0.5 nH parasitic inductance
△ : resonant frequency, 1.0 nH parasitic inductance

figure 5

Effects of DC blocking capacitors on VSWR as a function of frequency, capacitance and parasitic inductance.

S-parameter data

Freq.	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)			K
MHz	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang	
100	−15.92	0.61	−21	33.0	162	−40.00	0.01	38	−4.73	0.58	−24	0.79
500	−8.18	0.39	−77	27.8	109	−27.96	0.04	52	−9.37	0.34	−96	0.75
1000	−11.37	0.27	−113	23.0	80	−24.44	0.06	51	−13.56	0.21	−147	0.89
1500	−11.70	0.26	−139	19.4	62	−21.94	0.08	46	−14.89	0.18	174	0.96
2000	−10.46	0.30	−155	16.9	47	−20.00	0.10	41	−15.39	0.17	153	0.97
2500	−9.63	0.33	−180	14.8	32	−18.42	0.12	32	−14.42	0.19	127	1.01
3000	−8.87	0.36	167	12.9	20	−17.72	0.13	27	−17.08	0.14	111	1.07
3500	−7.54	0.42	153	11.4	6	−17.08	0.14	21	−17.72	0.13	107	1.06
4000	−6.94	0.45	141	9.8	−5	−16.48	0.15	14	−19.17	0.11	106	1.10

single and three-stage layouts

A typical MAR-layout is shown in Fig. 6 using 1/32″ PTFE woven-glass board—a reasonable compromise between cost durability, and electrical performance. Note that the transmission lines have no bends and are tapered near the package to minimize step discontinuities. Twelve plated through holes, including two under the emitter leads, provide solid ground planes and minimal emitter parasitics for best high frequency performance. The gaps in the transmission line are appropriate for 50 mil ceramic chip capacitors, which have relatively low associated parasitic inductances—typically about 0.5 nH. Mini-Circuits offers a wide variety of values. The DC pad arrangement requires that a bias stabilization resistor be used, but makes the use of an RF choke optional. If the choke is not used, the stabilization resistor would be connected between the output 50-ohm line and the V_{CC} supply line, and the bypass capacitor would be attached between the V_{CC} line and ground. Spacing is appropriate for 1/4 watt carbon resistors, molded inductors, and 1 uF electrolytic capacitors. The layout has been designed so that Fig. 6 can be repeated for multiple cascaded stages. Overall circuit dimensions are 1″ × 1.5″ for a single stage, with each additional stage adding one inch to the overall length. A three-stage cascaded design using chip resistors and inductors (R and L in diagram) is shown in Fig. 7.

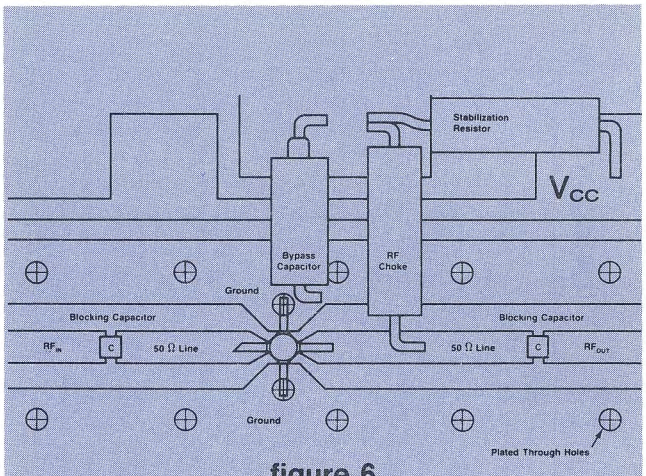


figure 6

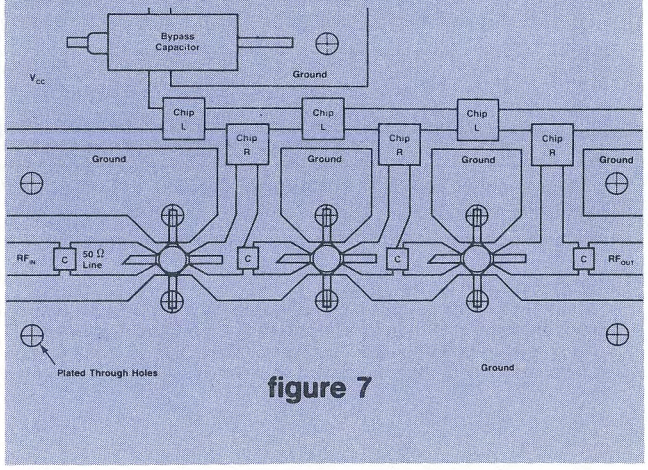


figure 7

Amplifier Selection Guide

GROUP		MODEL NO.	FREQ. (MHz) f_L	FREQ. (MHz) f_U	GAIN (dB) MIN.	MAX(1) POWER (dBm)	N.F. (dB) TYP.	3rd ORDER I.P. (dBm)	VSWR IN	VSWR OUT	DC POWER V VOLT	DC POWER I (mA)	CASE STYLE	STD CONN.	OPTION
MONOLITHIC		MAR-1	DC	1000	13.0	0	5.0	+15	1.5:1	1.5:1	+5.00	17	VV105		SMT▲
		MAR-2	DC	2000	8.5	+3	6.5	+18	1.3:1	1.6:1	+5.00	25	VV105		SMT▲
	●	MAR-3	DC	2000	8.0	+8	6.0	+23	1.6:1	1.6:1	+5.00	35	VV105		SMT▲
		MAR-4	DC	1000	7.0	+11	7.0	+27	1.9:1	2.0:1	+5.00	50	VV105		SMT▲
	●	MAR-6	DC	2000	9.0	0	2.8	+15	2.0:1	1.8:1	+3.50	16	VV105		SMT▲
	PIN ●	MAR-7	DC	2000	8.5	+4	5.0	+20	2.0:1	1.5:1	+4.00	22	VV105		SMT▲
		MAR-8	DC	1000	19.0	+10	3.5	+27	3.1:1	3.1:1	+7.50	36	VV105		SMT▲
		MAV-1	DC	1000	12.5	+1	5.0	+17	1.4:1	1.4:1	+5.00	17	BBB123		
		MAV-2	DC	1500	7.5	+4	7.0	+18	1.6:1	1.6:1	+5.00	25	BBB123		
		MAV-3	DC	1500	7.5	+8	6.0	+23	1.6:1	1.6:1	+5.00	35	BBB123		
		MAV-4	DC	1000	7.0	+11	7.0	+28	1.8:1	1.8:1	+5.25	50	BBB123		
		MAV-11	10	1000	9.0	+16	3.8	+30	2.5:1	2.2:1	+5.60	60	BBB123		
VAR. GAIN	CON	ZFL-1000G	10	1000	17.0	+3	12.0	+13	2.0:1	2.0:1	+15.00	100	Y39	SMA	—
		ZFL-1000GH	10	1200	24.0	+13	15.0	+25	2.2:1	2.0:1	+15.00	170	Y39	SMA	—
LOW NOISE (N.F. <4.0 dB)	PIN	MAN-1LN	0.5	500	28.0	+8	2.8	+18	1.8:1	1.8:1	+12.00	60	A05		
		AMP-76	5	500	26.0	+13.5	3.1	+28	2.0:1	2.0:1	+15.00	68	PP120		
		AMP-77	5	500	15.0	+16	3.3	+32	2.0:1	2.0:1	+15.00	56	PP120		
		AMP-75	5	500	19.0	+12	2.4	+28	2.0:1	2.0:1	+15.00	29	PP120		
		AMP-15	5	1000	13.0	+8	2.8	+22	2.0:1	2.0:1	+15.00	29	PP120		
		AMP-11-2	5	1000	14.0	−3.5	3.0	+13	2.0:1	2.0:1	+15.00	12	PP120		
		MAN-1HLN	10	500	10.0	+15	3.7	+30	1.8:1	1.8:1	+12.00	70	A06		
		TO-0812LN	800	1200	20.0	+8	1.6	+18	2.5:1	2.5:1	+15.00	70	QQ96		
		TO-1217LN	1200	1700	20.0	+10	1.6	+25	2.5:1	2.5:1	+15.00	70	QQ96		
		TO-1724LN	1700	2400	20.0	+10	1.6	+22	2.5:1	2.5:1	+15.00	70	QQ96		
	CON	ZFL-500LN	0.1	500	24.0	+5	2.9	+14	1.5:1	1.6:1	+15.00	60	Y39	SMA	BNC
		ZFL-1000LN	0.1	1000	20.0	+3	2.9	+14	1.5:1	2.0:1	+15.00	60	Y39	SMA	—
		ZFL-500HLN	10	500	19.0	+16	3.8	+30	1.5:1	1.5:1	+15.00	110	Y39	SMA	—
		ZEL-0812LN	800	1200	20.0	+8	1.5	+18	2.5:1	2.5:1	+15.00	70	EEE132	SMA	—
		ZHL-0812HLN	800	1200	30.0	+26	1.5	+36	2.4:1	2.4:1	+15.00	725	NN92	SMA	
		ZEL-1217LN	1200	1700	20.0	+10	1.5	+25	2.5:1	2.5:1	+15.00	70	EEE132	SMA	—
		ZHL-1217HLN	1200	1700	30.0	+26	1.5	+36	2.4:1	2.4:1	+15.00	725	NN92	SMA	
		ZEL-1724LN	1700	2400	20.0	+10	1.5	+22	2.5:1	2.5:1	+15.00	70	EEE132	SMA	—
		ZHL-1724HLN	1700	2400	30.0	+26	1.5	+36	2.4:1	2.4:1	+15.00	725	NN92	SMA	
HIGH ISOLATION	PIN	MAN-2AD	2	1000	9.0	−2	6.5	+14	2.0:1	2.0:1	+15.00	22	A05		
		MAN-11AD	2	2000	8.0	−3.5	6.5	+14	3.0:1	2.0:1	+15.00	22	A05		
		MAN-1AD	5	500	16.0	+7	7.2	+20	1.6:1	1.7:1	+12.00	85	A05		
	CON	ZFL-2AD	2	1000	10.0	−2	6.5	+14	2.0:1	2.0:1	+15.00	22	Y39	SMA	—
		ZFL-11AD	2	2000	8.0	−3.5	6.5	+14	2.5:1	2.0:1	+15.00	22	Y39	SMA	—
		ZFL-1HAD	10	500	10.0	+20	7.5	+30	1.3:1	1.35:1	+15.00	115	SS98	SMA	—
		ZHL-1HLD	225	400	23.0	+27	2.5	+40	2.0:1	2.0:1	+24.00	525	T34	SMA	—

(1) Minimum output power at 1 dB gain compression

▲ SMT Surface Mount

329 REV B

●Alternate package style SOT 123, see VAM series on page 3-15

Using theSelection Guide

Locate the Mini-Circuits' amplifier best suited for your particular application quickly with this convenient Selection Guide. Amplifiers are grouped into eight major categories and then listed in the sequence of frequency span.

If your amplifier requirements are not met by the catalog models listed, we encourage you to contact our Application Engineering Department. You will find them courteous and eager to support your needs with their depth of knowledge coupled with our extensive database on engineering and catalog models.

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Mini-Circuits

GROUP		MODEL NO.	FREQ. (MHz) f_L f_U	GAIN (dB) MIN.	MAX(1) POWER (dBm)	N.F. (dB) TYP.	3rd ORDER I.P. (dBm)	VSWR IN	VSWR OUT	DC POWER V VOLT	DC POWER I (mA)	CASE STYLE	STD CONN.	OPTION
LOW POWER	PIN	MAN-1	0.5-500	28.0	+8	4.5	+18	1.8:1	1.8:1	+12.00	60	A05		
		MAN-2	0.5-1000	18.0	+9	6.0	+19	1.8:1	1.8:1	+12.00	85	A05		
		AMP-74	5-500	27.0	+7	5.0	+20	2.0:1	2.0:1	+15.00	44	PP120		
		AMP-3G	30-3000	8.0	+9.5	3.5	+20	2.6:1	2.5:1	+15.00	55	PP120		
	CON	ZFL-500	0.05-500	20.0	+9	5.3	+18	1.9:1	1.9:1	+15.00	60	Y39	SMA	BNC
		ZFL-1000	0.1-1000	17.0	+9	6.0	+18	1.5:1	2.0:1	+15.00	105	Y39	SMA	—
		ZFL-750	0.2-750	18.0	+9	6.0	+18	1.5:1	2.0:1	+15.00	90	Y39	SMA	—
MEDIUM POWER		AMP-2000	10-2000	20.0	+16	5.0	+25	2.0:1	2.0:1	+15.00	100	QQ96		
	CON	ZHL-6A	.0025-500	21.0	+23	7.5	+34	1.8:1	2.0:1	+24.00	350	S32	BNC	—
		ZFL-1000H	10-1000	28.0	+20	5.0	+33	2.0:1	2.0:1	+15.00	150	SS98	SMA	—
		ZFL-1000VH	10-1000	20.0	+26	4.5	+38	1.8:1	2.0:1	+15.00	320	SS98	SMA	—
		ZFL-2000	10-2000	20.0	+16	7.0	+25	2.0:1	2.0:1	+15.00	100	SS98	SMA	—
		ZHL-1042J	10-4200	25.0	+20	4.5	+30	2.5:1	2.5:1	+15.00	300	NN92	SMA	—
HIGH POWER (UP TO 10W)	CON	ZHL-32A	.05-130	25.0	+29	10.0	+38	2.0:1	2.0:1	+24.00	600	S32	BNC	SMA, N
		ZHL-3A	.4-150	24.0	+29.5	11.0	+38	2.0:1	2.0:1	+24.00	600	S32	BNC	SMA, N
		ZHL-5W-1	1-500	40.0	+37	8.0	+49	2.0:1	2.5:1	+24.00	3300	DDD131	SMA	—
		ZHL-1A	2-500	16.0	+28	11.0	+38	2.0:1	2.0:1	+24.00	600	S32	BNC	SMA, N
		ZHL-1-2W	5-500	29.0	+33	12.0	+44	2.0:1	2.0:1	+24.00	900	T35	BNC	SMA, N
		ZHL-2	10-1000	16.0	+29	9.0	+38	2.0:1	2.0:1	+24.00	600	T34	BNC	SMA, N
		ZHL-2-8	10-1000	27.0	+29	10.0	+38	2.0:1	2.0:1	+24.00	600	T34	BNC	SMA, N
		ZHL-2-12	10-1200	24.0	+29	10.0	+38	2.0:1	2.0:1	+24.00	750	T34	SMA	—
		ZHL-42W	10-4200	30.0	+28	8.0	+38	2.5:1	2.5:1	+15.00	750	U36	SMA	—
		ZHL-4240W	10-4200	40.0	+28	8.0	+38	2.5:1	2.5:1	+15.00	850	U36	SMA	—
		ZHL-900-10W	480-900	19.0	+38	10.0	+50	2.0:1	2.0:1	+24.00	5500	DDD131	SMA	—
		ZHL-1000-3W	500-1000	38.0	+35	9.0	+45	2.0:1	2.5:1	+24.00	2000	DDD131	SMA	—
		ZHL-7-2W	600-800	28.0	+33	12.0	+43	2.0:1	2.0:1	+24.00	900	T35	BNC	SMA, N
		ZHL-42	700-4200	30.0	+28	10.0	+38	2.5:1	2.5:1	+15.00	800	U36	SMA	—
		ZHL-4240	700-4200	40.0	+28	4.0	+38	2.5:1	2.5:1	+15.00	700	U36	SMA	—
LOW DISTORTION FEED FORWARD	CON	ZHL-1-5093	50-500	22.0	+30	7.0	+50	1.5:1	1.5:1	+24.00	1300	U200	SMA	—
		ZHL-2-5093	50-1000	21.0	+25	8.0	+43	2.0:1	2.0:1	+24.00	650	U200	SMA	—

329 REV B

Environmental Specifications

MODEL	OPERATING TEMP.	STORAGE TEMP.	STABILIZATION BAKE (NON-OPER.) 125°C 24 hr.	TEMPERATURE CYCLING (NON-OPER.) −55°C TO +100°C	CONSTANT ACCELERATION (Y_1 PLANE ONLY)	BURN-IN (DC. ON) 85°C 160 hr.	SEAL TEST FINE	SEAL TEST GROSS
AMP	−54°C→ 85°C	−55°C→100°C	✔	✔	✔	✔	✔	✔
MAN	−54°C→ 85°C	−55°C→100°C	✔	✔	✔	✔	✔	✔
MAR	−20°C→ 85°C	−55°C→100°C	✔	✔	✔	✔	N.A.	N.A.
MAV/VAM	−20°C→ 85°C	−55°C→100°C	✔	✔	✔	✔	N.A.	N.A.
TO	−54°C→ 85°C	−55°C→100°C	✔	✔	✔	✔	✔	✔
ZEL	−54°C→ 85°C	−55°C→100°C	✔	✔	N.A.	✔	N.A.	N.A.
ZFL	−20°C→ 71°C	−55°C→100°C	✔	✔	N.A.	✔	N.A.	N.A.
ZFL-2000	−55°C→100°C	−55°C→100°C	✔	✔	N.A.	✔	N.A.	N.A.
ZHL	−20°C→ 65°C	−55°C→100°C	✔	✔	N.A.	✔	N.A.	N.A.
ZHL-HLN	−54°C→ 65°C	−55°C→100°C	✔	✔	N.A.	✔	N.A.	N.A.
RAM	−54°C→125°C	−65°C→+150°C	✔	✔	✔	✔	✔	✔

NOTES: Units are designed and manufactured to meet the environmental specifications as indicated.

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

broadband plug-in and surface mount
Monolithic Amplifiers

50 ohms

up to 56 mW (+17.5 dBm) output
dc to 2 GHz

case style selection

outline drawings Table of Contents



RAM



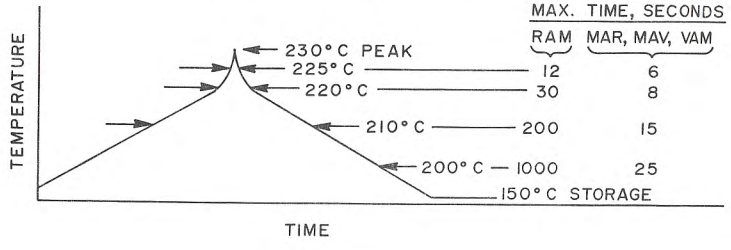
MAR



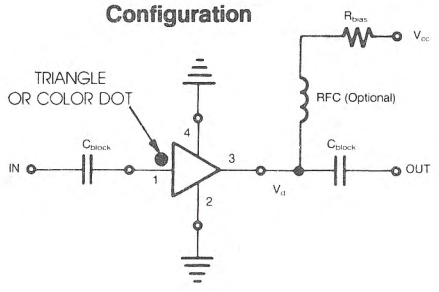
MAR–SM

	MODEL NO.	•FREQ. MHz		GAIN, dB Typical (at MHz)					MAXIMUM POWER, dBm		DYNAMIC RANGE		VSWR		MAXIMUM RATING		DC POWER at Pin 3		PRICE $ ▼	DISTRIBUTOR	
								(Note 4)	Output (1dB Comp.)	Input no damage	NF dB	IP3 dBm			(25°C)		Current	Volt.		FACTORY	LOCAL
		f_L	f_U	100	500	1000	2000	MIN			Typ.	Typ.	In	Out	I(mA)	P(mW)	(mA)	Typ.	Qty. (25)		
□ MAR case VV105	MAR-1	DC	1000	18.5	17.5	15.5	—	13.0	+ 1.5	+20	5.5	+14.0	1.3:1	1.3:1	40	200	17	5.0	0.99	●	●
	MAR-2	DC	2000	12.5	12.3	12.0	11.0	8.5	+ 4.5	+20	6.5	+17.0	1.3:1	1.4:1	60	325	25	5.0	1.35	●	●
	MAR-3	DC	2000	12.5	12.2	12.0	10.5	8.0	+10.0	+20	6.0	+23.0	1.5:1	1.7:1	70	400	35	5.0	1.45	●	●
	MAR-4	DC	1000	8.3	8.2	8.0	—	7.0	+12.5	+20	6.5	+25.5	1.6:1	2.0:1	85	500	50	5.25	1.55	●	●
	MAR-6	DC	2000	20.0	18.5	16.0	11.0	9.0	+ 2.0	+20	3.0	+14.5	1.5:1	1.4:1	50	200	16	3.5	1.29	●	●
	MAR-7	DC	2000	13.5	13.1	12.5	11.0	8.5	+ 5.5	+20	5.0	+19.0	1.4:1	1.5:1	60	275	22	4.0	1.75	●	●
	MAR-8	DC	1000	32.5	28.0	22.5	—	19.0	+12.5	+20	3.3	+27.0	#	#	65	500	36	7.8	1.70	●	●
○□ MAR-SM case WW107	MAR-1SM	DC	1000	18.5	17.5	15.5	—	13.0	+ 1.5	+20	5.5	+14.0	1.3:1	1.2:1	40	200	17	5.0	1.04	●	●
	MAR-2SM	DC	2000	12.5	12.3	12.0	11.0	8.5	+ 4.5	+20	6.5	+17.0	1.5:1	1.4:1	60	325	25	5.0	1.40	●	●
	MAR-3SM	DC	2000	12.5	12.2	12.0	10.5	8.0	+10.0	+20	6.0	+23.0	1.5:1	1.7:1	70	400	35	5.0	1.50	●	●
	MAR-4SM	DC	1000	8.3	8.2	8.0	—	7.0	+12.5	+20	7.0	+25.5	1.5:1	1.9:1	85	500	50	5.25	1.60	●	●
	MAR-6SM	DC	2000	20.0	18.5	16.0	11.0	9.0	+ 2.0	+20	3.0	+14.5	1.7:1	1.7:1	50	200	16	3.5	1.34	●	●
	MAR-7SM	DC	2000	13.5	13.1	12.5	11.0	8.5	+ 5.5	+20	5.0	+19.0	1.7:1	1.7:1	60	275	22	4.0	1.80	●	●
	MAR-8SM	DC	1000	32.5	28.0	22.5	—	19.0	+12.5	+20	3.3	+27.0	#	#	65	500	36	7.8	1.75	●	●
○ RAM case AF190	RAM-1	DC	1000	19.0	17.5	15.5	—	13.0	+ 1.5	+20	5.5	+14.0	1.3:1	1.3:1	40	200	17	5.0	4.95	●	●
	RAM-2	DC	2000	12.5	12.0	11.8	11.0	8.5	+ 4.5	+20	6.5	+17.0	1.2:1	1.4:1	60	325	25	5.0	4.95	●	●
	RAM-3	DC	2000	12.5	12.2	12.0	10.5	8.0	+10.0	+20	6.0	+23.0	1.6:1	1.7:1	80	425	35	5.0	4.95	●	●
	RAM-4	DC	1000	8.5	8.2	8.0	—	7.0	+12.5	+20	6.5	+25.5	1.4:1	1.9:1	100	540	50	5.25	4.95	●	●
	RAM-6	DC	2000	20.0	19.0	16.0	11.0	9.0	+ 2.0	+20	2.8	+14.5	1.4:1	1.3:1	50	200	16	3.5	4.95	●	●
	RAM-7	DC	2000	13.5	13.1	12.5	11.0	8.5	+ 5.5	+20	4.5	+19.0	2.0:1	1.8:1	60	275	22	4.0	4.95	●	●
	RAM-8	DC	1000	32.5	28.0	23.0	—	19.0	+12.5	+20	3.0	+27.0	#	#	65	420	36	7.8	4.95	●	●

REFLOW - SOLDERING PROFILE



Typical Biasing Configuration



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MAV



VAM



VAM Actual size

	MODEL NO.	•FREQ. MHz f_L	f_U	GAIN, dB Typical (at MHz) 100	500	1000	2000	(note 4) MIN.	MAXIMUM POWER, dBm Output (1 dB Comp.)	Input (no damage)	DYNAMIC RANGE NF dB Typ.	IP3 dBm Typ.	VSWR In	Out	MAXIMUM RATING (25°C) I (mA)	P (mW)	DC POWER at Pin 3 Current (mA)	Volt. Typ.	PRICE $ Qty. (25)	DISTRIBUTOR FACTORY	LOCAL
□MAV	MAV-1	DC-	1000	18.5	17.0	15.0	—	12.5	+ 1.5	+20	5.5	+14.0	1.4:1	1.3:1	40	200	17	5.0	1.10	●	●
case BBB-123	MAV-2	DC-	1500	12.5	12.0	11.0	10.0	7.5	+ 4.5	+20	6.5	+17.0	1.3:1	1.4:1	60	325	25	5.0	1.40	●	●
	MAV-3	DC-	1500	12.5	12.0	11.0	10.0	7.5	+10.0	+20	6.0	+23.0	1.3:1	1.6:1	70	400	35	5.0	1.50	●	●
	MAV-4	DC-	1000	8.3	8.0	7.5	—	7.0	+11.5	+20	7.0	+24.5	1.4:1	1.8:1	85	500	50	5.25	1.60	●	●
	MAV-11	DC-	1000	12.7	12.0	10.5	—	9.0	+17.5	+20	3.6	+30.0	1.5:1	1.7:1	80	550	60	5.5	2.10	●	●
○□VAM	VAM-3	DC-	2000	11.5	11.5	11.0	9.5	7.5	+ 9.0	+20	6.0	+22.0	1.5:1	1.7:1	60	240	35	4.7	1.45	●	●
case MMM-168	VAM-6	DC-	2000	19.5	18.0	15.0	10.0	8.0	+ 2.0	+20	3.0	+14.0	1.6:1	1.5:1	40	125	16	3.3	1.29	●	●
	VAM-7	DC-	2000	13.0	12.6	12.0	9.8	7.8	+ 5.5	+20	5.0	+18.0	1.5:1	1.5:1	50	175	22	3.8	1.75	●	●

NOTES:

□ NON-HERMETIC

○ Available on tape & reel. See Table of Contents, Section 0 for more information

▼ Prices of MAR-1 and MAR-1SM are for 100 quantity, price of RAM models is for 1-9 quantity.

Dash-8 models input and output impedances are not 50 ohms, see S-parameter data. Conditionally stable, source and load VSWR <3:1 required.

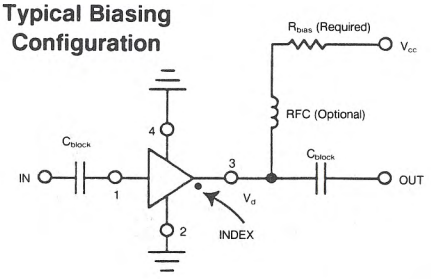
* Low-frequency cutoff determined by external coupling capacitors.

1. Specification in 50 ohms system.
2. Absolute Maximum Ratings: see Section 3 environmental table.
3. Prices and specifications subject to change without notice.
4. Minimum gain at highest frequency and over full temperature range.
5. Model number designated by color dot or alphanumeric code marking.
6. Frequency at which output power, NF and IP3 are specified:
   500 MHz for MAR-1, MAR-6, MAR-1SM, MAR-6SM, RAM-1, RAM-6, MAV-1, MAV-11, VAM-6.
   1000 MHz for the other models.
7. MAV-1SM thru MAV-11SM available tape and reel. See RRR 137 outline drawing.

features

- cascadable
- excellent repeatability
- wide bandwidth DC-2000 MHz
- unconditionally stable, except MAR-8, MAR-8SM, RAM-8
- low cost, MAR, MAV, VAM models
- hermetically sealed, RAM models
- low noise figure, 2.8 to 3.6 dB typ. MAR-6, MAR-8, MAV-11, RAM-6, RAM-8, VAM-6
- high output power, +17 dBm typ., MAV-11

Typical Biasing Configuration



marking identification

Model	Alphanumeric Code	Color Dot
MAR-1/SM	A01	Brown
MAR-2/SM	A02	Red
MAR-3/SM	A03	Orange
MAR-4/SM	A04	Yellow
MAR-6/SM	A06	White
MAR-7/SM	A07	Violet
MAR-8/SM	A08	Blue
RAM-1	1	—
RAM-2	2	—
RAM-3	3	—
RAM-4	4	—
RAM-6	6	—
RAM-7	7	—
RAM-8	8	—
MAV-1/SM	1	—
MAV-2/SM	2	—
MAV-3/SM	3	—
MAV-4/SM	4	—
MAV-11/SM	A	—
VAM-3	A03	—
VAM-6	A06	—
VAM-7	A07	—

broadband, linear

Low-Noise Amplifiers

up to 40mW (+16dBm) output
0.1 to 1000 MHz

case style selection

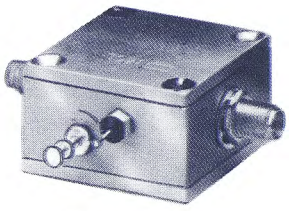
outline drawings see Table of Contents



AMP



MAN



ZFL

	MODEL NO.	FREQUENCY MHz		GAIN, dB			MAX. POWER, dBm		DYNAMIC RANGE		VSWR		DC POWER		PRICE $	DISTRIBUTOR	
					Flatness Max.											FACTORY	LOCAL
		f_L	f_U	Min.	m	Total Range	(Output 1 dB Comp.)	(Input no damage)	NF dB Typ.	IP3 dBm Typ.	In	Out	Volt. V.	Current mA	Qty. (1-9)		
AMP	AMP-11-2	5-1000		14	±1.0	±1.0	−3.5	+13	3.0	+13	2:1	2:1	15	12	44.95	●	
case PP120	AMP-15	5-1000		13	±0.6	±1.2	+8.0	+13	2.8	+22	2:1	2:1	15	29	40.95	●	
	AMP-75	5-500		19	±0.4	±1.0	+12.0	+13	2.4	+28	2:1	2:1	15	29	43.95	●	
	AMP-76	5-500		26	±0.7	±1.0	+13.5	+6	3.1	+28	2:1	2:1	15	68	78.95	●	
	AMP-77	5-500		15	±0.4	±1.0	+16.0	+13	3.3	+32	2:1	2:1	15	56	45.95	●	
MAN	MAN-1LN	0.5-500		28	±0.5	±1.0	+8	+15	2.8	+18	1.8:1	1.8:1	12	60	19.95	●	●
case A05	MAN-1HLN●	10-500		10	±0.5	±0.8	+15	+15	3.7	+30	1.8:1	1.8:1	12	70	19.95	●	●
ZFL	ZFL-500HLN	10-500		19	—	±0.4	+16	+15	3.8	+30	1.5:1	1.5:1	15	110	99.95	●	
	** ZFL-500LN	0.1-500		24	—	±0.3	+5	+5	2.9	+14	1.5:1	1.6:1	15	60	79.95	●	
case Y39	ZFL-1000LN	0.1-1000		20	—	±0.5	+3	+5	2.9	+14	1.5:1	2:1	15	60	89.95	●	

L_W = Low Range (f_L to $f_{U/2}$) m = mid Range (2 f_L to $f_{U/2}$) U = Upper Range ($f_{U/2}$ to f_U)

features

- ideal for printed-circuit designs (MAN & AMP series)
- smooth response over entire band, no external resonances
- low impedance, less susceptible to EMI
- easy to use, 50 ohm input/output
- all models are cascadable

PIN CONFIGURATION

SERIES	MAN	AMP
RF IN	1	2
RF OUT	8	4
DC	5	1
CASE GND	2,3,4,6	3
NOT USED	7	—

NOTES:

** VSWR 1.6 maximum from 01. to 0.2 MHz.
Also available with BNC connectors. $5.00 additional

● case A06

1. For quality control procedures, environmental specifications, see Table of Contents.
2. Absolute Maximum Ratings, see Environmental Specifications page 3-13.
3. Prices and specifications subject to change without notice.
4. Maximum Operating Temperature for AMP series: −54°C-+85°C.
5. Maximum DC Voltage: 17V for AMP series, 12.5V for MAN series.

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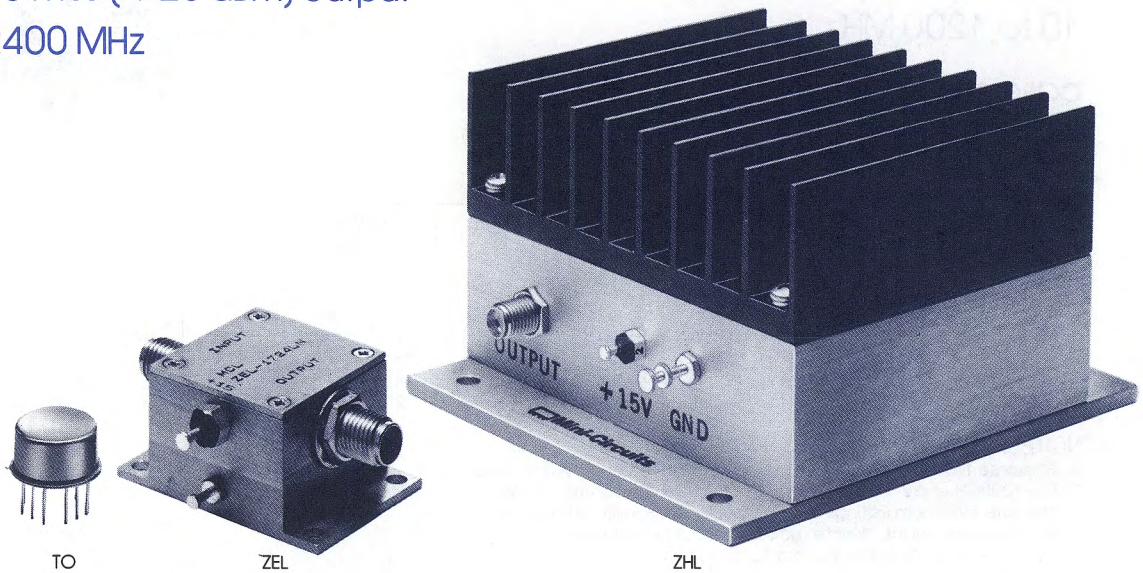
Mini-Circuits

up to 400 mW (+26 dBm) output
800 to 2400 MHz



TO ZEL ZHL

	MODEL NO.	FREQ. MHz f_L f_U	NF, dB Max.	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output 1 dB Comp.	MAXIMUM POWER, dBm Input no damage	INTERCEPT PT., dBm IP3 Typ.	VSWR In	VSWR Out	DC POWER Volt. V	DC POWER Current mA	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
TO case QQ 96	TO-0812LN	800-1200	1.6	20	±1.0	+ 8	+13	+18	2.5:1	2.5:1	15	70	199.00	•	
	TO-1217LN	1200-1700	1.6	20	±1.0	+10	+13	+25	2.5:1	2.5:1	15	70	199.00	•	
	TO-1724LN	1700-2400	1.6	20	±1.0	+10	+13	+22	2.5:1	2.5:1	15	70	199.00	•	
ZEL case EEE 132	ZEL-0812LN	800-1200	1.5	20	±1.0	+ 8	+13	+18	2.5:1	2.5:1	15	70	274.95	•	
	ZEL-1217LN	1200-1700	1.5	20	±1.0	+10	+13	+25	2.5:1	2.5:1	15	70	274.95	•	
	ZEL-1724LN	1700-2400	1.5	20	±1.0	+10	+13	+22	2.5:1	2.5:1	15	70	274.95	•	
ZHL case NN 92	ZHL-0812HLN	800-1200	1.5	30	±1.0	+26	+10	+36	2.4:1	2.4:1	15	725	349.95	•	
	ZHL-1217HLN	1200-1700	1.5	30	±1.0	+26	+10	+36	2.4:1	2.4:1	15	725	349.95	•	
	ZHL-1724HLN	1700-2400	1.5	30	±1.0	+26	+10	+36	2.4:1	2.4:1	15	725	349.95	•	

features

- very low noise
- high dynamic range (ZHL-HLN series)
- ideal for printed-circuit designs (TO series)
- smooth response over entire band, no external resonance
- easy to use, 50 ohms input/output
- all models are cascadable

PIN CONFIGURATION

SERIES	TO
RF IN	5
RF OUT	11
DC	2
CASE GND	1,3,4,6,7 8,9,10,12

NOTES:

ZEL & TO
NF Max. at room temperature, increases to 2 dB typ. at +85°C.

ZHL Units
NF Max. at room temperature, increases to 2.3 dB max. at +65°C.

1. With no load output, derate max. input power (no damage) by 10 dB.
2. SMA connectors only, ZEL, ZHL units.
3. Absolute Maximum Ratings, see Environmental Specification page 3-13.
4. Prices and specifications subject to change without notice.

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

broadband, linear

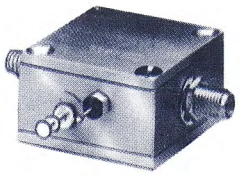
Amplifiers

Variable Gain

up to 20mW (+13 dBm) output
10 to 1200 MHz

case style selection

outline drawings see Table of Contents



ZFL

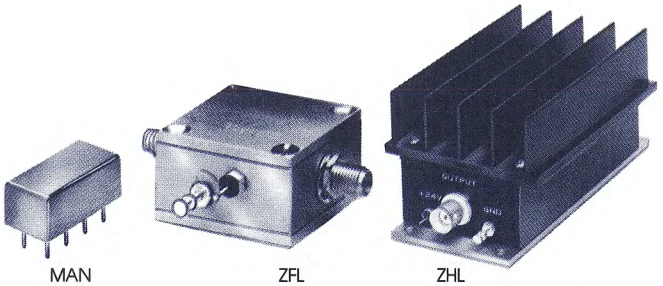
	MODEL NO.	FREQ. MHz		GAIN, dB			MAXIMUM POWER, dBm		DYNAMIC RANGE		VSWR		DC POWER		PRICE $	DISTRIBUTOR	
		f_L	f_U	Min.	Flatness Max.	Control range	Output 1 dB Comp.	Input no damage	NF dB Typ.	IP3 dBm Typ.	In	Out	Volt. V	Current mA	Qty. (1-9)	FACTORY	LOCAL
ZFL case Y39	* ZFL-1000GH	10-1200		24	±1.5	30≠	+13	+10	15	+25	2.2:1	2:1	15	170	219.00	•	
	* ZFL-1000G	10-1000		17	±1.5	30≠	+3	+10	12	+13	2:1	2:1	15	100	199.00	•	

NOTES:

≠ Response time (10 to 90%) 25 μsec., control voltage 0 volt to 5 volts.
* ZFL-1000GH and ZFL-1000G ALL SPECS at 0 volts control voltage.
1. Absolute Maximum Ratings see Environmental Specifications page 3-13.
2. With no load output, derate maximum input power (no damage) by 10 dB.
3. Prices and specifications subject to change without notice.

High Isolation

up to 500mW (+27 dBm) output
2 to 2000 MHz



MAN ZFL ZHL

	MODEL NO.	FREQUENCY MHz		GAIN, dB			MAX. POWER dBm		DYNAMIC RANGE		VSWR		ACTIVE DIRECTIVITY* dB				DC POWER		PRICE $
		f_L	f_U	Min.	Flatness Max. m	Total Range	Output 1 dB Comp. Lw	Output 1 dB Comp. U	Input no damage	NF dB Typ.	IP3 dBm Typ.	In	Out	Lw Typ.	Lw Min.	U Typ.	U Min.	Volt V.	Current mA	Qty. (1-9)
MAN-AD case A05	MAN-1AD	5-500		16	±0.5	±1.0	+7.0	+6.0	+15	7.2	+20	1.6:1	1.7:1	35	25	30	20	12	85	26.45
	MAN-11AD	2-2000		8	±0.5	±1.5	−2.0	−3.5	+10	6.5	+14	3.0:1	2.0:1	21	14	16	12	15	22	31.95
	MAN-2AD	2-1000		9	±0.4	±0.7	−2.0	−2.0	+10	6.5	+14	2.0:1	2.0:1	24	19	19	14	15	22	23.95
ZFL-AD case Y39	ZFL-11AD	2-2000		8	±0.5	±1.3	−2.0	−3.5	+10	6.5	+14	2.5:1	2.0:1	21	14	16	12	15	22	91.95
	ZFL-2AD	2-1000		10	±0.4	±0.5	−2.0	−2.0	+10	6.5	+14	2.0:1	2.0:1	24	19	19	14	15	22	83.95
case SS98	ZFL-1HAD**	10-500		10	—	±1.0	+20	+20	+17	7.5	+30	1.3:1	1.35:1	30	20	25	18	15	115	210.00
ZHL-HLD case T34	ZHL-1HLD***	225-400		23	—	±1.0	+27	+27	+10	2.5	+40	2.0:1	2.0:1	34	28	34	28	24	525	395.00

L_W = Low Range (f_L to $f_{u/2}$) m = mid Range ($2f_L$ to $f_{u/2}$) U = Upper Range ($f_{u/2}$ to f_u)

* Active Directivity (dB) = Isolation (dB) − Gain (dB)
** Input VSWR of ZFL-1HAD in 10-20 MHz band increases to 1.45 at −55°C
*** Model ZHL-1HLD is available in SMA connector only.

NOTES:

1. Absolute Maximum Ratings, see Environmental Specifications 3-13.
2. Prices and specifications subject to change without notice.
3. Maximum DC Voltage: 16V except for MAN-1AD (12.5V), ZHL-1HLD(28V), ZHL-1HAD(17V).

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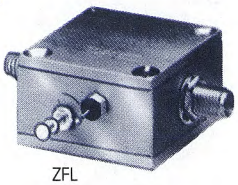
Low Power

up to 10mW (+10 dBm) output
50 KHz to 3000 MHz

case style selection

outline drawings see Table of Contents



ZFL



AMP



MAN

	MODEL NO.	FREQ. MHz f_L	FREQ. MHz f_U	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output 1 dB (comp) L_W	MAXIMUM POWER, dBm Output 1 dB (comp) U	MAXIMUM POWER, dBm Input no damage	DYNAMIC RANGE NF dB Typ.	DYNAMIC RANGE IP3 dBm Typ.	VSWR In	VSWR Out	DC POWER Volt. V	DC POWER Current mA	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZFL case Y39	ZFL-500▲	0.05	500	20	±1.0	—	+9	+5	5.3	+18	1.9:1	1.9:1	15	80	69.95	●	
	ZFL-750	0.2	750	18	±0.5	—	+9	+5	6.0	+18	1.5:1	2:1	15	90	74.95	●	
	■ ZFL-1000	0.1	1000	17	±0.6	—	+9	+5	6.0	+18	1.5:1	2:1	15	105	79.95	●	
AMP case PP120	AMP-3G	30	3000	8.0	±0.75	+9.5	+9.5	+13	3.5△	+20	2.6:1	2.5:1	15	55	89.95	●	
	AMP-74	5	500	27	±1.0	+7.0	+7.0	+13	5.0	+20	2:1	2:1	15	44	44.95	●	
MAN case A05	MAN-1	0.5	500	28	±1.0	+8	+8	+15	4.5	+18	1.8:1	1.8:1	12	60	15.95	●	●
	MAN-2	0.5	1000	18	±1.5	+9	+7	+15	6.0	+19	1.8:1	1.8:1	12	85	19.95	●	●

L_W = Low Range (f_L to $f_{U/2}$) m = mid Range (2 f_L to $f_{U/2}$) U = Upper Range ($f_{U/2}$ to f_U)

pin configuration

SERIES	MAN	AMP
RF IN	1	2
RF OUT	8	4
DC	5	1
CASE GND	2,3,4,6	3
NOT USED	7	—

NOTES:

▲ ZFL-500 available with BNC also, $5.00 additional.

■ ZFL-1000 output VSWR 2.8:1 maximum over 750-1000 MHz; 1 dB compression +7 dBm 500-1000 MHz

△ NF increases with decreasing frequency, 5 dB Typ. at 300 MHz and 10 dB Typ. at 30 MHz.

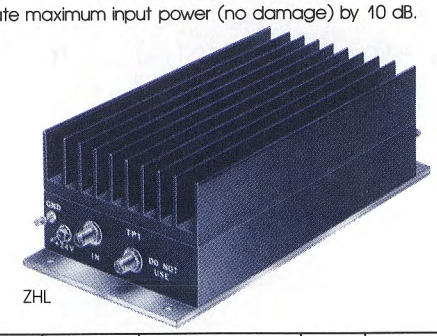
1. Absolute maximum ratings, see Environmental Specifications page 3-13.
2. Prices and specifications subject to change without notice.
3. Maximum DC Voltage: 17V for AMP series, 12.5V for MAN series, 28V for ZHL series.
4. With no load output, derate maximum input power (no damage) by 10 dB.

High Power

feed-forward, low-distortion

case style selection

outline drawings see Table of Contents



ZHL

	MODEL NO.	FREQ. MHz	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output 1 dB (comp)	MAXIMUM POWER, dBm Input no damage	DYNAMIC RANGE NF dB Typ.	DYNAMIC RANGE Intercept Point dBm, Min.* 2nd Order In-Band	DYNAMIC RANGE Intercept Point dBm, Min.* 3rd Order	VSWR In/Out	DC POWER Volt. V	DC POWER Current A	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZHL case U200	ZHL-1-50P3	50-500	22	±1.0	+27★	+15	7	+70	+50	1.5:1	24	1.3	695.00	●	
	ZHL-2-50P3	50-1000	21	±1.0	+25	+15	8	+63	+43	2.0:1	24	0.65	895.00	●	

•AT +15 dBm output, each fundamental tone, at room temperature

••+50 dBm typ., for out-of-band products

★30 dBm, 50-250 MHz

features

- high 3rd order I.P., typically 20 dB above 1 dB compression
- high 2nd order I.P., typically 40 dB above 1 dB compression
- high reverse isolation, 55 dB typical (ZHL-1-50P3), 45 dB typical (ZHL-2-50P3).

broadband, linear

Amplifiers

Medium Power

up to 400mW (+26 dBm) output
2.5 KHz to 4.2 GHz

case style selection

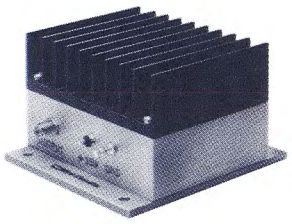
outline drawings see Table of Contents



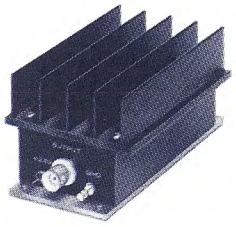
ZFL–case Y39



ZFL–case SS98



ZHL–1042J



ZHL–A



AMP

	MODEL NO.	FREQ. MHz		GAIN, dB		MAXIMUM POWER, dBm		DYNAMIC RANGE		VSWR		DC POWER		PRICE $	DISTRIBUTOR	
		f_L	f_U	Min.	Flatness Max.	Output 1 dB Comp.	Input no damage	NF dB Typ.	IP3 dBm Typ.	In	Out	Volt. V	Current mA	Qty. (1-9)	FACTORY	LOCAL
ZFL case Y39	ZFL-2000	10	2000	20	±1.5	+16●	+5	7.0	+25	2:1	2:1	15	100	219.00	●	
case SS98	ZFL-1000H	10	1000	28	±1.0	+20	+5	5	+33	2:1	2:1	15	150	219.00	●	
	▪▪ZFL-1000VH	10	1000	20	±1	+26	+15	4.5	+38	1.8:1	2.0:1	15	320	229.00	●	
ZHL–1042J case NN92	ZHL-1042J	10	4200	25	±1.5	+20	+10	4.5	+30	2.5:1	2.5:1	15	300	495.00	●	
ZHL–A:: case S32	ZHL-6A	.0025	500	21	±1.0	+23	+10	7.5	+34	1.8:1	2:1	24	350	199.00	●	
AMP case QQ96	AMP-2000	10	2000	20	±1.5	+15.0	+ 5	5.0	+25	2:1	2:1	15	100	139.95	●	

L_W = Low Range (f_L to $f_{U/2}$) m = mid Range (2 f_L to $f_{U/2}$) U = Upper Range ($f_{U/2}$ to f_U)

pin configuration

SERIES	AMP-2000
RF IN	5
RF OUT	11
DC	2
CASE GND	1,3,4,6,7,8,9,10,12

NOTES:

- ● +15dBm below 1000 MHz.
- ▪▪ 24dBm at 500–1000 MHz.
- :: NF SPEC above 10 MHz. Output VSWR above 400 MHz is 2.2:1 max. Available only with BNC connectors.
- ■ +27 dBm, 10 MHz to 700 MHz
- // Below 100 MHz, increases to 15 dB at 10 MHz
- ∴ +28.5 dB maximum output 1000–1200 MHz. Available only with SMA.
- * 1.5 dB over temperature range −20°C to +65°C
- ** 1 dB compression point typ. 37 dBm

1. Absolute Maximum Ratings, see Environmental Specifications page 3-13.
2. With no load output, derate maximum input power (no damage) by 10 dB.
3. Prices and specifications subject to change without notice.

NSN GUIDE

MCL NO.	NSN
ZHL-1A	6130-01-088-2322
ZHL-1A (BNC)	5895-01-123-0792
ZHL-1A (SMA)	5895-01-201-4500
ZHL-3A	5895-01-194-1718
ZHL-32A	5895-01-238-7973
ZHL-42 (SMA)	5895-01-253-2397
ZHL-4240	5895-01-263-5871
ZFL-1000H	5895-01-299-5588
ZFL-2000	5895-01-220-2213
ZFL-2000B	5895-01-220-2213

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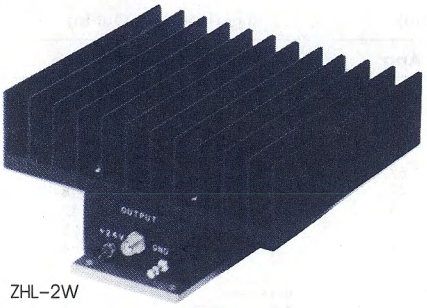
Mini-Circuits

High Power

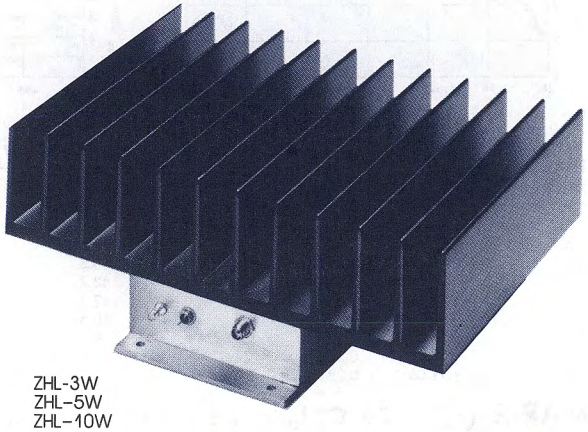
up to 10 Watts (+40 dBm) output
50 KHz to 4.2 GHz

case style selection

outline drawings see Table of Contents

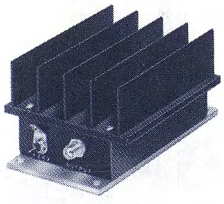


ZHL-2W

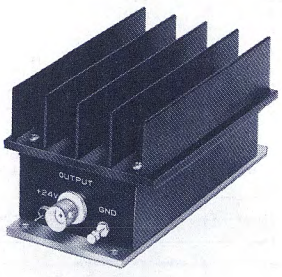


ZHL-3W
ZHL-5W
ZHL-10W

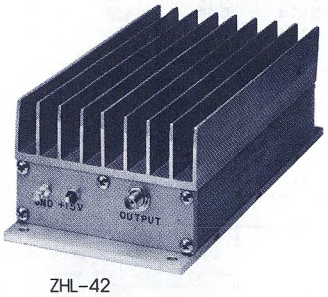
	MODEL NO.	FREQ. MHz f_L f_U	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output 1 dB Comp.	MAXIMUM POWER, dBm Input no damage	DYNAMIC NF dB Typ.	DYNAMIC IP3 dBm Typ.	VSWR In	VSWR Out	DC POWER Volt. V	DC POWER Current A	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZHL-2W case T 35	ZHL-1-2W	5-500	29	±1.0	+33	+10	12	+44	2:1	2:1	24	0.9	525.00	●	
	ZHL-7-2W	600-800	28	±1.0	+33	+10	12	+43	2:1	2:1	24	0.9	590.00	●	
ZHL-3W case DDD-131	ZHL-1000-3W	500-1000	38	±1.0*	+35**	0	9	+45	2:1	2.5:1	24	2	695.00	●	
ZHL-5W case DDD-131	ZHL-5W-1	1-500	40	±1.5	+37	0	8	+49	2:1	2.5:1	24	3.3	995.00	●	
ZHL-10W case DDD-131	ZHL-900-10W	480-900	19	±1.0	+38	+25	10	+50	2:1	2:1	24	5.5	1995.00	●	



ZHL-A



ZHL



ZHL-42

	MODEL NO.	FREQUENCY MHz f_L f_U	GAIN, dB Min.	GAIN, dB Flatness Max.	MAXIMUM POWER, dBm Output 1 dB Comp.	MAXIMUM POWER, dBm Input no damage	DYNAMIC RANGE NF dB Typ.	DYNAMIC RANGE IP3 dBm Typ.	VSWR In	VSWR Out	DC POWER Volt. V	DC POWER Current A	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZHL-A case S 32	ZHL-1A	2-500	16	±1.0	+28	+20	11	+38	2:1	2:1	24	0.6	199.00	●	
	ZHL-3A	0.4-150	24	±1.0	+29.5	+10	11	+38	2:1	2:1	24	0.6	199.00	●	
	ZHL-32A	0.05-130	25	±1.0	+29	+10	10	+38	2:1	2:1	24	0.6	199.00	●	
ZHL case T 34	ZHL-2	10-1000	16	±1.0	+29	+20	9	+38	2:1	2:1	24	0.6	349.00	●	
	ZHL-2-8	10-1000	27	±1.0	+29	+5	10	+38	2:1	2:1	24	0.6	525.00	●	
	ZHL-2-12	10-1200	24	±1.0	+29.∴	+10	10	+38	2:1	2:1	24	0.75	625.00	●	
ZHL-42 case U 36	ZHL-42	700-4200	30	±1.0	+28	+5	10	+38	2.5:1	2.5:1	15	0.85	895.00	●	
	ZHL-4240	700-4200	40	±1.5	+28	−5	4	+38	2.5:1	2.5:1	15	0.85	1395.00	●	
	ZHL-42W	10-4200	30	±1.5	+28 ■	0	8 //	+38	2.5:1	2.5:1	15	0.83	1095.00	●	
	ZHL-4240W	10-4200	40	±1.5	+28 ■	−5	8 //	+38	2.5:1	2.5:1	15	0.90	1495.00	●	

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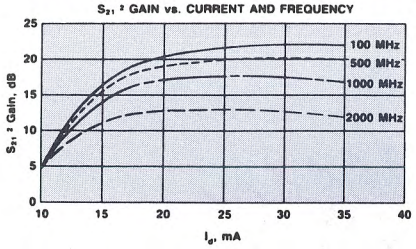
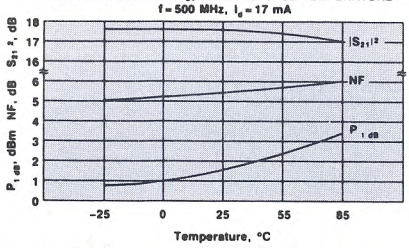
Amplifiers

MAR-1 (T_A = 25°C, I_d = 17 mA)

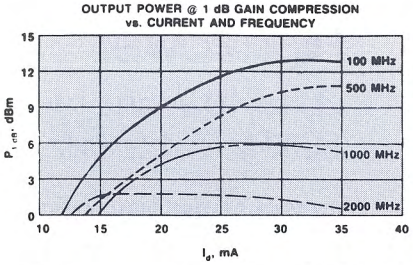
S_{21} ² GAIN vs. CURRENT AND FREQUENCY



OUTPUT POWER @ 1 dB GAIN COMPRESSION, NOISE FIGURE AND S_{21} ² GAIN vs. CASE TEMPERATURE
f = 500 MHz, I_d = 17 mA



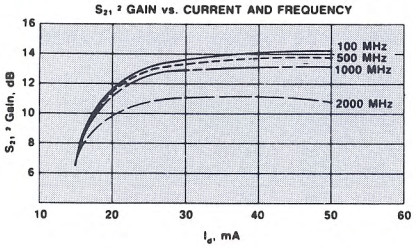
OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. CURRENT AND FREQUENCY



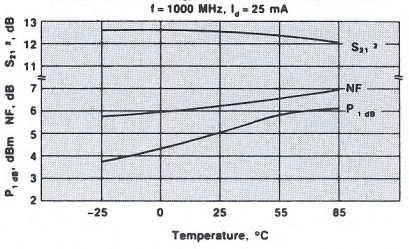
Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−23.10	0.07	164	18.5	171	−21.94	0.08	4	−23.10	0.07	−14
500	−24.44	0.06	106	17.5	141	−21.94	0.08	15	−23.10	0.07	−68
1000	−24.44	0.06	72	15.5	111	−20.00	0.10	24	−20.92	0.09	−124
1500	−27.96	0.04	59	13.7	87	−17.72	0.13	26	−20.00	0.10	−161
2000	−24.44	0.06	149	12.3	67	−15.92	0.16	21	−15.92	0.16	−177
2500	−20.00	0.10	142	10.6	49	−14.89	0.18	18	−15.92	0.16	155
3000	−18.42	0.12	139	9.3	34	−13.98	0.20	12	−16.48	0.15	144
3500	−13.98	0.20	129	7.9	19	−13.15	0.22	5	−15.92	0.16	135
4000	−11.06	0.28	120	6.6	3	−12.04	0.25	−4	−15.39	0.17	127

MAR-2 (T_A = 25°C, I_d = 25 mA)

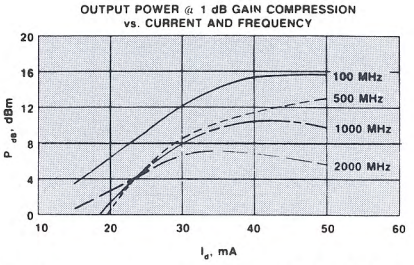
S_{21} ² GAIN vs. CURRENT AND FREQUENCY



OUTPUT POWER @ 1 dB GAIN COMPRESSION, NOISE FIGURE AND S_{21} ² GAIN vs. CASE TEMPERATURE
f = 1000 MHz, I_d = 25 mA



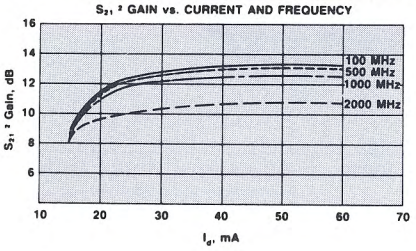
OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. CURRENT AND FREQUENCY



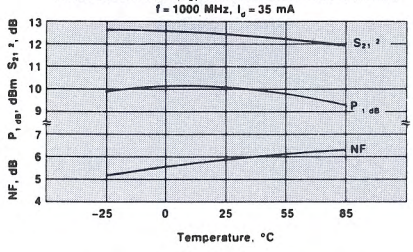
Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−18.42	0.12	173	13.0	174	−18.42	0.12	1	−17.72	0.13	−8
500	−19.17	0.11	154	12.8	156	−18.42	0.12	5	−18.42	0.12	−38
1000	−20.00	0.10	130	12.5	131	−17.72	0.13	7	−18.42	0.12	−75
1500	−21.94	0.08	120	11.8	109	−17.08	0.14	10	−18.42	0.12	−112
2000	−24.44	0.06	126	11.0	90	−16.48	0.15	9	−17.72	0.13	−121
2500	−20.92	0.09	147	10.4	67	−15.39	0.17	6	−17.72	0.13	−165
3000	−17.08	0.14	147	9.4	46	−14.42	0.19	−1	−17.72	0.13	171
3500	−13.56	0.21	136	8.2	30	−13.98	0.20	−5	−17.72	0.13	155
4000	−11.37	0.27	123	7.3	14	−13.56	0.21	−10	−18.42	0.12	142

MAR-3 (T_A = 25°C, I_d = 35 mA)

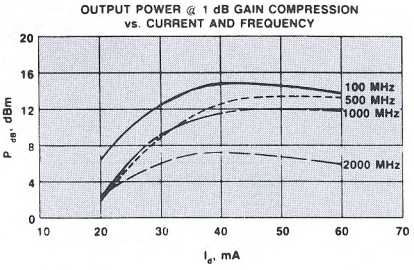
S_{21} ² GAIN vs. CURRENT AND FREQUENCY



OUTPUT POWER @ 1 dB GAIN COMPRESSION, NOISE FIGURE AND $|S_{21}|^2$ GAIN vs. CASE TEMPERATURE
f = 1000 MHz, I_d = 35 mA



OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. CURRENT AND FREQUENCY



Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−23.10	0.07	172	13.0	174	−18.42	0.12	1	−16.48	0.15	−11
500	−24.44	0.06	156	12.8	152	−18.42	0.12	5	−15.92	0.16	−45
1000	−26.02	0.05	146	12.5	128	−17.72	0.13	10	−14.98	0.18	−88
1500	−27.96	0.04	172	11.8	103	−17.08	0.14	12	−13.56	0.21	−120
2000	−24.44	0.06	173	10.5	83	−14.98	0.18	11	−12.04	0.25	−142
2500	−15.39	0.17	175	10.3	59	−14.42	0.19	5	−11.70	0.26	−173
3000	−12.40	0.24	157	9.1	38	−13.98	0.20	−0	−12.04	0.25	168
3500	−9.90	0.32	140	7.8	21	−13.56	0.21	−6	−12.04	0.25	152
4000	−8.18	0.39	124	6.5	3	−13.15	0.22	−14	−12.04	0.25	138

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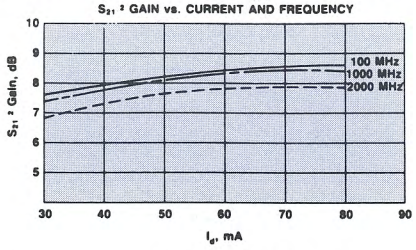
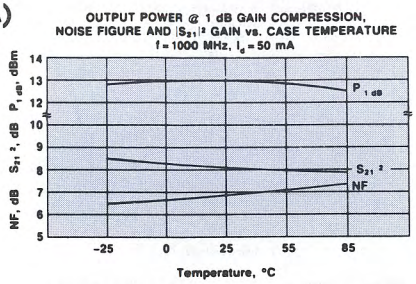
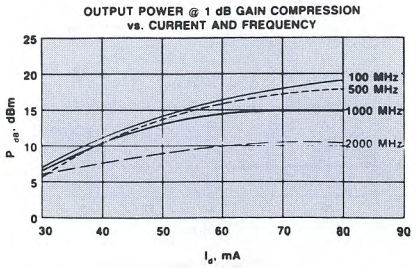
MAR-4 (T_A = 25°C, I_d = 50 mA)

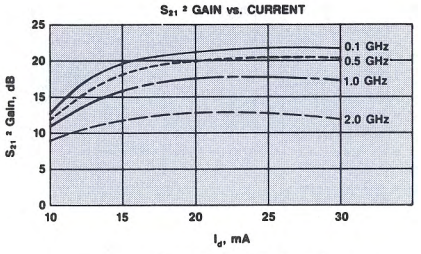


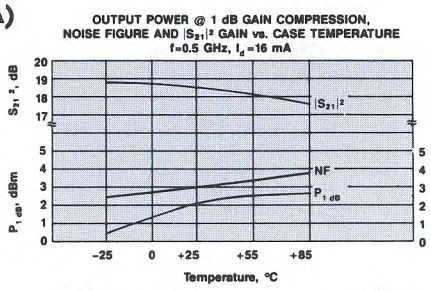


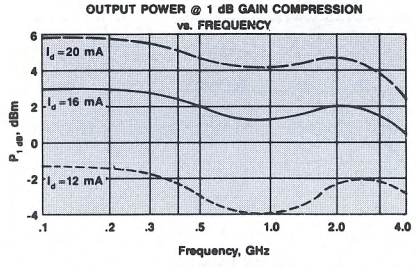


Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−14.42	0.19	177	8.2	174	−15.92	0.16	0	−20.00	0.10	−14
500	−14.89	0.18	169	8.2	156	−15.92	0.16	1	−17.72	0.13	−54
1000	−15.39	0.17	159	8.1	135	−15.92	0.16	3	−14.89	0.18	−94
1500	−15.39	0.17	157	8.0	112	−15.39	0.17	4	−12.40	0.24	−121
2000	−14.42	0.19	151	7.7	90	−14.42	0.19	3	−11.06	0.28	−145
2500	−12.40	0.24	159	7.6	69	−13.98	0.20	−1	−9.37	0.34	−165
3000	−10.17	0.31	151	6.9	46	−13.15	0.22	−6	−9.12	0.35	176
3500	−8.18	0.39	139	6.0	27	−12.77	0.23	−11	−8.64	0.37	160
4000	−6.74	0.46	126	4.9	8	−12.04	0.25	−23	−8.40	0.38	147

MAR-6 (T_A = 25°C, I_d = 16 mA)

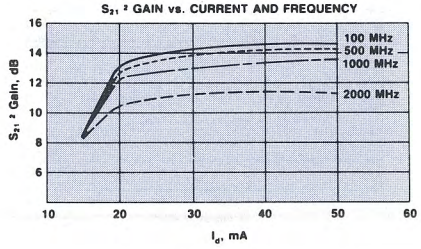


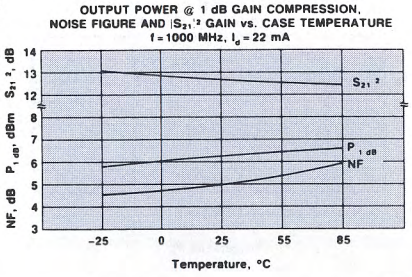


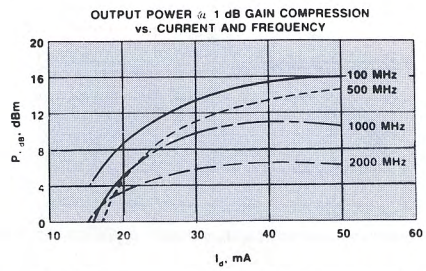


Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−27.96	.04	171	20.1	171	−22.5	.075	5	−27.96	.04	−30
500	−26.02	.05	−105	18.7	138	−21.3	.086	21	−20.00	.10	−104
1000	−17.72	.13	−118	16.4	107	−18.8	.115	28	−17.08	.14	−150
1500	−13.56	.21	−140	14.1	84	−17.1	.140	28	−16.48	.15	180
2000	−10.75	.29	−163	12.0	65	−15.8	.163	26	−15.92	.16	157
2500	−9.37	.34	−176	10.3	55	−15.2	.174	28	−15.92	.16	150
3000	−7.74	.41	169	8.7	42	−14.8	.181	25	−16.48	.15	143
3500	−6.74	.46	157	7.2	30	−14.2	.194	22	−17.72	.13	144
4000	−6.20	.49	146	6.1	18	−13.8	.203	20	−20.00	.10	156

MAR-7 (T_A = 25°C, I_d = 22 mA)





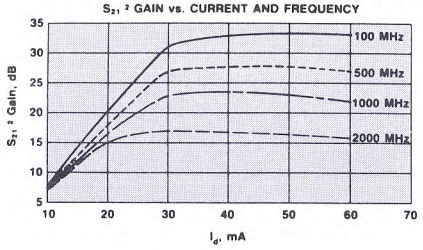


Freq. MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	dB	Mag	Ang	dB	Ang	dB	Mag	Ang	dB	Mag	Ang
100	−26.02	0.05	169	13.5	173	−19.17	0.11	1	−17.08	0.14	−7
500	−30.46	0.03	133	13.1	150	−18.42	0.12	6	−17.72	0.13	−41
1000	−40.00	0.01	58	12.5	122	−17.72	0.13	10	−19.17	0.11	−94
1500	−24.44	0.06	−113	11.8	95	−16.48	0.15	10	−17.72	0.13	−148
2000	−16.48	0.15	−144	10.5	70	−15.39	0.17	7	−15.39	0.17	174
2500	−11.37	0.27	−165	9.6	48	−14.89	0.18	1	−14.42	0.19	154
3000	−8.64	0.37	169	8.1	27	−13.98	0.20	−6	−14.89	0.18	144
3500	−6.94	0.45	150	6.5	10	−14.42	0.19	−11	−15.39	0.17	144
4000	−5.98	0.51	134	5.0	−4	−14.42	0.19	−15	−15.39	0.17	152

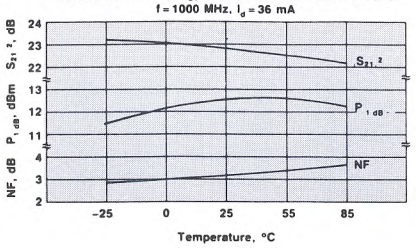
Amplifiers

MAR-8 (T_A = 25°C, I_d = 36 mA)

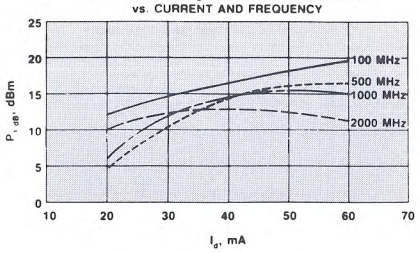
S_{21} ² GAIN vs. CURRENT AND FREQUENCY



OUTPUT POWER @ 1 dB GAIN COMPRESSION, NOISE FIGURE AND S_{21} ² GAIN vs. CASE TEMPERATURE
f = 1000 MHz, I_d = 36 mA



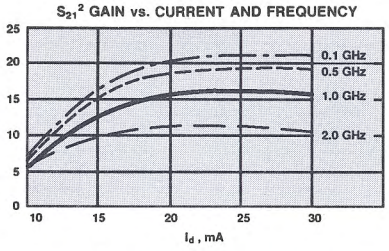
OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. CURRENT AND FREQUENCY



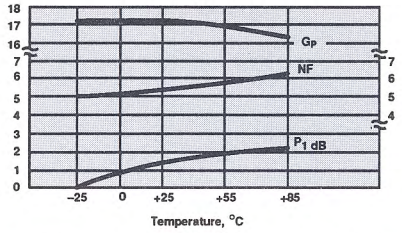
Freq. MHz	S_{11} (Input Return Loss) dB	Mag	Ang	S_{21} (Power Gain) dB	Ang	S_{12} (Isolation Out-In) dB	Mag	Ang	S_{22} (Output Return Loss) dB	Mag	Ang	K
100	−15.92	0.61	−21	33.0	162	−40.00	0.01	38	−4.73	0.58	−24	0.79
500	−8.18	0.39	−77	27.8	109	−27.96	0.04	52	−9.37	0.34	−96	0.75
1000	−11.37	0.27	−113	23.0	80	−24.44	0.06	51	−13.56	0.21	−147	0.89
1500	−11.70	0.26	−139	19.4	62	−21.94	0.08	46	−14.89	0.18	174	0.96
2000	−10.46	0.30	−155	16.9	47	−20.00	0.10	41	−15.39	0.17	153	0.97
2500	−9.63	0.33	−180	14.8	32	−18.42	0.12	32	−14.42	0.19	127	1.01
3000	−8.87	0.36	167	12.9	20	−17.72	0.13	27	−17.08	0.14	111	1.07
3500	−7.54	0.42	153	11.4	6	−17.08	0.14	21	−17.72	0.13	107	1.06
4000	−6.94	0.45	141	9.8	−5	−16.48	0.15	14	−19.17	0.11	106	1.10

MAV-1 (T_A = 25°C, I_d = 17 mA)

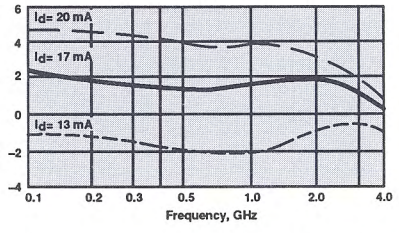
S_{21}² GAIN vs. CURRENT AND FREQUENCY



OUTPUT POWER @ 1 dB GAIN COMPRESSION
NOISE FIGURE AND S_{21}² GAIN vs. CASE TEMPERATURE
f = 0.5 GHz, I_d = 17 mA



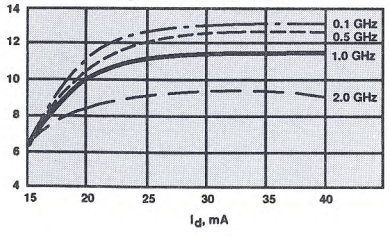
OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. CURRENT AND FREQUENCY



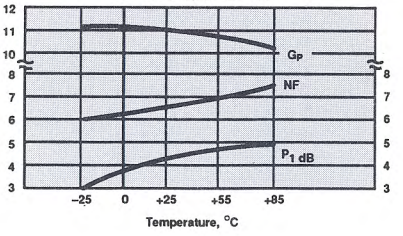
Freq. MHz	S_{11} (Input Return Loss) Mag	Ang	S_{21} (Power Gain) dB	Ang	S_{12} (Isolation Out-In) dB	Mag	Ang	S_{22} (Output Return Loss) Mag	Ang
100	.06	141	18.4	170	−22.3	.077	5	.07	−9
200	.08	112	18.1	160	−22.3	.077	9	.07	−15
400	.12	77	17.4	142	−21.6	.083	16	.07	−32
1000	.17	28	14.3	102	−18.9	.114	29	.08	−61
1500	.17	5	12.1	78	−16.6	.148	30	.08	−73
2000	.13	−12	10.2	59	−14.9	.179	25	.07	−90
2500	.08	−20	8.9	46	−13.6	.209	25	.05	−112
3000	.02	−37	7.7	31	−12.7	.232	18	.05	−134
3500	.05	128	6.7	15	−11.9	.253	10	.06	−160
4000	.12	113	5.7	−1	−11.3	.272	2	.06	−175

MAV-2 (T_A = 25°C, I_d = 25 mA)

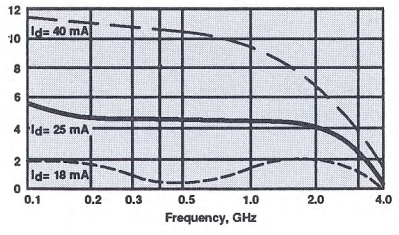
S_{21}² GAIN vs. CURRENT



OUTPUT POWER @ 1 dB GAIN COMPRESSION
NOISE FIGURE AND S_{21}² GAIN vs. CASE TEMPERATURE
f = 1.0 GHz, I_d = 25 mA



OUTPUT POWER @ 1 dB GAIN COMPRESSION vs. FREQUENCY



Freq. MHz	S_{11} (Input Return Loss) Mag	Ang	S_{21} (Power Gain) dB	Ang	S_{12} (Isolation Out-In) dB	Mag	Ang	S_{22} (Output Return Loss) Mag	Ang
100	.12	170	12.5	174	−18.5	.119	2	.12	−7
200	.12	160	12.4	168	−18.5	.119	4	.12	−14
400	.11	140	12.2	156	−18.1	.124	6	.12	−29
1000	.10	84	11.2	123	−17.0	.142	14	.13	−61
1500	.09	42	10.2	99	−16.1	.157	16	.12	−79
2000	.07	16	9.1	77	−14.8	.181	15	.11	−96
2500	.05	17	8.2	63	−13.9	.202	16	.09	−115
3000	.02	95	7.3	46	−13.2	.220	13	.08	−141
3500	.08	112	6.5	29	−12.4	.239	7	.09	−167
4000	.14	100	5.7	12	−11.8	.258	0	.11	171

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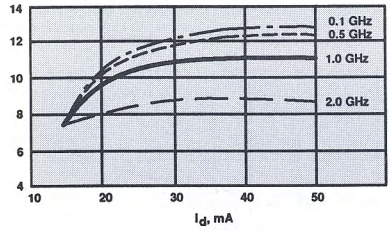
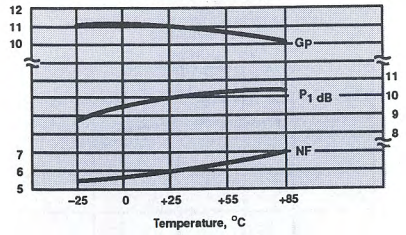
MAV-3 (T_A = 25°C, I_d = 35 mA)

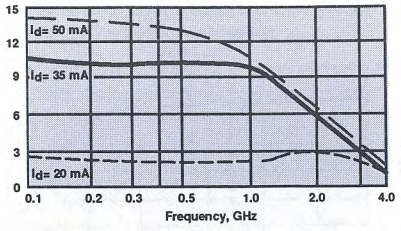
S_{21}^2 GAIN vs. CURRENT



OUTPUT POWER @ 1 dB GAIN COMPRESSION
NOISE FIGURE AND S_{21}^2 GAIN vs. CASE TEMPERATURE
f=1.0 GHz, I_d=35 mA



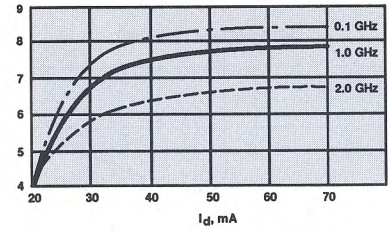
OUTPUT POWER @ 1 dB GAIN COMPRESSION
vs. FREQUENCY



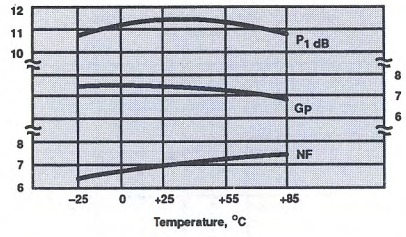
Freq. MHz	S_{11} (Input Return Loss)		S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)	
	Mag	Ang	dB	Ang	dB	Mag	Ang	Mag	Ang
100	.10	173	12.5	173	−18.5	.120	3	.12	−13
200	.10	162	12.5	167	−18.2	.123	4	.12	−24
400	.09	142	12.2	153	−18.0	.125	7	.13	−46
1000	.06	92	11.1	118	−16.8	.144	16	.17	−91
1500	.03	58	10.0	93	−15.5	.169	19	.19	−117
2000	.03	175	8.8	71	−14.1	.197	18	.20	−139
2500	.05	163	7.8	55	−13.2	.218	18	.21	−158
3000	.12	148	6.8	38	−12.2	.246	15	.22	−174
3500	.19	129	5.9	20	−11.2	.275	7	.24	171
4000	.26	110	5.0	3	−10.6	.296	1	.26	158

MAV-4 (T_A = 25°C, I_d = 50 mA)

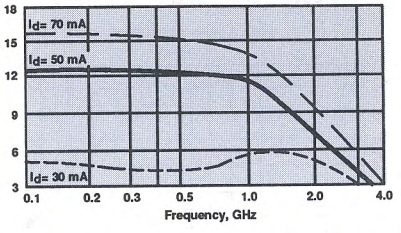
S_{21}^2 GAIN vs. CURRENT



OUTPUT POWER @ 1 dB GAIN COMPRESSION
NOISE FIGURE AND S_{21}^2 GAIN vs. CASE TEMPERATURE
f=1.0 GHz, I_d=50 mA



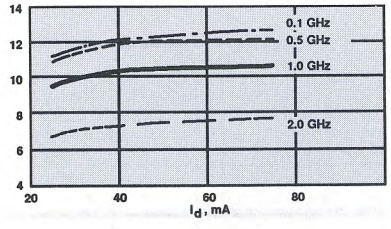
OUTPUT POWER @ 1 dB GAIN COMPRESSION
vs. FREQUENCY



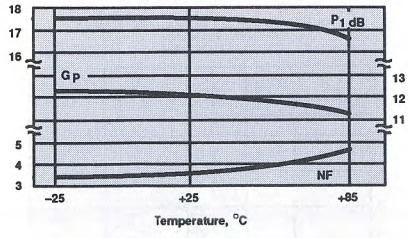
Freq. MHz	S_{11} (Input Return Loss)		S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)	
	Mag	Ang	dB	Ang	dB	Mag	Ang	Mag	Ang
100	.16	175	8.3	174	−16.2	.156	0	.13	−13
200	.16	170	8.2	168	−16.2	.155	2	.13	−25
400	.15	161	8.1	156	−16.0	.158	4	.14	−47
1000	.11	141	7.7	122	−15.4	.169	9	.21	−91
1500	.07	141	7.2	96	−14.6	.186	13	.24	−118
2000	.09	161	6.6	71	−13.3	.215	12	.26	−140
2500	.14	159	5.9	53	−12.4	.240	13	.28	−157
3000	.22	146	5.1	33	−11.7	.260	7	.29	−176
3500	.30	128	4.3	13	−10.9	.286	0	.32	167
4000	.38	109	3.2	−6	−10.4	.301	−7	.33	153

MAV-11 (T_A = 25°C, I_d = 60 mA)

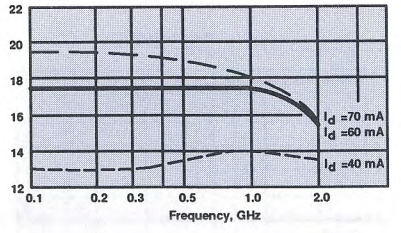
S_{21}^2 GAIN vs. CURRENT



OUTPUT POWER @ 1 dB GAIN COMPRESSION
NOISE FIGURE AND S_{21}^2 GAIN vs. CASE TEMPERATURE
f=0.5 GHz, I_d=60 mA

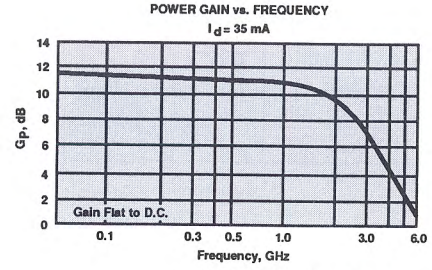


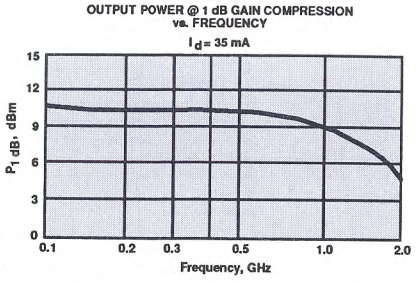
OUTPUT POWER @ 1 dB GAIN COMPRESSION
vs. FREQUENCY

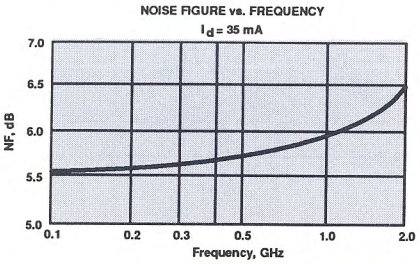


Freq. MHz	S_{11} (Input Return Loss)		S_{21} (Power Gain)		S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	Mag	Ang	dB	Ang	dB	Mag	Ang	Mag	Ang	k
0.5	.76	−22	19.3	167	−24.4	.060	54	.77	−22	0.48
5.0	.20	−79	13.7	164	−16.5	.149	12	.21	−83	0.96
50.0	.04	−75	12.7	174	−16.4	.151	2	.05	−136	1.09
100.0	.04	−81	12.6	171	−16.4	.152	2	.05	−137	1.09
500.0	.09	−124	12.1	141	−15.8	.162	6	.15	−144	1.06
1000.0	.18	−161	10.7	106	−14.7	.184	6	.26	−173	1.03
1500.0	.28	171	9.1	77	−13.5	.211	2	.35	163	0.99
2000.0	.37	149	7.6	52	−13.0	.224	−5	.43	140	0.99
2500.0	.45	133	6.1	33	−12.7	.231	−10	.47	125	1.02
3000.0	.52	118	4.6	14	−12.6	.234	−16	.50	112	1.05

VAM-3 (T_A = 25°C, I_d = 35 mA)

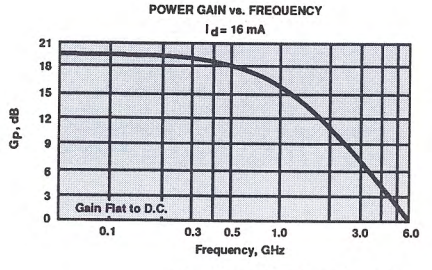


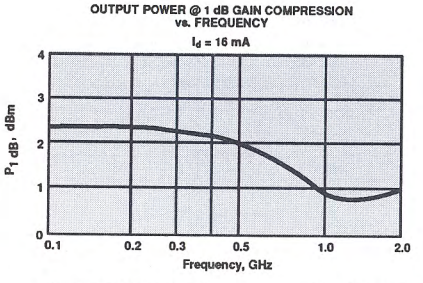


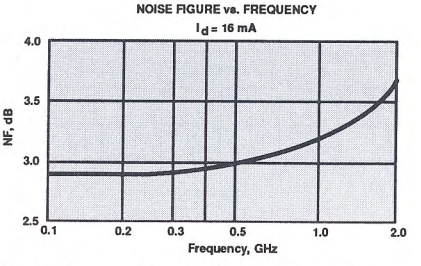


MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)			S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang
0.1	-24.44	.06	25	11.7	3.84	175	-17.9	.127	2	-12.40	.24	-7
0.2	-23.10	.07	31	11.7	3.83	170	-17.9	.128	3	-12.77	.23	-13
0.4	-23.10	.07	38	11.6	3.78	159	-17.8	.129	6	-12.40	.24	-28
0.6	-23.10	.07	30	11.4	3.72	149	-17.6	.132	8	-12.40	.24	-40
0.8	-21.94	.08	21	11.2	3.65	140	-17.3	.136	11	-12.40	.24	-53
1.0	-21.94	.08	10	11.0	3.56	130	-17.0	.141	13	-12.40	.24	-65
1.5	-20.92	.09	-32	10.4	3.31	106	-15.9	.160	17	-12.40	.24	-91
2.0	-20.92	.09	-105	9.5	2.99	84	-14.9	.179	16	-12.77	.23	-115
2.5	-17.72	.13	-151	8.5	2.66	70	-14.1	.197	19	-12.77	.23	-133
3.0	-14.43	.19	-176	7.4	2.35	51	-13.5	.212	15	-13.15	.22	-145

VAM-6 (T_A = 25°C, I_d = 16 mA)

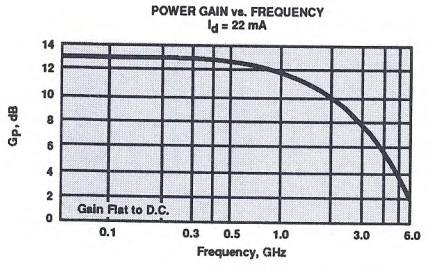


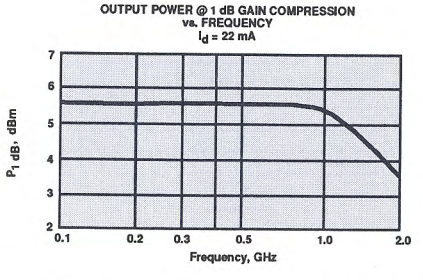


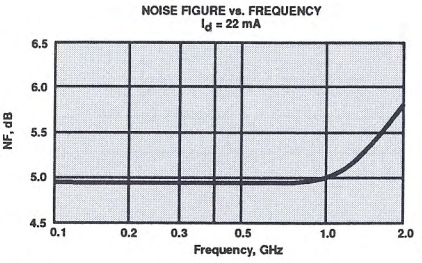


MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)			S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang
0.1	-27.96	.04	-176	19.6	9.53	170	-23.0	.071	6	-27.96	.04	-57
0.2	-30.46	.03	-163	19.3	9.25	160	-22.7	.073	10	-23.10	.07	-82
0.3	-30.46	.03	-149	18.9	8.79	150	-22.8	.072	14	-20.92	.09	-97
0.4	-27.96	.04	-132	18.5	8.38	141	-21.9	.080	17	-19.17	.11	-111
0.5	-26.02	.05	-127	18.0	7.96	133	-21.6	.083	21	-17.72	.13	-122
0.6	-23.10	.07	-123	17.3	7.33	125	-21.2	.087	23	-16.48	.15	-131
0.8	-20.00	.10	-129	16.2	6.46	111	-19.7	.103	25	-15.39	.17	-147
1.0	-17.72	.13	-139	15.0	5.64	98	-19.0	.112	28	-14.90	.18	-160
1.5	-13.15	.22	-164	12.5	4.22	73	-17.1	.139	25	-14.43	.19	175
2.0	-10.17	.31	171	10.1	3.20	53	-16.1	.157	21	-14.43	.19	160

VAM-7 (T_A = 25°C, I_d = 22 mA)







MHz	S_{11} (Input Return Loss)			S_{21} (Power Gain)			S_{12} (Isolation Out-In)			S_{22} (Output Return Loss)		
	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang	(dB)	Mag	Ang
0.1	-30.46	.03	1	13.0	4.47	174	-18.6	.118	1	-14.43	.19	-8
0.2	-27.96	.04	1	12.9	4.42	168	-18.5	.119	2	-14.43	.19	-18
0.4	-27.96	.04	-4	12.8	4.38	157	-18.4	.120	4	-14.43	.19	-36
0.6	-26.02	.05	-19	12.6	4.28	146	-18.1	.125	9	-14.43	.19	-52
0.8	-23.10	.07	-32	12.3	4.14	135	-17.7	.130	10	-13.98	.20	-68
1.0	-21.94	.08	-44	12.0	3.99	123	-17.4	.135	12	-14.43	.19	-82
1.5	-17.72	.13	-88	10.9	3.52	98	-16.1	.157	13	-14.43	.19	-113
2.0	-14.90	.18	-130	9.8	3.08	75	-15.2	.173	8	-14.90	.18	-138
2.5	-12.04	.25	-155	8.6	2.68	61	-14.7	.184	9	-14.90	.18	-151
3.0	-9.90	.32	-178	7.2	2.30	42	-14.7	.185	5	-15.39	.17	-158

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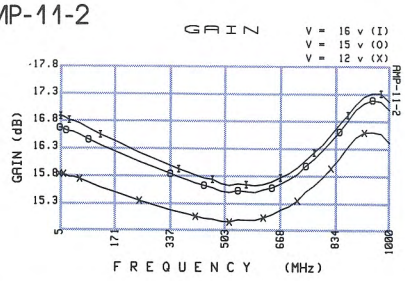
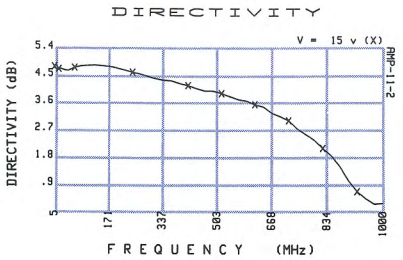
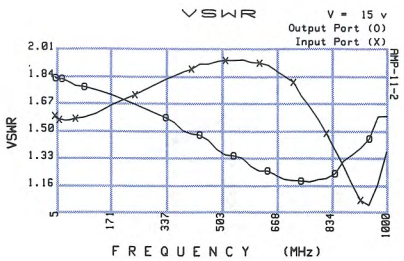


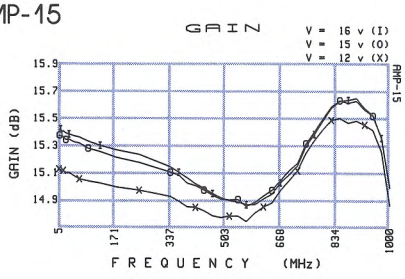


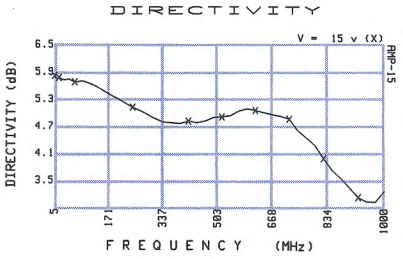


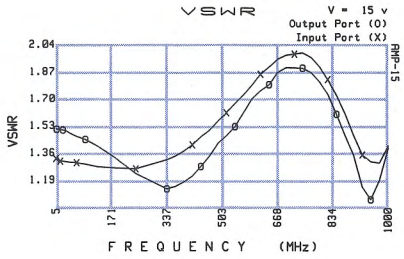
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	15.78	16.63	16.84	.45	4.7	4.8	4.9	1.58	.13	1.82	.13	—	— .05
13.2	15.78	16.61	16.84	.47	4.7	4.7	4.7	1.56	.11	1.81	.12	2.36	— .11
48.2	15.73	16.55	16.75	.47	4.7	4.6	4.7	1.55	.14	1.79	.12	2.38	— .10
176.2	15.44	16.18	16.37	.48	4.8	4.8	4.7	1.65	.11	1.71	.10	2.54	0.00
387.7	15.05	15.67	15.82	.33	4.5	4.2	4.1	1.86	.13	1.49	.07	2.49	.15
489.7	14.92	15.47	15.61	.41	4.4	4.0	3.9	1.92	.12	1.38	.06	2.40	.50
617.3	14.99	15.49	15.59	.27	4.0	3.5	3.5	1.91	.12	1.24	.05	2.50	1.09
744.9	15.46	15.93	16.03	.29	3.2	2.7	2.6	1.71	.11	1.18	.03	2.60	2.23
872.4	16.27	16.75	16.86	.41	2.0	1.5	1.4	1.28	.13	1.31	.09	2.54	3.52
1000.0	16.35	16.96	17.11	.40	1.0	.3	.1	1.37	.09	1.59	.12	2.58	4.92

σ equals standard deviation, see Amplifier terms

AMP-15



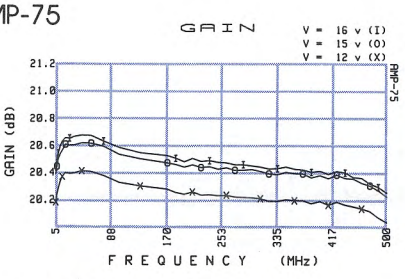


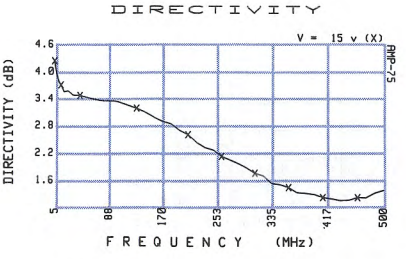


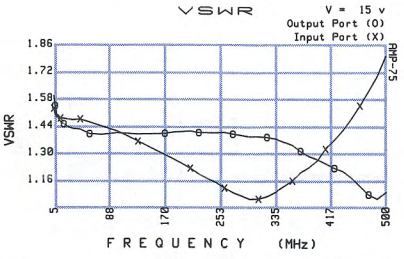
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	15.10	15.34	15.38	.08	5.9	5.8	5.8	1.32	.08	1.51	.11	—	11.17
13.2	15.09	15.34	15.37	.08	5.8	5.8	5.8	1.31	.08	1.51	.11	3.27	11.15
48.2	15.05	15.30	15.34	.08	5.8	5.8	5.7	1.30	.08	1.48	.11	3.23	11.24
176.2	14.96	15.18	15.24	.15	5.5	5.4	5.4	1.27	.09	1.34	.14	3.31	11.01
387.7	14.82	14.99	15.03	.26	4.9	4.8	4.8	1.37	.09	1.18	.13	3.19	10.62
489.7	14.74	14.88	14.89	.30	5.0	4.9	5.0	1.56	.10	1.42	.07	3.21	11.06
617.3	14.82	14.90	14.88	.36	5.0	5.1	5.2	1.85	.14	1.75	.24	3.26	12.39
744.9	15.22	15.28	15.27	.48	4.5	4.6	4.8	1.99	.14	1.89	.31	3.00	14.22
872.4	15.44	15.58	15.60	.52	3.5	3.6	3.7	1.60	.15	1.47	.14	2.95	15.82
1000.0	14.83	14.96	14.96	.64	3.2	3.3	3.3	1.40	.28	1.39	.33	3.07	15.12

σ equals standard deviation, see Amplifier terms

AMP-75





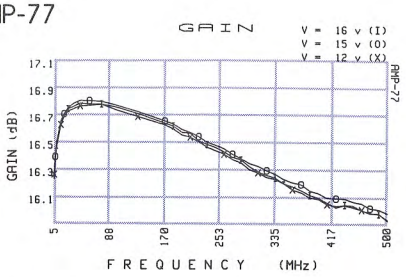


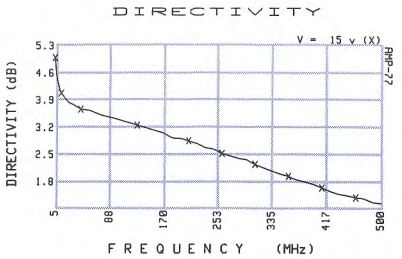
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	20.23	20.44	20.48	.11	4.1	4.2	4.2	1.52	.05	1.59	.02	—	13.88
11.3	20.38	20.59	20.65	.11	3.7	3.7	3.8	1.47	.06	1.47	.03	2.83	14.23
33.4	20.45	20.65	20.72	.11	3.5	3.4	3.5	1.46	.06	1.42	.03	2.81	14.80
98.8	20.38	20.58	20.64	.13	3.3	3.3	3.3	1.40	.05	1.40	.03	2.91	14.90
195.4	20.29	20.49	20.53	.21	2.7	2.7	2.7	1.24	.04	1.40	.05	2.92	14.99
246.2	20.28	20.47	20.52	.26	2.2	2.2	2.2	1.14	.04	1.40	.06	2.94	14.83
309.6	20.25	20.46	20.49	.31	1.8	1.7	1.7	1.05	.01	1.37	.08	2.95	14.51
373.1	20.24	20.44	20.47	.33	1.3	1.3	1.3	1.19	.09	1.30	.09	2.92	14.64
436.5	20.21	20.40	20.45	.30	1.2	1.1	1.1	1.41	.13	1.20	.11	2.98	15.03
500.0	20.08	20.27	20.29	.23	1.4	1.3	1.3	1.79	.17	1.09	.20	3.13	15.57

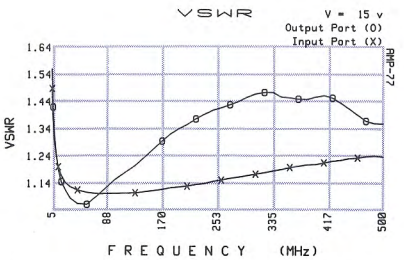
σ equals standard deviation, see Amplifier terms

Amplifiers

AMP-77



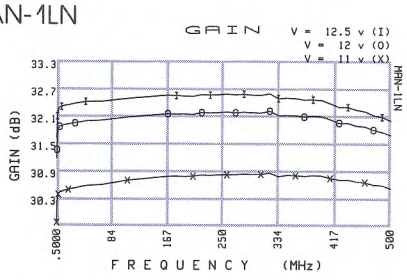


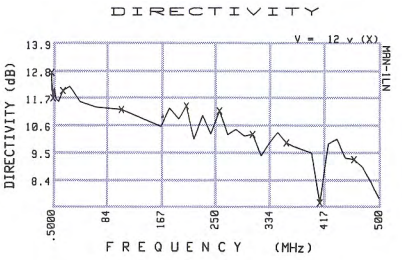


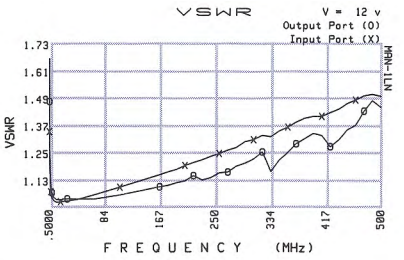
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	16.26	16.25	16.23	.22	5.0	5.0	5.1	1.49	.03	1.57	.02	—	18.30
11.3	16.55	16.58	16.55	.21	4.3	4.3	4.3	1.25	.02	1.25	.02	3.30	18.96
33.4	16.75	16.79	16.76	.21	3.8	3.8	3.8	1.13	.02	1.09	.03	3.27	19.66
98.8	16.74	16.77	16.76	.20	3.5	3.5	3.5	1.11	.02	1.16	.03	3.30	19.68
195.4	16.55	16.59	16.57	.20	2.9	3.0	3.0	1.13	.03	1.35	.05	3.24	19.62
246.2	16.43	16.47	16.46	.21	2.5	2.7	2.7	1.15	.03	1.41	.05	3.24	19.49
309.6	16.27	16.32	16.28	.21	2.2	2.3	2.4	1.18	.03	1.47	.06	3.27	19.24
373.1	16.13	16.19	16.14	.19	1.8	1.9	2.0	1.21	.04	1.45	.06	3.25	19.08
436.5	16.04	16.08	16.04	.15	1.4	1.6	1.7	1.23	.05	1.44	.06	3.26	19.11
500.0	15.92	15.98	15.93	.08	1.1	1.3	1.4	1.24	.06	1.36	.06	3.28	19.25

σ equals standard deviation, see Amplifier terms

MAN-1LN



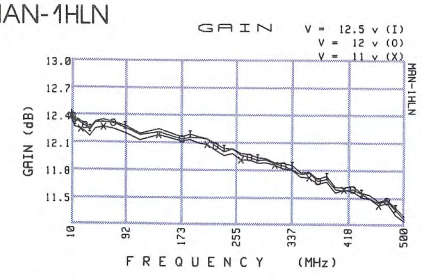


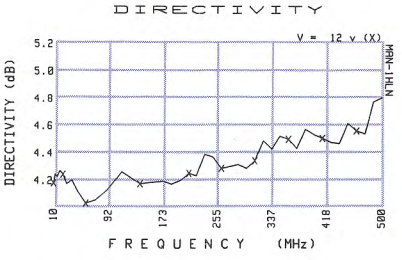


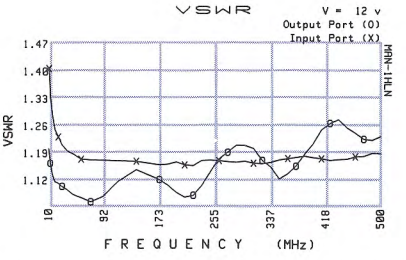
FREQUENCY (MHz)	GAIN (dB) 11.0V	12.0V	12.5V	σ1	DIRECTIVITY (dB) 11.0V	12.0V	12.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.5	29.88	31.30	31.73	.32	13.2	12.9	12.6	1.35	.08	1.67	.04	—	8.01
1.9	30.44	31.89	32.32	.30	12.5	12.1	11.9	1.13	.01	1.18	.02	—	8.42
11.4	30.58	32.02	32.45	.30	12.5	11.7	11.4	1.04	.02	1.05	.04	2.82	8.32
68.3	30.71	32.13	32.54	.29	12.7	11.5	11.5	1.07	.02	1.05	.03	2.91	8.54
192.6	30.89	32.27	32.66	.29	12.2	11.0	11.1	1.18	.04	1.12	.01	2.81	8.47
243.8	30.93	32.30	32.69	.30	11.6	10.4	10.9	1.24	.05	1.15	.02	2.84	8.45
307.9	30.94	32.29	32.68	.33	11.3	10.4	10.3	1.31	.07	1.23	.05	2.88	8.50
371.9	30.90	32.20	32.58	.35	11.1	9.9	10.3	1.39	.09	1.30	.06	2.95	8.45
436.0	30.82	32.07	32.42	.37	10.4	10.2	9.8	1.45	.10	1.31	.07	3.01	8.49
500.0	30.63	31.80	32.12	.41	9.3	7.8	7.3	1.50	.14	1.46	.14	3.08	8.52

σ equals standard deviation, see Amplifier terms

MAN-1HLN







FREQUENCY (MHz)	GAIN (dB) 11.0V	12.0V	12.5V	σ1	DIRECTIVITY (dB) 11.0V	12.0V	12.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	12.42	12.46	12.48	.33	4.2	4.2	4.2	1.41	.04	1.20	.06	3.91	17.02
19.3	12.29	12.37	12.39	.36	4.2	4.3	4.2	1.25	.06	1.12	.07	3.87	17.33
46.5	12.28	12.35	12.36	.37	4.1	4.1	4.1	1.19	.08	1.08	.07	3.86	17.41
111.8	12.16	12.22	12.23	.35	4.2	4.3	4.3	1.17	.09	1.12	.09	4.07	17.42
198.5	12.13	12.19	12.20	.35	4.2	4.2	4.2	1.17	.09	1.09	.05	4.14	17.29
248.7	12.01	12.06	12.06	.32	4.3	4.4	4.4	1.17	.09	1.14	.08	3.93	17.27
311.5	11.88	11.90	11.91	.34	4.3	4.4	4.3	1.16	.09	1.20	.03	3.97	17.23
374.4	11.68	11.71	11.73	.32	4.4	4.4	4.6	1.18	.09	1.16	.05	4.03	17.29
437.2	11.53	11.57	11.58	.32	4.5	4.5	4.5	1.17	.08	1.28	.04	4.07	17.35
500.0	11.27	11.29	11.32	.32	4.8	4.8	4.7	1.19	.08	1.23	.04	4.13	17.38

σ equals standard deviation, see Amplifier terms

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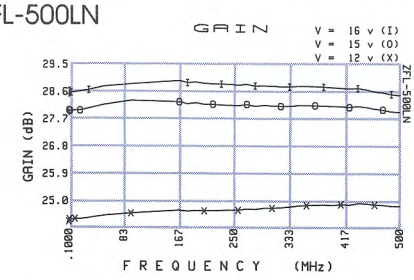
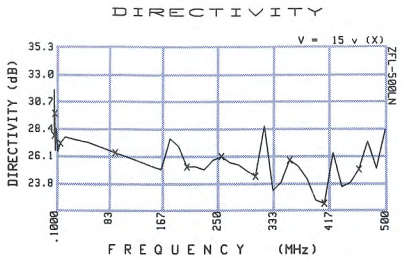
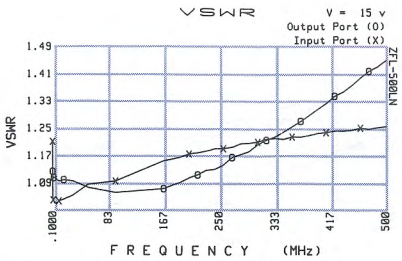
ZFL-500LN



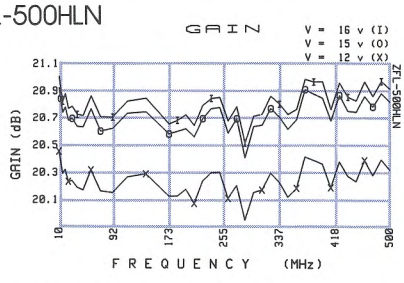


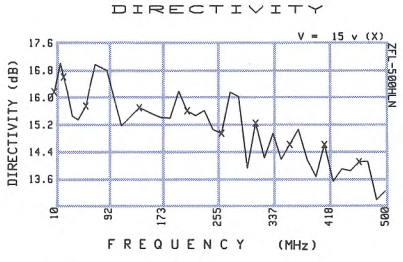


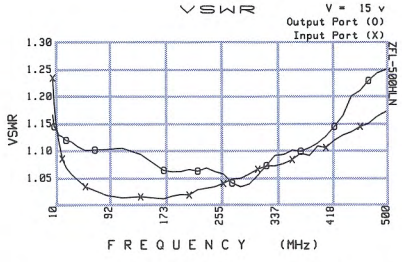
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.1	24.30	27.80	28.40	.17	34.4	27.8	30.8	1.22	.02	1.17	.01	—	7.74
.6	24.41	27.98	28.60	.17	30.0	28.8	28.4	1.05	.02	1.10	.01	—	7.97
5.4	24.37	27.94	28.56	.16	29.0	26.5	25.5	1.03	.02	1.10	.02	—	8.09
53.3	24.49	28.15	28.75	.19	26.9	27.2	26.4	1.09	.03	1.08	.01	2.89	7.94
192.4	24.65	28.21	28.89	.24	26.2	26.9	26.5	1.17	.04	1.10	.03	3.03	7.72
243.6	24.66	28.12	28.81	.21	29.6	25.7	25.5	1.19	.04	1.13	.02	3.04	7.77
307.7	24.73	28.10	28.75	.20	27.2	24.4	25.0	1.21	.04	1.21	.02	3.03	7.82
371.8	24.83	28.11	28.74	.19	26.8	25.2	25.1	1.23	.05	1.28	.02	3.00	7.89
435.9	24.88	28.09	28.68	.19	27.2	23.5	23.3	1.25	.05	1.36	.02	2.98	7.88
500.0	24.79	27.89	28.44	.16	26.5	28.3	24.6	1.26	.04	1.45	.02	2.98	8.01

σ equals standard deviation, see Amplifier terms

ZFL-500HLN



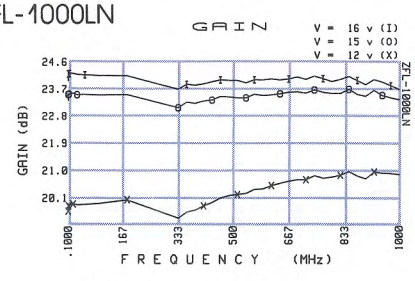


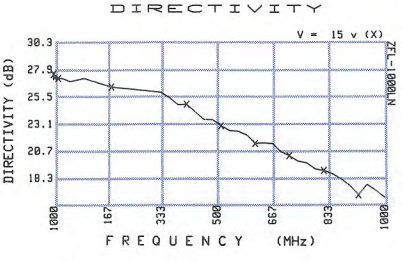


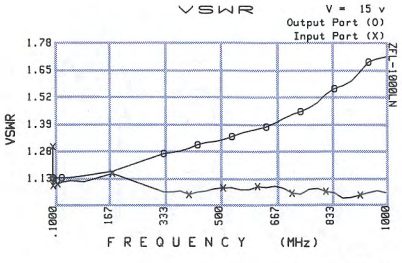
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	20.50	20.97	21.05	.04	16.7	16.2	16.3	1.24	.02	1.17	.04	3.83	16.78
19.3	20.37	20.82	20.92	.06	17.1	17.0	16.0	1.12	.02	1.13	.04	3.84	17.09
46.5	20.21	20.68	20.76	.07	17.5	15.3	15.9	1.05	.03	1.11	.04	3.83	17.14
111.8	20.31	20.78	20.87	.08	16.2	15.2	16.5	1.02	.04	1.11	.04	3.89	17.19
198.5	20.22	20.66	20.77	.07	15.6	16.2	15.3	1.02	.05	1.06	.02	3.88	17.17
248.7	20.35	20.82	20.90	.08	15.8	15.1	14.9	1.04	.05	1.07	.02	3.92	17.13
311.5	20.22	20.69	20.77	.10	15.8	15.2	15.0	1.07	.05	1.06	.03	3.95	16.97
374.4	20.46	20.96	21.03	.06	14.3	15.1	14.2	1.10	.05	1.10	.03	3.96	16.95
437.2	20.32	20.79	20.90	.04	14.2	13.9	13.6	1.13	.05	1.17	.04	3.97	16.91
500.0	20.36	20.87	20.96	.04	13.8	13.2	12.3	1.17	.05	1.25	.04	3.97	16.91

σ equals standard deviation, see Amplifier terms

ZFL-1000LN





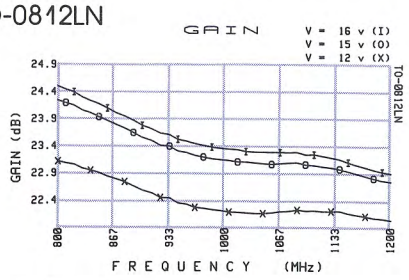


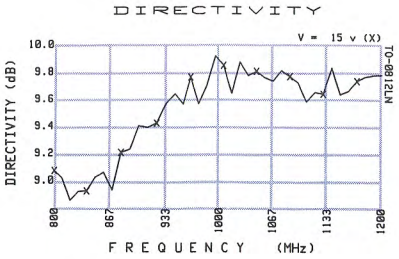
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.1	19.66	23.31	23.96	.28	29.3	27.5	27.9	1.28	.02	1.19	.01	—	4.76
.7	19.90	23.56	24.24	.27	28.8	27.1	26.9	1.11	.02	1.13	.03	—	4.95
7.9	19.89	23.55	24.21	.28	28.6	27.1	27.2	1.11	.02	1.13	.03	—	5.02
95.7	19.91	23.50	24.14	.25	28.5	27.2	26.7	1.11	.01	1.14	.03	2.98	4.91
384.7	19.69	23.21	23.81	.29	25.9	24.8	24.1	1.07	.04	1.26	.02	3.07	6.08
487.2	20.16	23.42	23.97	.34	25.0	23.5	22.8	1.08	.02	1.30	.03	3.09	6.60
615.4	20.48	23.49	24.02	.37	22.8	21.3	21.3	1.09	.04	1.36	.04	3.08	7.14
743.6	20.81	23.65	24.11	.37	21.3	19.8	19.3	1.05	.03	1.45	.05	3.05	7.47
871.8	20.79	23.50	23.96	.38	19.5	18.2	17.4	1.03	.04	1.57	.06	3.07	7.43
1000.0	20.84	23.32	23.66	.30	18.1	16.6	16.2	1.06	.02	1.71	.08	3.11	7.00

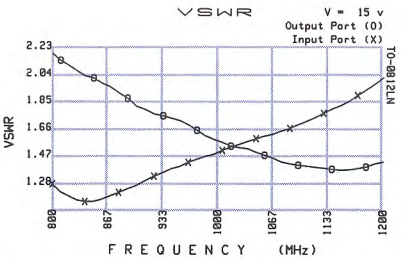
σ equals standard deviation, see Amplifier terms

Amplifiers

TO-0812LN



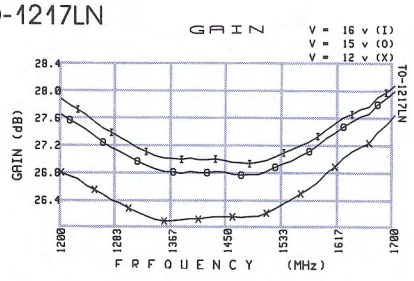


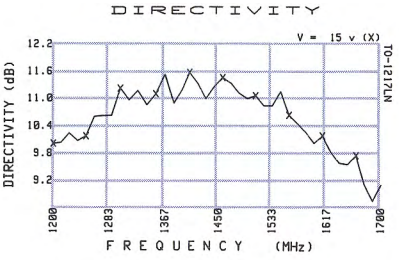


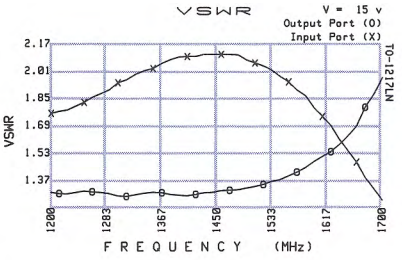
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
800.0	23.09	24.22	24.48	1.02	9.9	9.1	8.7	1.26	.47	2.18	.20	1.49	11.86
829.0	22.97	24.04	24.28	1.11	9.7	8.9	8.9	1.15	.37	2.06	.17	1.47	12.11
869.2	22.77	23.77	23.99	1.17	9.7	8.9	9.0	1.18	.25	1.94	.14	1.36	12.31
911.5	22.51	23.47	23.69	1.13	10.1	9.4	9.5	1.29	.18	1.78	.11	1.25	12.51
953.8	22.30	23.25	23.46	1.07	10.1	9.5	9.6	1.39	.13	1.71	.09	1.18	12.59
994.9	22.18	23.11	23.33	.99	10.2	9.9	9.8	1.47	.09	1.58	.08	1.16	12.74
1046.2	22.13	23.04	23.25	.92	10.1	9.8	9.9	1.58	.08	1.49	.08	1.16	12.61
1097.4	22.17	23.02	23.20	.88	9.7	9.7	9.6	1.68	.12	1.40	.09	1.24	12.39
1148.7	22.12	22.89	23.06	.85	9.5	9.6	9.8	1.81	.20	1.36	.11	1.33	12.14
1200.0	22.00	22.70	22.85	.80	9.5	9.8	9.9	2.01	.29	1.42	.14	1.44	11.98

σ equals standard deviation, see Amplifier terms

TO-1217LN



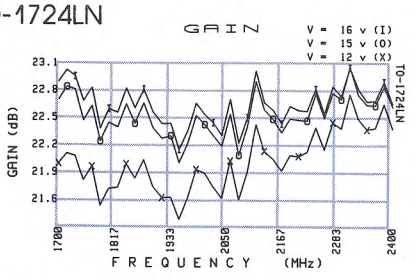


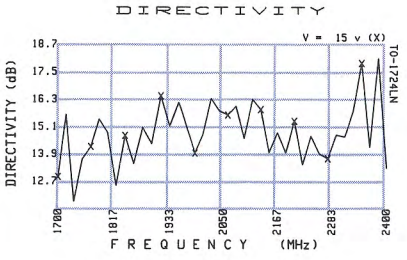


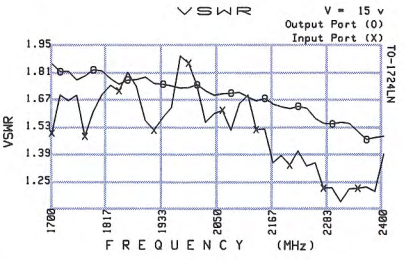
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
1200.0	26.83	27.68	27.91	.28	9.9	10.0	9.8	1.76	.27	1.30	.09	1.18	13.08
1236.6	26.64	27.45	27.67	.30	10.4	10.1	10.1	1.80	.29	1.30	.07	1.11	13.30
1287.0	26.38	27.13	27.34	.31	10.6	10.6	10.5	1.90	.25	1.29	.09	1.07	13.41
1339.6	26.14	26.88	27.07	.32	11.1	10.9	10.9	2.01	.22	1.29	.11	1.11	13.55
1392.3	26.15	26.84	27.04	.32	11.5	11.2	11.3	2.09	.21	1.28	.13	1.22	13.64
1443.6	26.18	26.83	27.00	.34	11.0	11.3	11.5	2.11	.21	1.30	.12	1.32	13.79
1507.7	26.23	26.84	27.00	.37	10.8	11.1	11.3	2.06	.23	1.33	.11	1.41	13.94
1571.8	26.59	27.13	27.27	.41	10.1	10.5	10.8	1.90	.25	1.42	.09	1.46	14.19
1635.9	27.13	27.57	27.68	.52	9.1	9.6	10.1	1.61	.28	1.58	.08	1.43	14.50
1700.0	27.66	28.02	28.10	.70	7.9	9.1	9.4	1.25	.26	1.97	.12	1.40	14.65

σ equals standard deviation, see Amplifier terms

TO-1724LN







FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
1700.0	22.01	22.71	22.91	.80	13.1	12.9	14.4	1.49	.11	1.85	.24	1.35	12.75
1751.2	21.83	22.49	22.70	.78	15.0	13.7	15.9	1.69	.13	1.77	.25	1.34	12.91
1821.9	21.75	22.42	22.58	.77	14.8	12.5	14.7	1.74	.12	1.78	.27	1.37	12.97
1895.5	21.76	22.41	22.58	.71	15.7	14.4	15.4	1.56	.10	1.78	.29	1.37	13.19
1969.2	21.64	22.24	22.38	.74	16.0	15.0	18.3	1.89	.13	1.73	.28	1.36	13.53
2041.0	21.64	22.21	22.33	.83	15.6	15.8	14.8	1.60	.12	1.69	.28	1.31	13.79
2130.8	22.16	22.61	22.69	.84	12.5	15.9	15.9	1.52	.14	1.66	.27	1.21	14.18
2220.5	22.15	22.49	22.59	.96	15.8	13.4	15.3	1.41	.14	1.64	.23	1.17	14.61
2310.3	22.77	23.08	23.07	1.07	15.4	14.7	16.3	1.15	.15	1.55	.18	1.23	15.02
2400.0	22.40	22.64	22.67	1.34	14.7	13.3	16.5	1.39	.11	1.48	.40	1.34	15.01

σ equals standard deviation, see Amplifier terms

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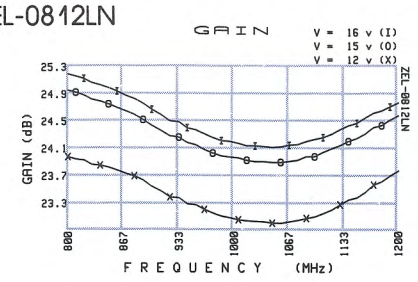
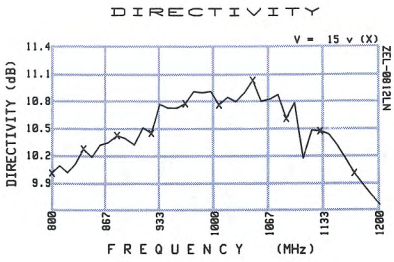
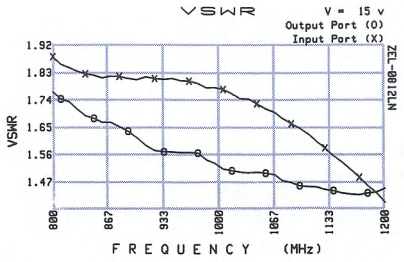
ZEL-0812LN



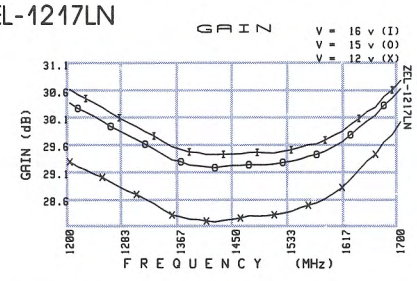


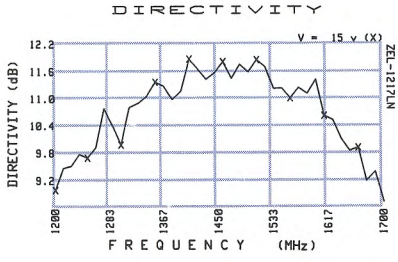


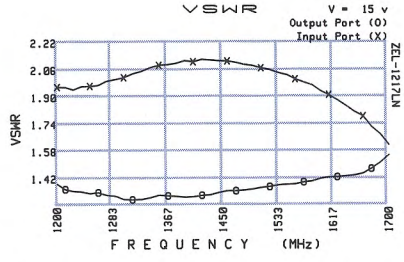
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
800.0	24.02	25.00	25.24	1.03	10.8	10.0	9.7	1.88	.16	1.77	.13	1.43	14.93
829.0	23.91	24.86	25.11	1.06	10.7	10.1	10.2	1.83	.11	1.71	.12	1.41	14.82
869.2	23.78	24.69	24.92	1.09	10.9	10.3	10.1	1.82	.08	1.67	.12	1.40	14.78
911.5	23.52	24.40	24.64	1.14	10.9	10.5	10.6	1.81	.08	1.59	.11	1.39	14.73
953.8	23.31	24.19	24.41	1.19	11.1	10.7	10.5	1.80	.10	1.57	.10	1.33	14.85
994.9	23.13	24.01	24.24	1.27	11.4	10.9	10.4	1.78	.12	1.53	.10	1.31	14.97
1046.2	23.05	23.93	24.15	1.40	11.1	11.0	10.5	1.73	.16	1.50	.09	1.27	14.98
1097.4	23.14	24.02	24.27	1.55	11.0	10.7	10.5	1.65	.18	1.46	.08	1.23	15.25
1148.7	23.41	24.28	24.50	1.61	10.3	10.3	10.1	1.53	.18	1.43	.08	1.22	15.39
1200.0	23.81	24.61	24.80	1.54	9.6	9.6	9.4	1.40	.26	1.45	.11	1.24	15.20

σ equals standard deviation, see Amplifier terms

ZEL-1217LN



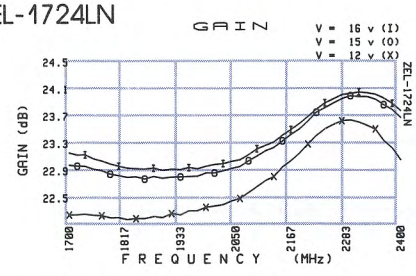


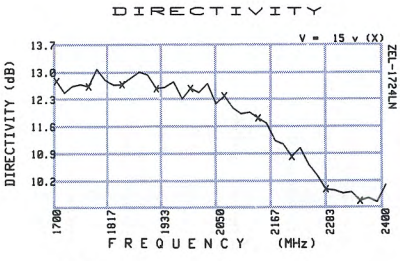


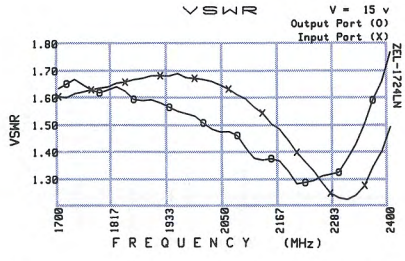
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
1200.0	29.28	30.36	30.62	1.56	9.7	9.0	9.2	1.97	.35	1.40	.14	1.30	11.67
1236.6	29.06	30.12	30.37	1.53	10.5	9.8	9.7	1.97	.31	1.35	.10	1.20	11.72
1287.0	28.74	29.77	30.00	1.48	10.4	10.4	10.1	2.01	.29	1.33	.07	1.11	11.81
1339.6	28.41	29.42	29.65	1.41	11.4	11.1	11.2	2.08	.29	1.32	.07	1.08	11.74
1392.3	28.23	29.21	29.45	1.35	11.5	11.2	11.3	2.12	.30	1.32	.08	1.09	11.83
1443.6	28.23	29.21	29.42	1.33	11.8	11.6	11.7	2.12	.31	1.35	.09	1.14	12.05
1507.7	28.31	29.24	29.44	1.28	11.5	11.9	11.7	2.08	.32	1.37	.12	1.22	12.07
1571.8	28.53	29.41	29.61	1.23	11.3	11.3	11.5	2.00	.32	1.41	.15	1.32	12.47
1635.9	29.13	29.91	30.07	1.27	10.1	10.1	10.1	1.86	.29	1.44	.22	1.43	12.79
1700.0	30.01	30.62	30.77	1.37	8.1	8.8	8.7	1.63	.20	1.57	.34	1.49	13.13

σ equals standard deviation, see Amplifier terms

ZEL-1724LN





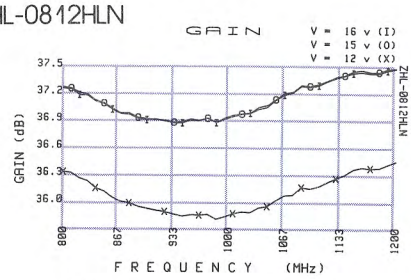


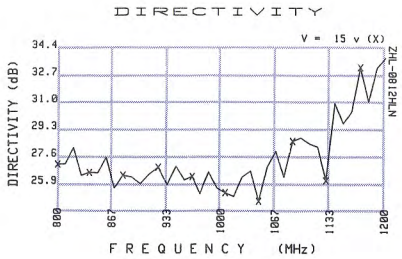
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
1700.0	22.23	22.96	23.14	1.45	12.7	12.8	12.7	1.61	.26	1.64	.17	1.28	11.46
1751.2	22.22	22.90	23.05	1.36	12.5	12.7	12.7	1.63	.22	1.65	.18	1.31	11.45
1821.9	22.16	22.78	22.91	1.29	12.6	12.7	13.0	1.66	.19	1.65	.19	1.40	11.64
1895.5	22.19	22.77	22.88	1.25	12.5	13.0	13.1	1.69	.18	1.60	.20	1.45	11.65
1969.2	22.29	22.79	22.90	1.23	12.3	12.4	13.0	1.68	.14	1.55	.20	1.47	11.79
2041.0	22.43	22.91	23.01	1.24	11.7	12.2	12.6	1.65	.16	1.48	.20	1.46	11.86
2130.8	22.78	23.21	23.29	1.29	10.8	11.9	12.2	1.55	.21	1.38	.20	1.39	12.00
2220.5	23.39	23.73	23.77	1.35	10.0	11.1	11.1	1.37	.22	1.29	.19	1.32	12.00
2310.3	23.58	23.96	24.02	1.38	9.3	9.9	10.2	1.23	.20	1.38	.10	1.31	11.58
2400.0	23.02	23.65	23.75	1.40	9.8	10.2	10.0	1.50	.10	1.77	.20	1.44	10.58

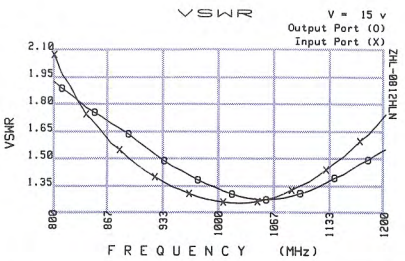
σ equals standard deviation, see Amplifier terms

Amplifiers

ZHL-0812HLN



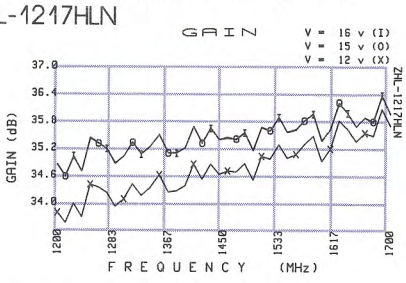


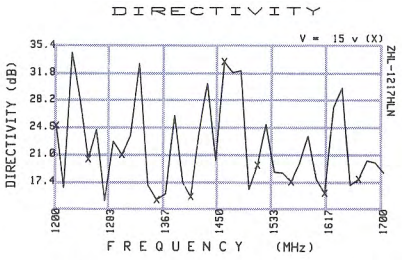


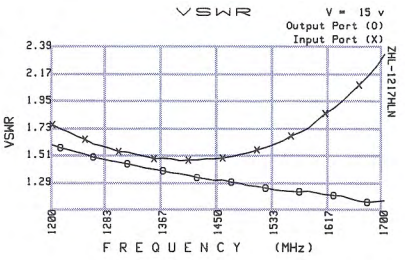
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	OUT	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
800.0	36.34	37.28	37.26	28.0	26.9	28.0	2.06	1.91	1.13	26.61
829.0	36.24	37.20	37.19	26.8	26.3	26.9	1.80	1.81	1.11	26.56
869.2	36.02	36.99	36.98	28.2	25.5	24.3	1.57	1.68	1.07	26.55
911.5	35.92	36.92	36.93	27.2	26.4	25.9	1.42	1.55	1.06	26.49
953.8	35.87	36.93	36.91	26.7	26.0	24.8	1.32	1.43	1.08	26.47
994.9	35.85	36.94	36.93	26.0	25.5	25.1	1.26	1.33	1.09	26.40
1046.2	35.96	37.08	37.06	28.0	24.7	27.7	1.26	1.27	1.11	26.39
1097.4	36.16	37.29	37.28	27.7	28.6	27.4	1.34	1.30	1.16	26.43
1148.7	36.37	37.46	37.44	30.1	29.5	29.6	1.50	1.41	1.23	26.50
1200.0	36.46	37.49	37.49	32.1	33.6	34.1	1.74	1.55	1.34	26.66

σ equals standard deviation, see Amplifier terms

ZHL-1217HLN



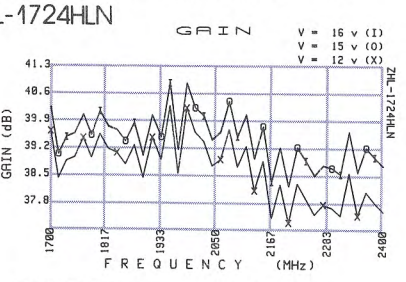


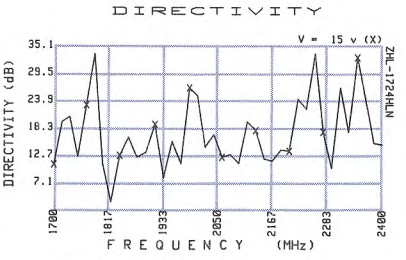


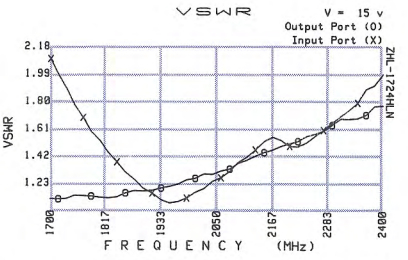
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	OUT	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
1200.0	33.75	34.80	34.82	28.7	24.8	26.1	1.75	1.59	1.30	26.55
1236.6	33.66	34.66	34.66	26.9	28.1	34.4	1.66	1.53	1.26	26.55
1287.0	33.89	34.84	34.83	20.9	22.7	16.8	1.56	1.46	1.24	26.60
1339.6	34.30	35.21	35.21	26.0	16.9	26.3	1.50	1.40	1.20	26.69
1392.3	34.34	35.18	35.19	22.7	17.2	15.1	1.46	1.36	1.16	26.91
1443.6	34.60	35.37	35.36	20.2	20.2	29.2	1.48	1.30	1.14	27.11
1507.7	35.00	35.64	35.63	17.9	19.6	24.0	1.55	1.26	1.13	27.47
1571.8	35.26	35.78	35.79	23.1	19.8	23.0	1.69	1.21	1.15	28.20
1635.9	35.60	35.95	35.95	19.3	29.8	14.3	1.95	1.18	1.22	28.89
1700.0	35.67	35.94	35.93	12.6	18.6	13.4	2.32	1.14	1.35	28.72

σ equals standard deviation, see Amplifier terms

ZHL-1724HLN







FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	OUT	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
1700.0	39.56	40.17	40.15	11.2	10.7	17.3	2.09	1.11	1.33	27.69
1751.2	38.88	39.50	39.50	15.2	12.3	12.2	1.77	1.14	1.21	27.57
1821.9	39.10	39.69	39.66	15.8	3.1	14.5	1.44	1.12	1.10	27.36
1895.5	38.37	38.94	38.93	23.5	13.2	9.0	1.19	1.17	1.08	27.31
1969.2	38.48	39.09	39.09	15.2	10.9	14.8	1.10	1.22	1.12	27.00
2041.0	38.68	39.37	39.35	24.6	16.9	21.5	1.24	1.29	1.16	26.97
2130.8	38.05	38.89	38.87	13.3	17.8	17.3	1.46	1.42	1.20	26.77
2220.5	38.23	39.17	39.16	10.6	24.2	10.6	1.48	1.52	1.21	26.52
2310.3	37.42	38.47	38.48	17.3	26.6	13.9	1.69	1.68	1.20	26.42
2400.0	37.51	38.68	38.69	13.8	14.9	14.8	1.98	1.76	1.19	26.15

σ equals standard deviation, see Amplifier terms

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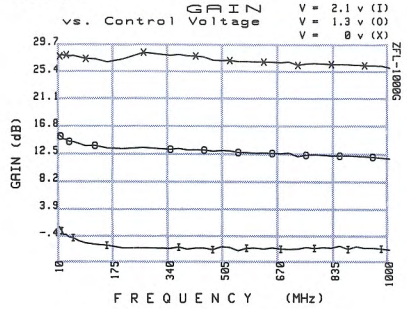
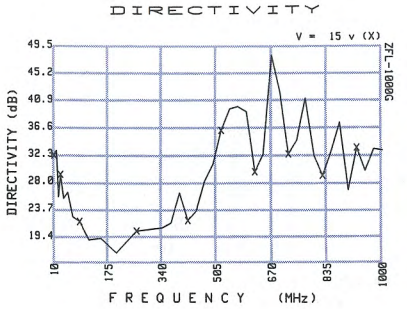
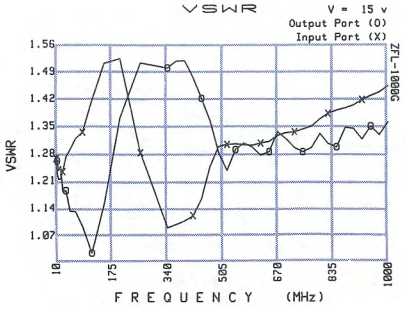
ZFL-1000G



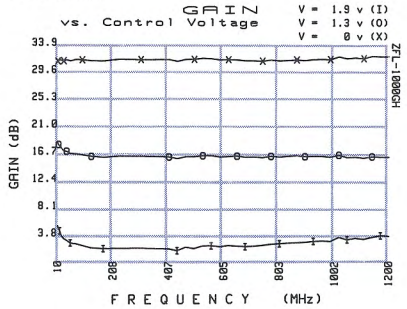


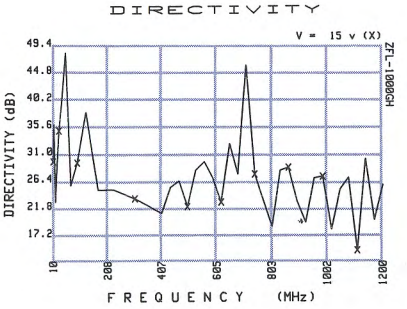


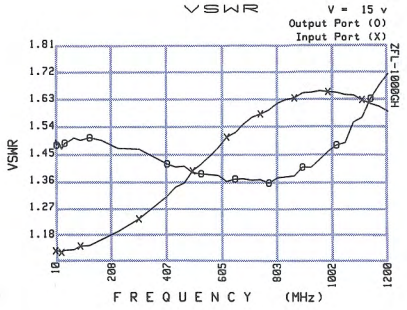
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	24.14	27.63	28.03	.26	37.3	32.1	33.4	1.26	.04	1.27	.09	9.36	10.50
17.2	24.20	27.68	28.06	.27	35.7	32.8	28.7	1.21	.02	1.23	.06	9.29	10.81
38.8	24.05	27.44	27.82	.17	28.8	25.2	23.6	1.27	.04	1.18	.08	9.09	10.89
87.6	23.89	27.22	27.58	.11	26.9	21.6	20.8	1.33	.05	1.09	.07	9.14	10.91
197.6	23.89	27.17	27.55	.60	20.0	16.7	17.4	1.52	.18	1.37	.10	9.14	10.82
365.4	24.04	27.75	28.16	.51	25.6	21.4	20.5	1.09	.10	1.51	.15	9.38	10.70
441.5	23.72	27.35	27.76	.34	26.9	23.2	24.2	1.16	.10	1.42	.08	9.45	10.69
517.7	23.27	26.75	27.14	.48	37.6	35.9	34.0	1.30	.05	1.23	.14	9.49	10.67
568.5	23.18	26.71	27.11	.38	47.9	39.7	33.0	1.30	.09	1.30	.10	9.53	10.51
619.2	23.09	26.65	27.05	.32	37.7	29.3	32.9	1.30	.04	1.27	.07	9.58	10.38
695.4	22.91	26.46	26.88	.31	51.0	41.8	35.0	1.33	.04	1.31	.04	9.68	10.16
771.5	22.75	26.35	26.76	.31	31.1	40.9	32.3	1.35	.03	1.29	.06	9.79	9.88
847.7	22.59	26.20	26.62	.30	52.0	32.5	36.6	1.39	.02	1.29	.06	9.90	9.55
923.8	22.46	26.12	26.55	.31	37.7	33.1	31.9	1.41	.02	1.31	.04	9.99	9.14
1000.0	22.16	25.92	26.36	.33	47.0	32.7	30.6	1.45	.02	1.36	.03	10.01	8.73

σ equals standard deviation, see Amplifier terms

ZFL-1000GH





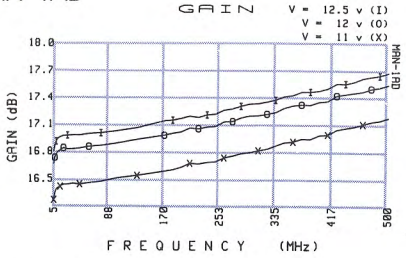


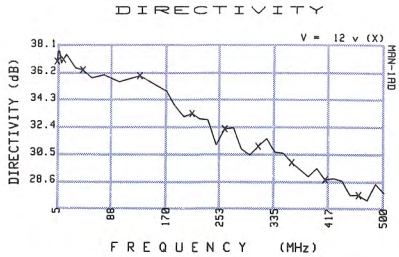
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	27.54	31.27	31.66	.84	39.9	29.3	31.9	1.12	0.00	1.49	.13	17.02	17.04
17.7	27.35	31.14	31.50	.86	29.6	22.4	31.2	1.12	0.00	1.48	.14	16.97	17.36
41.6	27.35	31.43	31.48	.92	36.6	39.5	46.9	1.12	0.00	1.48	.14	16.83	17.35
97.8	27.70	32.02	31.82	.96	27.4	29.0	27.5	1.14	0.00	1.49	.13	16.77	17.17
230.0	28.29	32.69	32.42	.98	28.2	24.4	20.4	1.18	.01	1.46	.12	16.45	16.94
437.2	28.19	32.70	32.38	.96	29.3	24.8	25.6	1.33	.01	1.40	.08	15.62	16.66
528.7	27.51	31.97	31.66	.97	26.0	27.7	25.2	1.41	.01	1.38	.07	15.19	16.71
620.3	27.82	32.29	31.97	.96	23.2	22.4	30.2	1.50	.02	1.35	.05	14.75	16.71
681.3	28.06	32.53	32.23	.95	30.6	27.1	30.3	1.54	.02	1.36	.04	14.50	16.65
742.3	27.49	31.98	31.66	.95	30.1	27.1	23.5	1.57	.02	1.36	.03	14.25	16.62
833.8	27.74	32.30	31.98	.97	28.0	27.7	21.5	1.62	.02	1.37	.03	13.94	16.46
925.4	27.20	31.88	31.54	1.01	31.3	19.0	27.5	1.64	.03	1.40	.02	13.60	16.23
1016.9	27.85	32.75	32.41	1.05	27.4	17.8	19.2	1.64	.03	1.47	.03	13.23	15.84
1108.5	27.50	32.66	32.31	1.12	32.9	14.2	21.0	1.62	.03	1.56	.04	12.84	15.32
1200.0	27.37	32.77	32.38	1.21	28.4	25.3	23.7	1.58	.04	1.71	.06	12.50	14.68

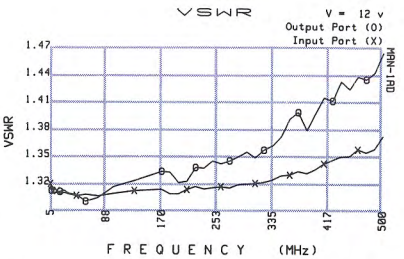
σ equals standard deviation, see Amplifier terms

Amplifiers

MAN-1AD



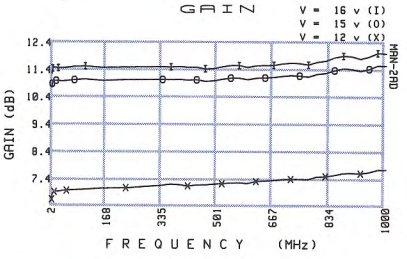


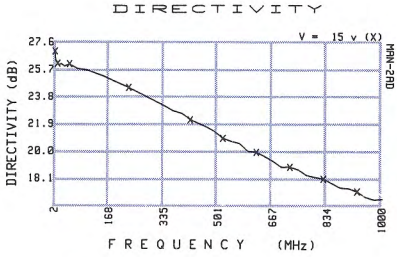


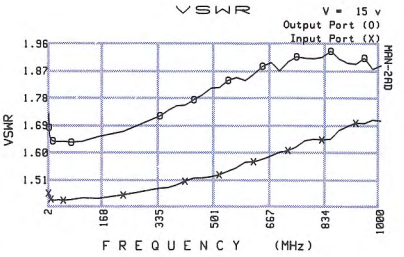
FREQUENCY (MHz)	GAIN (dB) 11.0V	12.0V	12.5V	σ1	DIRECTIVITY (dB) 11.0V	12.0V	12.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	Pout(dBm) (@1dBCOMPR)
5.0	16.25	16.65	16.78	.59	37.1	36.9	37.1	1.31	.03	1.31	.07	—	9.50
11.3	16.38	16.78	16.92	.61	36.0	36.7	36.8	1.31	.03	1.30	.07	7.41	9.48
33.4	16.43	16.81	16.96	.63	37.1	36.4	37.2	1.30	.02	1.30	.07	7.29	9.67
98.8	16.49	16.87	17.01	.62	36.3	35.4	36.0	1.30	.02	1.31	.07	7.46	9.59
195.4	16.61	17.00	17.15	.59	32.6	33.0	33.5	1.30	.02	1.32	.06	7.45	9.50
246.2	16.67	17.06	17.19	.57	33.8	31.0	32.2	1.31	.02	1.34	.06	7.24	9.52
309.6	16.79	17.18	17.31	.54	31.5	31.0	30.4	1.32	.03	1.34	.06	7.25	9.49
373.1	16.92	17.30	17.44	.51	30.1	29.3	29.7	1.33	.03	1.39	.05	7.31	9.36
436.5	17.04	17.41	17.53	.47	28.5	28.6	28.2	1.35	.03	1.43	.05	7.39	9.37
500.0	17.15	17.52	17.65	.43	27.5	27.7	27.1	1.37	.03	1.46	.04	7.49	9.40

σ equals standard deviation, see Amplifier terms

ZFL-2AD/MAN-2AD



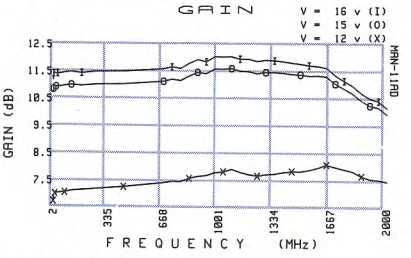


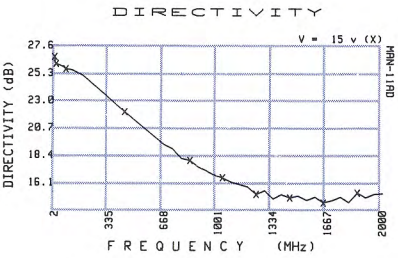


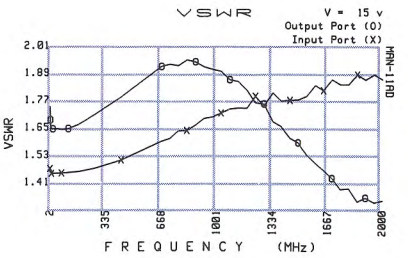
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	Pout(dBm) (@1dBCOMPR)
2.0	6.66	10.75	11.25	.08	26.8	26.9	27.3	1.47	.01	1.73	.01	—	— .40
6.5	6.92	10.99	11.49	.08	25.9	26.3	26.6	1.45	.01	1.65	.01	—	— .28
31.5	6.97	10.99	11.47	.07	25.7	25.9	26.4	1.45	.01	1.64	.01	5.94	— .05
152.2	7.06	11.01	11.49	.08	25.1	25.2	25.5	1.45	.01	1.66	.01	5.89	— .03
385.8	7.19	11.05	11.52	.11	22.9	22.6	22.6	1.50	.01	1.76	.01	5.85	— .07
488.2	7.23	11.01	11.45	.12	22.0	21.4	21.3	1.52	.01	1.82	.01	5.90	.02
616.2	7.33	11.10	11.56	.15	20.7	19.9	20.0	1.57	.01	1.86	.02	6.02	.01
744.1	7.41	11.19	11.65	.17	19.7	18.7	18.7	1.62	.01	1.92	.02	6.15	.02
872.1	7.62	11.46	11.93	.19	18.6	17.5	17.4	1.68	.01	1.92	.02	7.14	— .34
1000.0	7.76	11.56	12.02	.19	17.8	16.7	16.7	1.71	.02	1.89	.03	6.31	— .56

σ equals standard deviation, see Amplifier terms

ZFL-11AD/MAN-11AD







FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	Pout(dBm) (@1dBCOMPR)
2.0	6.79	10.76	11.24	.08	26.5	26.6	27.2	1.47	.01	1.74	.01	—	— .31
7.6	7.04	10.99	11.47	.07	25.8	26.1	26.5	1.45	.01	1.65	.01	—	— .21
45.7	7.10	10.99	11.47	.07	25.6	25.9	26.3	1.45	.01	1.64	.01	5.56	— .01
273.2	7.24	11.07	11.54	.07	24.0	23.9	24.0	1.47	.01	1.71	.01	5.53	— .05
770.5	7.50	11.21	11.65	.10	19.3	18.1	18.0	1.63	.02	1.92	.04	5.75	.02
975.4	7.83	11.63	12.08	.09	17.8	16.7	16.6	1.69	.03	1.90	.04	5.88	— .49
1231.5	7.71	11.46	11.91	.10	16.8	15.1	14.9	1.79	.05	1.76	.04	5.88	— 1.40
1487.7	7.87	11.42	11.82	.13	16.3	15.0	14.7	1.77	.08	1.58	.04	6.09	— 1.87
1743.8	7.95	10.91	11.19	.20	15.7	14.9	14.8	1.84	.11	1.38	.03	6.49	— 1.41
2000.0	7.50	9.96	10.19	.23	15.2	15.2	15.2	1.86	.14	1.33	.03	6.62	— 1.50

σ equals standard deviation, see Amplifier terms

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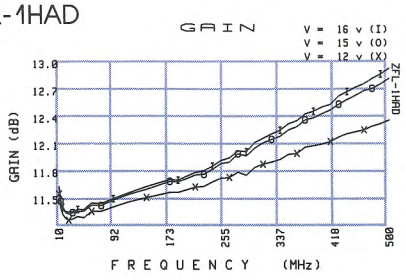
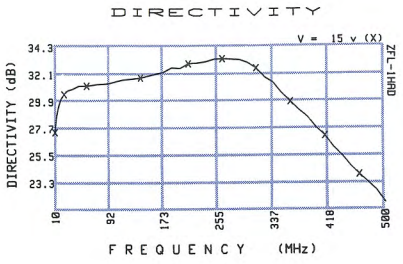
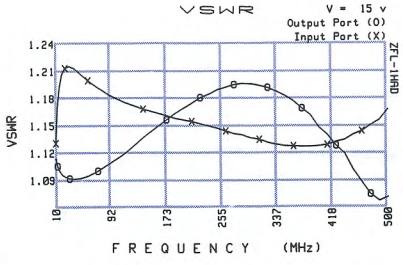
ZFL-1HAD



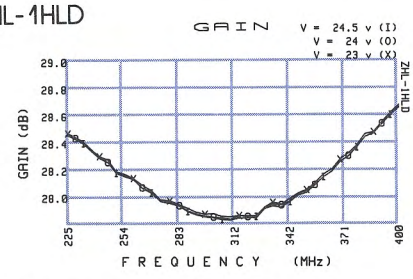


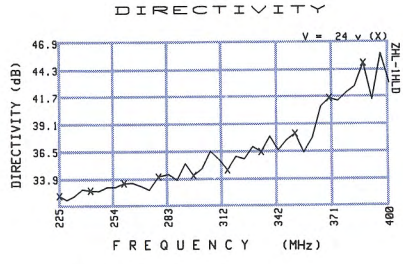


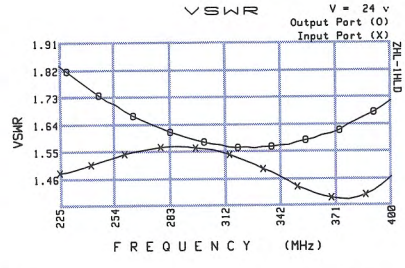
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	Pout(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	11.57	11.63	11.65	.17	27.4	27.5	27.4	1.13	.01	1.11	.03	6.77	20.80
19.3	11.30	11.37	11.38	.19	30.1	30.2	30.2	1.21	.01	1.10	.04	6.78	22.17
46.5	11.31	11.38	11.40	.20	31.1	31.2	31.2	1.21	.01	1.09	.04	6.75	22.56
111.8	11.48	11.56	11.58	.21	31.6	31.7	31.5	1.18	.01	1.12	.04	6.76	22.61
198.5	11.61	11.74	11.76	.26	32.4	32.6	32.8	1.16	0.00	1.17	.03	6.82	22.21
248.7	11.74	11.90	11.94	.31	32.7	33.3	33.4	1.15	0.00	1.19	.03	6.93	21.99
311.5	11.89	12.13	12.18	.36	31.4	32.6	33.0	1.14	.01	1.19	.03	7.05	21.71
374.4	12.08	12.38	12.45	.43	28.3	29.2	29.3	1.13	.01	1.17	.04	7.19	21.35
437.2	12.23	12.60	12.69	.47	25.2	25.5	25.6	1.13	.02	1.12	.05	7.33	21.27
500.0	12.37	12.83	12.94	.51	21.6	21.7	21.7	1.17	.02	1.07	.03	7.46	21.26

σ equals standard deviation, see Amplifier terms

ZHL-1HLD



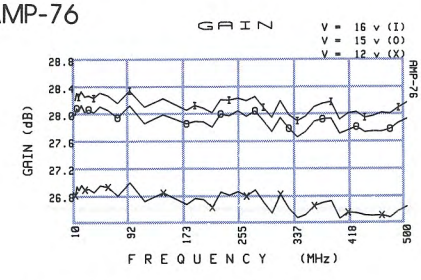


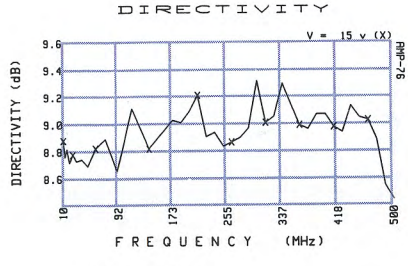


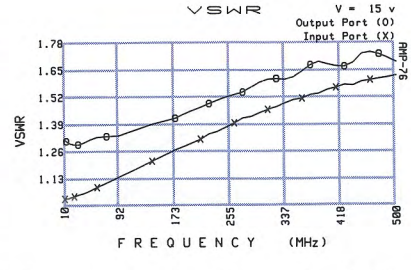
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	Pout(dBm)
(MHz)	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
225.0	28.50	28.49	28.49	.74	32.2	32.4	31.7	1.48	.11	1.84	.16	1.96	29.63
237.3	28.38	28.37	28.37	.73	32.3	33.0	32.2	1.50	.14	1.78	.16	1.94	29.44
254.7	28.20	28.19	28.18	.74	33.1	33.2	33.2	1.54	.15	1.71	.16	1.94	29.22
273.5	28.01	28.00	28.00	.76	33.9	33.0	34.0	1.56	.16	1.65	.15	1.97	29.13
292.3	27.92	27.91	27.90	.76	35.7	35.5	35.2	1.57	.16	1.60	.14	2.00	29.04
310.3	27.88	27.87	27.86	.77	35.4	35.9	35.2	1.55	.16	1.58	.13	2.02	29.01
332.7	27.99	27.98	27.96	.77	37.2	36.6	37.2	1.49	.15	1.57	.12	2.03	28.96
355.1	28.13	28.12	28.11	.78	37.4	36.5	37.6	1.43	.15	1.59	.11	1.98	28.98
377.6	28.41	28.40	28.39	.79	41.0	42.2	40.1	1.39	.13	1.64	.12	1.92	28.90
400.0	28.71	28.69	28.68	.80	47.5	43.2	42.8	1.47	.10	1.72	.14	1.82	28.77

σ equals standard deviation, see Amplifier terms

AMP-76





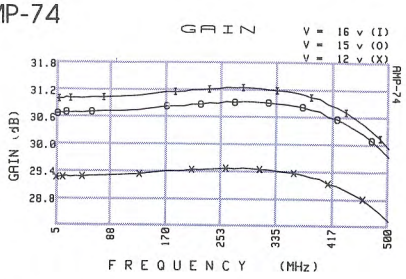


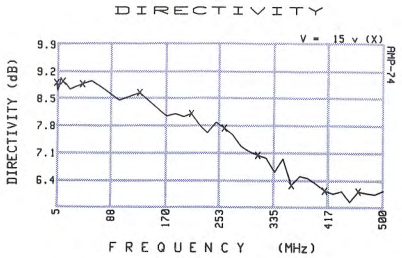
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	Pout(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	26.84	28.02	28.24	.05	9.4	8.8	8.8	1.04	.01	1.32	.01	3.06	16.64
19.3	26.99	28.17	28.37	.07	9.1	8.7	8.6	1.04	.01	1.30	.01	3.01	16.90
46.5	26.99	28.15	28.35	.05	9.3	8.7	8.6	1.07	.01	1.32	.01	2.97	16.83
111.8	26.75	27.90	28.14	.05	9.5	9.1	8.8	1.17	.01	1.37	.01	3.01	16.73
198.5	26.78	27.92	28.12	.05	9.5	9.1	8.9	1.31	.01	1.46	.01	2.96	16.71
248.7	26.89	28.08	28.27	.04	9.6	8.8	8.7	1.38	.02	1.52	.01	3.00	16.70
311.5	26.86	27.98	28.23	.09	9.6	9.0	8.7	1.47	.02	1.61	.01	3.04	16.73
374.4	26.74	27.96	28.19	.09	9.9	8.9	8.7	1.54	.03	1.68	.02	3.12	16.66
437.2	26.55	27.77	27.98	.12	9.9	9.1	8.8	1.58	.04	1.69	.03	3.21	16.55
500.0	26.67	27.96	28.20	.16	9.6	8.4	8.2	1.63	.04	1.69	.04	3.25	16.42

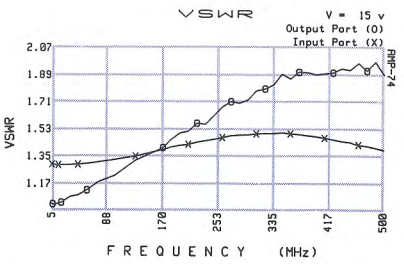
σ equals standard deviation, see Amplifier terms

Amplifiers

AMP-74



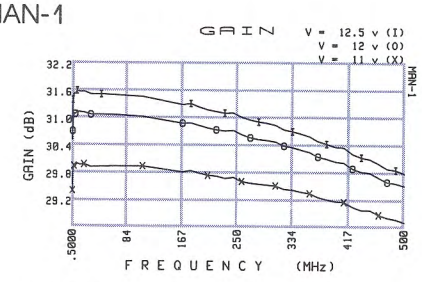


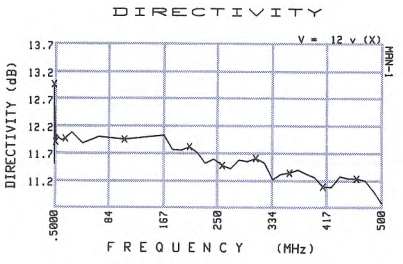


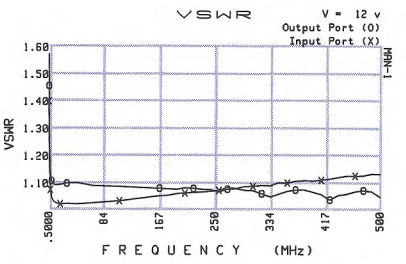
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	29.29	30.70	31.03	.05	9.4	8.9	9.0	1.29	.03	1.04	.02	—	9.84
11.3	29.29	30.72	31.04	.05	9.3	9.1	8.7	1.29	.03	1.03	.01	4.53	9.70
33.4	29.30	30.72	31.05	.06	9.1	8.8	8.8	1.29	.03	1.09	.01	4.46	9.83
98.8	29.33	30.75	31.07	.09	9.3	8.5	8.7	1.33	.04	1.22	.03	4.57	9.66
195.4	29.43	30.86	31.18	.23	8.8	8.1	8.3	1.42	.08	1.50	.07	4.69	9.57
246.2	29.47	30.92	31.25	.31	8.3	7.9	7.7	1.46	.10	1.62	.08	4.81	9.39
309.6	29.46	30.95	31.25	.33	7.7	7.1	6.8	1.50	.14	1.78	.09	4.91	8.98
373.1	29.35	30.84	31.13	.24	7.4	6.5	6.1	1.50	.17	1.91	.08	4.96	8.74
436.5	29.01	30.48	30.73	.14	6.9	6.2	5.9	1.45	.18	1.93	.09	4.96	8.64
500.0	28.33	29.74	29.94	.27	7.3	6.2	6.3	1.39	.16	1.89	.11	4.95	8.58

σ equals standard deviation, see Amplifier terms

MAN-1



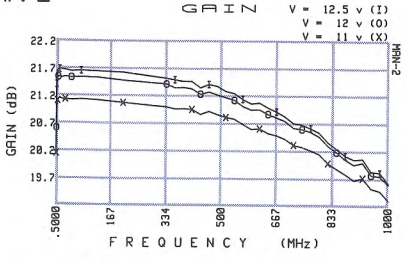


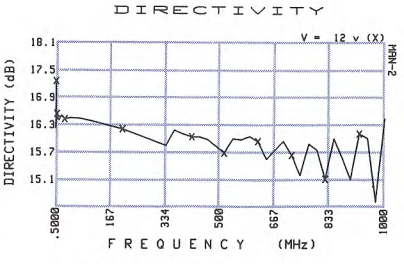


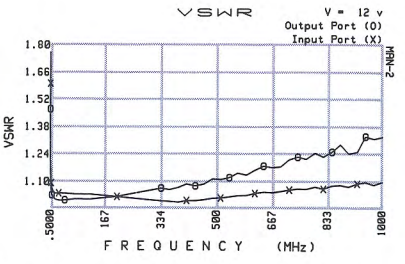
FREQUENCY (MHz)	GAIN (dB) 11.0V	12.0V	12.5V	σ1	DIRECTIVITY (dB) 11.0V	12.0V	12.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.5	29.45	30.56	30.97	.48	13.3	13.0	12.7	1.40	.08	1.57	.04	—	8.35
1.9	29.93	31.07	31.52	.43	12.8	12.3	12.0	1.12	.03	1.18	.02	—	8.31
11.4	30.02	31.17	31.62	.42	12.4	12.0	11.8	1.03	.04	1.09	.03	2.80	8.16
68.3	29.99	31.11	31.54	.42	12.4	12.0	11.9	1.03	.04	1.09	.03	2.74	8.32
192.6	29.83	30.87	31.28	.42	12.0	11.8	11.5	1.06	.04	1.08	.03	2.77	8.41
243.8	29.74	30.77	31.15	.43	12.0	11.6	11.3	1.07	.04	1.08	.03	2.80	8.24
307.9	29.55	30.52	30.88	.43	11.9	11.6	11.3	1.09	.04	1.07	.03	2.84	8.28
371.9	29.29	30.19	30.53	.42	11.8	11.4	11.2	1.11	.05	1.07	.03	2.89	8.38
436.0	29.01	29.86	30.17	.39	11.5	11.3	11.1	1.12	.04	1.05	.04	2.95	8.51
500.0	28.74	29.54	29.82	.38	11.2	10.8	10.7	1.13	.05	1.05	.03	3.02	8.52

σ equals standard deviation, see Amplifier terms

MAN-2







FREQUENCY (MHz)	GAIN (dB) 11.0V	12.0V	12.5V	σ1	DIRECTIVITY (dB) 11.0V	12.0V	12.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.5	20.16	20.56	20.71	.60	17.5	17.3	17.1	1.61	.03	1.77	.04	—	9.12
2.2	21.09	21.48	21.63	.59	16.9	16.5	16.6	1.16	.02	1.11	.06	—	9.45
16.6	21.15	21.54	21.70	.63	16.7	16.5	16.3	1.05	.03	1.02	.06	6.40	9.56
122.7	21.13	21.55	21.66	.64	16.6	16.4	16.2	1.04	.03	1.02	.05	6.32	9.46
384.9	20.98	21.37	21.48	.65	16.5	16.1	16.0	1.00	.04	1.08	.03	6.44	9.33
487.4	20.88	21.24	21.39	.69	16.2	15.9	15.8	1.02	.04	1.12	.01	6.47	9.31
615.6	20.62	20.96	21.09	.72	16.2	16.0	15.9	1.05	.04	1.17	.02	6.50	9.42
743.7	20.28	20.61	20.69	.74	15.6	15.2	15.3	1.07	.04	1.23	.04	6.49	9.34
871.9	19.79	20.05	20.12	.81	15.8	15.6	15.4	1.09	.06	1.30	.08	6.52	9.21
1000.0	19.31	19.59	19.62	.80	16.9	16.5	16.5	1.11	.08	1.34	.13	6.56	8.74

σ equals standard deviation, see Amplifier terms

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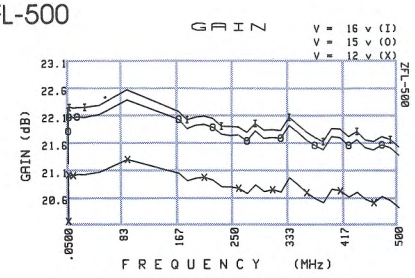
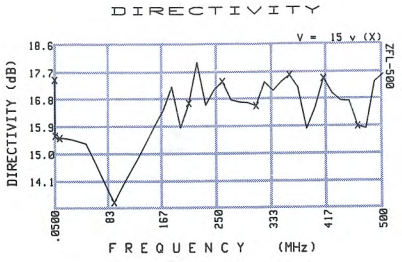
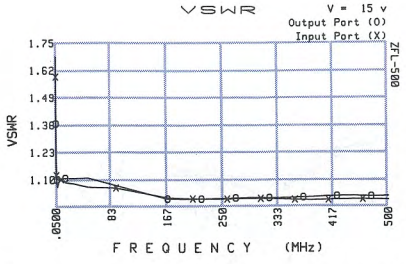
ZFL-500



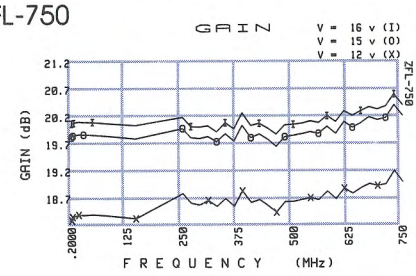


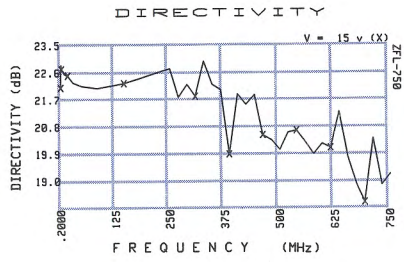


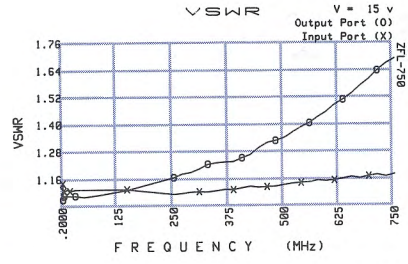
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.050	20.18	21.24	21.41	.50	18.1	17.5	17.4	1.59	.08	1.69	.04	—	10.52
.325	21.00	22.06	22.23	.55	16.4	15.7	15.6	1.17	.03	1.11	.04	—	10.82
3.944	21.03	22.08	22.27	.55	16.3	15.6	15.5	1.09	.05	1.11	.05	—	10.84
47.856	21.08	22.13	22.30	.55	16.1	15.4	15.3	1.07	.06	1.11	.04	5.72	10.87
192.338	20.96	21.93	22.07	.53	15.4	15.9	17.1	1.01	.01	1.01	0.00	5.74	10.31
243.615	20.79	21.74	21.90	.55	16.8	17.2	16.8	1.01	.01	1.01	0.00	5.76	10.28
307.712	20.74	21.70	21.84	.52	16.2	16.6	16.6	1.01	0.00	1.02	0.00	5.77	10.26
371.808	20.58	21.55	21.70	.53	16.4	17.2	17.6	1.01	.01	1.02	0.00	5.77	10.23
435.904	20.69	21.65	21.80	.52	15.7	16.8	16.1	1.01	0.00	1.03	0.00	5.78	10.14
500.000	20.40	21.36	21.52	.52	17.1	17.7	16.7	1.01	.01	1.02	0.00	5.79	10.05

σ equals standard deviation, see Amplifier terms

ZFL-750



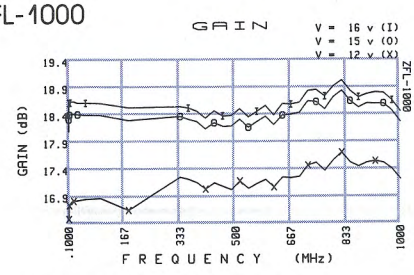


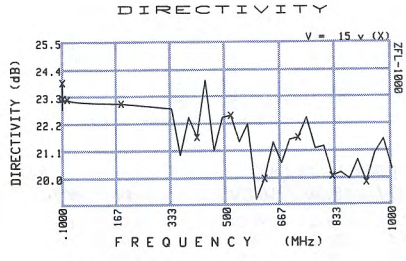


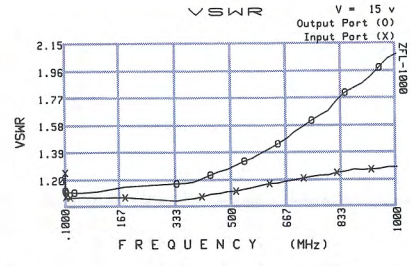
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.2	18.30	19.78	20.01	.33	22.9	22.2	22.0	1.14	.03	1.10	.01	—	10.39
1.0	18.36	19.85	20.08	.31	23.9	22.9	22.6	1.10	.03	1.08	.02	—	10.50
9.3	18.38	19.86	20.10	.27	23.7	22.6	22.5	1.11	.04	1.09	.02	—	10.61
83.5	18.38	19.84	20.07	.24	23.1	22.1	21.9	1.11	.03	1.09	.02	6.17	10.55
288.6	18.57	19.79	20.00	.10	22.7	22.3	20.7	1.10	.01	1.19	.02	6.22	10.14
365.5	18.55	19.74	19.97	.09	22.4	22.1	20.4	1.11	.01	1.23	.02	6.25	10.07
461.6	18.44	19.64	19.87	.10	22.6	20.6	20.8	1.12	.01	1.32	.02	6.25	9.94
557.7	18.66	19.88	20.07	.14	21.8	20.4	19.7	1.14	.01	1.40	.02	6.20	9.87
653.9	18.87	20.06	20.29	.17	22.1	19.8	20.3	1.17	.01	1.54	.03	6.13	9.54
750.0	18.98	20.20	20.39	.20	19.4	19.3	19.5	1.18	.01	1.69	.04	6.09	9.26

σ equals standard deviation, see Amplifier terms

ZFL-1000





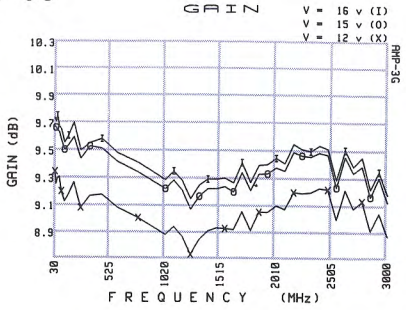


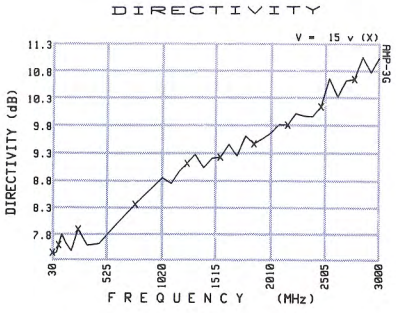
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.1	16.48	18.08	18.31	.45	25.1	23.9	23.8	1.26	.04	1.17	.01	—	10.39
.7	16.72	18.38	18.60	.19	24.6	23.3	23.1	1.10	.03	1.12	.03	—	10.43
7.9	16.79	18.40	18.64	.21	24.4	23.3	23.1	1.09	.03	1.13	.03	—	10.53
95.7	16.86	18.38	18.60	.21	24.1	23.1	23.0	1.09	.03	1.13	.03	6.15	10.50
384.7	17.14	18.26	18.45	.14	22.8	22.5	23.0	1.08	.02	1.19	.03	6.21	9.78
487.2	17.01	18.18	18.37	.16	23.3	22.5	22.8	1.13	.02	1.28	.03	6.20	9.75
615.4	17.06	18.20	18.38	.18	22.3	20.0	23.2	1.18	.03	1.42	.04	6.13	9.45
743.6	17.50	18.62	18.85	.18	23.9	22.5	21.2	1.23	.05	1.62	.04	6.04	9.11
871.8	17.43	18.52	18.70	.17	21.2	20.0	19.3	1.28	.05	1.85	.04	8.29	8.60
1000.0	17.19	18.25	18.44	.19	20.0	20.4	20.1	1.29	.06	2.08	.04	6.09	7.99

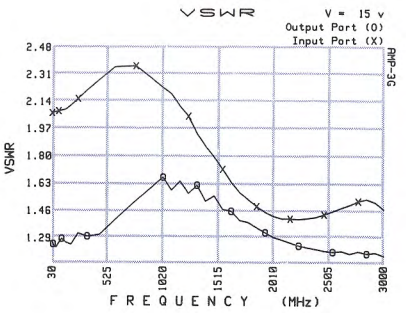
σ equals standard deviation, see Amplifier terms

Amplifiers

AMP-3G



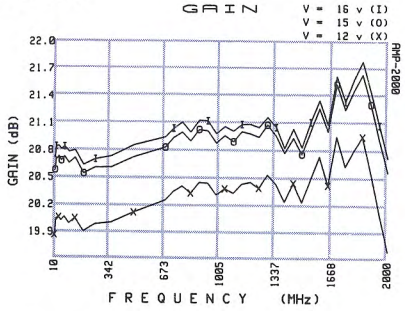


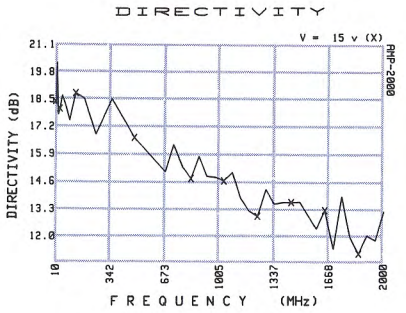


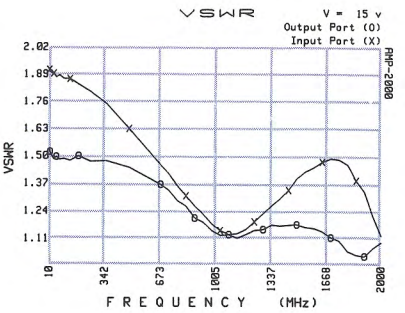
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
30.0	9.39	9.72	9.78	.38	7.8	7.5	7.4	2.07	.08	1.28	.01	10.05	15.54
51.6	9.34	9.69	9.80	.38	7.8	7.5	7.3	2.08	.08	1.24	.02	9.44	15.40
116.5	9.17	9.55	9.60	.38	8.2	7.8	7.8	2.09	.07	1.29	.02	7.92	15.37
262.8	9.13	9.49	9.55	.36	8.3	7.9	7.9	2.16	.07	1.33	.02	6.04	15.18
592.9	9.13	9.46	9.53	.36	8.3	8.0	7.9	2.36	.06	1.41	.04	4.35	15.02
1096.2	8.99	9.33	9.39	.37	9.0	8.7	8.7	2.19	.06	1.59	.10	3.79	14.55
1324.6	8.90	9.21	9.29	.37	9.4	9.3	9.2	1.94	.06	1.62	.12	3.52	14.59
1553.1	8.98	9.28	9.35	.38	9.3	9.2	9.2	1.72	.06	1.47	.11	3.49	15.07
1705.4	9.10	9.39	9.46	.39	9.3	9.2	9.2	1.58	.06	1.40	.10	3.58	15.41
1857.7	9.10	9.38	9.44	.39	9.6	9.5	9.5	1.49	.05	1.36	.10	3.52	15.51
2086.2	9.12	9.40	9.45	.37	9.9	9.8	9.9	1.41	.05	1.28	.10	3.30	15.33
2314.6	9.24	9.50	9.54	.34	9.9	10.0	10.1	1.41	.05	1.23	.08	3.11	15.68
2543.1	9.04	9.28	9.33	.32	10.4	10.7	10.8	1.46	.07	1.21	.07	3.37	15.99
2771.5	9.18	9.43	9.50	.32	10.4	10.6	10.8	1.52	.09	1.21	.07	3.54	16.27
3000.0	8.92	9.17	9.22	.35	10.6	11.0	11.2	1.47	.07	1.18	.03	3.34	16.32

σ equals standard deviation, see Amplifier terms

AMP-2000







FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	19.85	20.55	20.70	.37	19.6	18.4	19.3	1.92	.06	1.54	.18	8.26	15.59
19.1	20.02	20.69	20.82	.33	19.4	20.2	18.1	1.91	.06	1.51	.11	8.01	16.22
50.5	20.01	20.66	20.79	.35	19.4	18.7	18.5	1.88	.05	1.50	.09	7.15	16.25
133.4	20.03	20.69	20.78	.35	18.3	18.8	17.9	1.87	.05	1.48	.09	6.19	16.27
352.3	19.98	20.59	20.71	.32	18.3	18.5	16.6	1.75	.05	1.48	.06	5.10	16.47
724.4	20.33	20.92	21.02	.45	16.0	16.3	16.0	1.42	.07	1.34	.06	4.32	16.98
877.4	20.42	21.01	21.11	.44	15.9	15.7	13.6	1.27	.07	1.21	.07	4.28	17.03
1030.5	20.36	20.94	21.04	.40	14.5	14.6	14.6	1.15	.06	1.13	.05	4.43	17.31
1132.6	20.41	20.99	21.07	.35	14.9	13.8	14.0	1.14	.05	1.11	.07	4.62	17.38
1234.6	20.36	20.93	21.03	.35	14.2	12.9	14.2	1.19	.07	1.15	.04	4.64	17.41
1387.7	20.21	20.75	20.80	.37	14.1	13.6	14.5	1.30	.08	1.17	.02	4.32	17.59
1540.8	20.46	20.99	21.09	.42	13.3	12.9	13.4	1.43	.10	1.17	.04	4.64	17.89
1693.8	20.93	21.51	21.59	.45	12.0	11.4	12.2	1.49	.11	1.12	.06	5.05	17.70
1846.9	20.93	21.61	21.76	.32	10.7	11.1	11.7	1.38	.09	1.03	.04	4.51	17.26
2000.0	19.68	20.54	20.69	.22	13.3	13.1	13.1	1.12	.04	1.09	.03	4.90	16.11

σ equals standard deviation, see Amplifier terms

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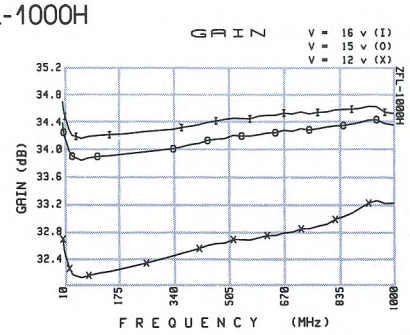
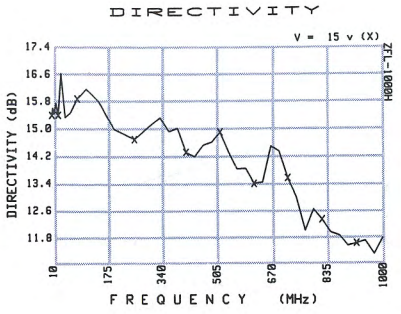
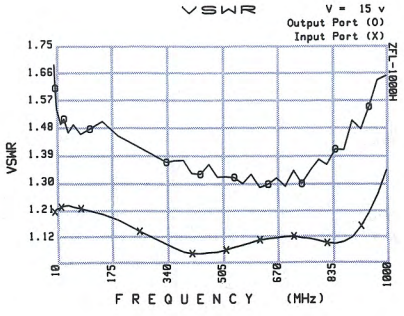
ZFL-1000H



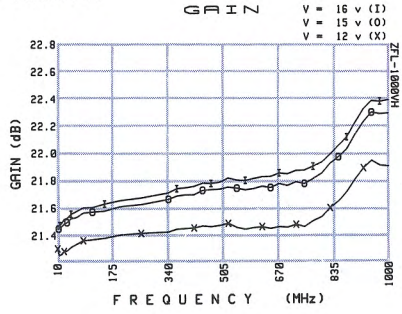


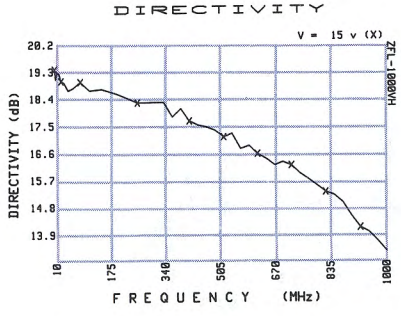


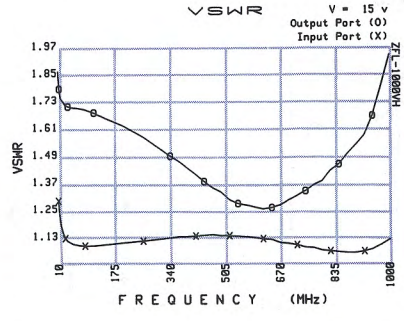
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	32.70	34.40	34.71	.24	16.1	15.3	15.4	1.21	.03	1.69	.16	4.82	21.35
17.2	32.46	34.18	34.49	.21	16.4	15.4	15.6	1.22	.02	1.54	.08	4.77	21.44
38.8	32.18	33.91	34.21	.21	16.3	16.6	15.5	1.22	.02	1.51	.05	4.63	21.13
87.6	32.17	33.88	34.20	.21	16.8	15.8	16.3	1.21	.02	1.46	.05	4.63	21.14
197.6	32.28	33.94	34.24	.20	16.4	14.9	14.8	1.18	.03	1.45	.03	4.58	21.07
365.4	32.49	34.04	34.32	.17	15.4	14.8	15.6	1.08	.04	1.37	.06	4.67	20.84
441.5	32.61	34.13	34.40	.19	15.5	14.1	15.3	1.07	.05	1.33	.08	4.72	20.57
517.7	32.69	34.21	34.46	.20	14.4	14.8	13.9	1.08	.06	1.32	.09	4.74	20.37
568.5	32.68	34.20	34.45	.21	14.1	13.7	14.3	1.09	.07	1.29	.12	4.75	20.24
619.2	32.75	34.24	34.50	.23	14.2	13.3	13.5	1.11	.08	1.28	.11	4.74	20.38
695.4	32.79	34.27	34.52	.24	13.9	14.2	13.0	1.12	.10	1.28	.17	4.75	20.63
771.5	32.88	34.30	34.54	.25	13.3	11.9	12.7	1.11	.10	1.34	.18	4.79	20.95
847.7	33.02	34.35	34.58	.23	12.5	11.9	12.9	1.10	.08	1.41	.16	4.81	21.49
923.8	33.21	34.43	34.63	.22	11.7	11.5	11.7	1.15	.05	1.47	.12	4.85	21.95
1000.0	33.21	34.36	34.52	.31	11.1	11.7	11.3	1.34	.12	1.65	.14	4.90	22.42

σ equals standard deviation, see Amplifier terms

ZFL-1000VH





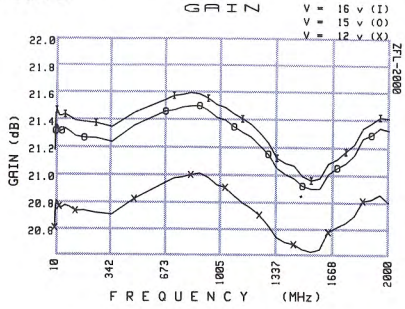


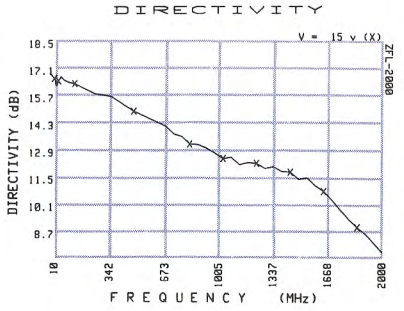
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	21.30	21.45	21.46	.16	19.1	19.4	19.3	1.29	.02	1.86	.06	4.70	26.78
17.2	21.25	21.45	21.47	.13	19.0	19.3	18.7	1.18	.01	1.74	.04	4.68	27.09
38.8	21.28	21.49	21.52	.11	18.8	18.9	18.8	1.11	.01	1.70	.04	4.61	27.16
87.6	21.36	21.56	21.60	.11	18.8	19.0	18.6	1.09	.01	1.69	.04	4.62	27.15
197.6	21.40	21.60	21.65	.11	18.6	18.5	18.6	1.10	.01	1.62	.04	4.60	27.25
365.4	21.44	21.68	21.73	.14	18.0	17.8	17.9	1.13	.02	1.46	.04	4.76	27.69
441.5	21.46	21.72	21.77	.18	17.5	17.5	17.3	1.13	.03	1.37	.04	4.82	27.74
517.7	21.48	21.74	21.81	.20	16.9	17.1	17.3	1.13	.03	1.29	.03	4.87	27.50
568.5	21.44	21.72	21.79	.21	17.0	16.7	17.0	1.12	.03	1.26	.02	4.90	27.38
619.2	21.45	21.75	21.82	.22	16.7	16.5	16.8	1.11	.03	1.25	.02	4.94	27.14
695.4	21.45	21.75	21.83	.24	16.3	16.3	16.3	1.09	.04	1.28	.02	5.00	27.04
771.5	21.49	21.80	21.89	.26	15.6	15.7	15.5	1.08	.04	1.35	.04	5.09	26.93
847.7	21.63	21.96	22.04	.32	14.8	15.1	15.1	1.06	.05	1.44	.07	5.24	26.89
923.8	21.87	22.22	22.31	.41	14.3	14.1	14.2	1.06	.06	1.57	.09	5.40	26.85
1000.0	21.89	22.28	22.38	.46	13.4	13.3	13.3	1.11	.06	1.92	.16	5.57	26.47

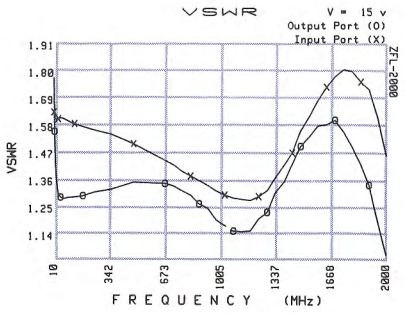
σ equals standard deviation, see Amplifier terms

Amplifiers

ZFL-2000



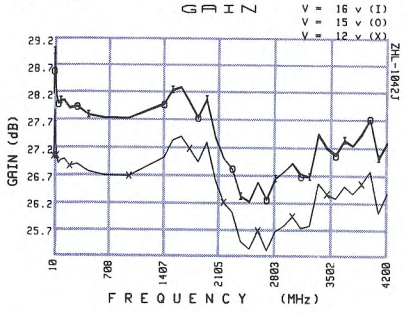


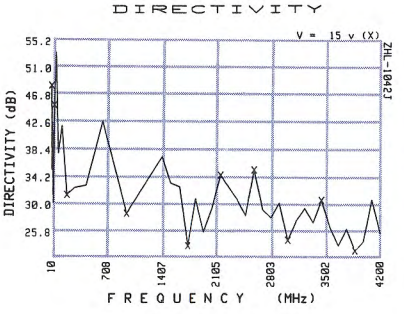


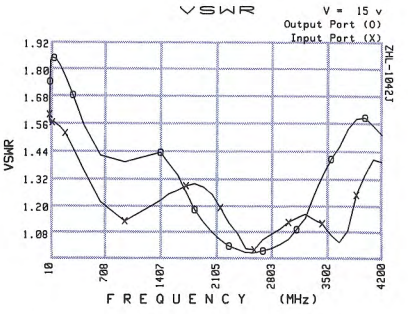
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	20.67	21.23	21.35	.77	17.5	16.7	16.8	1.65	.09	1.78	.29	5.52	15.80
19.1	20.87	21.42	21.53	.68	16.8	16.4	16.6	1.62	.08	1.44	.11	5.24	16.11
50.5	20.82	21.38	21.49	.67	17.1	16.8	16.6	1.62	.08	1.30	.05	4.28	15.83
133.4	20.79	21.34	21.45	.62	17.0	16.5	16.2	1.60	.07	1.30	.07	3.96	15.95
352.3	20.77	21.30	21.41	.46	16.1	15.8	15.8	1.56	.06	1.33	.09	4.14	16.30
724.4	21.03	21.53	21.64	.19	14.5	13.9	13.9	1.43	.15	1.35	.08	4.23	16.76
877.4	21.07	21.56	21.65	.27	13.8	13.3	13.0	1.37	.20	1.27	.08	4.28	16.72
1030.5	20.97	21.46	21.55	.37	13.0	12.6	12.6	1.31	.16	1.19	.07	4.39	16.69
1132.6	20.85	21.37	21.47	.44	12.9	12.3	12.3	1.29	.09	1.16	.07	4.44	16.60
1234.6	20.76	21.27	21.37	.57	12.5	12.4	12.4	1.30	.08	1.21	.08	4.49	16.73
1387.7	20.56	21.06	21.14	.66	12.2	11.9	12.1	1.43	.14	1.36	.05	4.59	16.74
1540.8	20.50	20.96	21.02	.56	11.6	11.6	11.5	1.63	.16	1.54	.05	4.78	16.74
1693.8	20.68	21.11	21.17	.48	10.2	10.5	10.5	1.79	.18	1.61	.09	4.90	16.99
1846.9	20.87	21.32	21.40	.51	8.6	9.1	9.1	1.77	.17	1.43	.10	4.99	16.99
2000.0	20.86	21.38	21.47	.42	7.5	7.8	8.1	1.47	.13	1.07	.16	5.30	16.80

σ equals standard deviation, see Amplifier terms

ZHL-1042J







FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	12.0V	15.0V	16.0V	σ1	12.0V	15.0V	16.0V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
10.0	27.55	28.68	28.68	1.15	33.4	32.6	33.8	1.60	.10	1.57	.14	19.14	22.32
21.4	28.01	29.08	29.09	1.08	30.7	19.8	26.4	1.56	.03	1.83	.13	17.99	23.20
67.0	27.31	28.36	28.37	1.01	28.3	27.7	27.5	1.57	.04	1.84	.14	13.37	22.82
209.9	27.41	28.43	28.44	1.09	32.3	29.8	34.4	1.52	.05	1.78	.16	7.36	22.75
657.2	27.06	28.06	28.06	.96	29.8	23.0	30.5	1.24	.10	1.43	.07	5.90	21.80
1514.1	27.81	28.70	28.71	1.04	29.5	29.1	27.4	1.53	.22	1.62	.16	5.28	20.96
1836.4	27.53	28.29	28.28	1.08	30.0	26.7	27.7	1.88	.26	1.47	.19	5.40	21.14
2158.7	26.69	27.44	27.44	.85	25.5	26.2	27.9	1.94	.23	1.29	.22	5.39	20.59
2373.6	26.44	27.26	27.27	.73	25.0	26.0	28.5	1.83	.20	1.20	.22	5.30	20.84
2588.5	26.30	27.16	27.18	.85	29.7	23.1	24.8	1.65	.17	1.10	.24	5.34	21.04
2910.8	26.45	27.38	27.41	.76	23.9	28.1	23.2	1.48	.15	1.12	.17	5.41	20.61
3233.1	26.74	27.60	27.60	.40	23.5	31.5	25.7	1.45	.18	1.34	.06	5.43	20.72
3555.4	26.87	27.63	27.64	.48	28.6	25.9	25.8	1.17	.22	1.64	.10	5.43	20.61
3877.7	27.26	28.14	28.15	.92	22.2	20.8	22.2	1.31	.17	1.75	.20	5.55	21.22
4200.0	27.17	28.06	28.08	.85	21.9	18.3	21.2	1.46	.44	1.66	.25	5.58	20.82

σ equals standard deviation, see Amplifier terms

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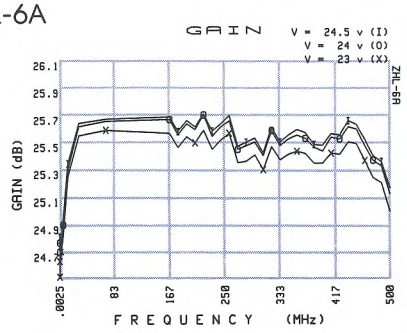
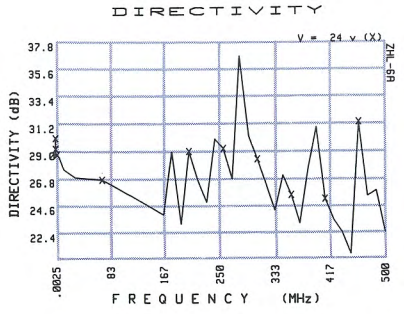
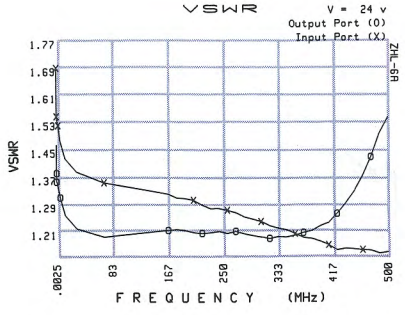
ZHL-6A



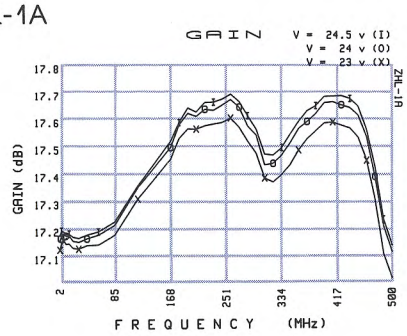


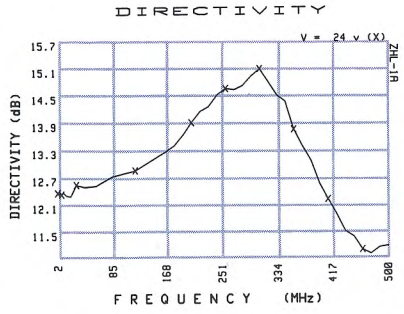


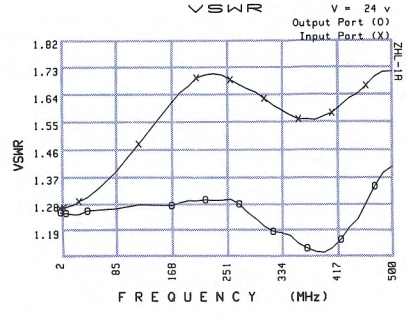
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
.0025	24.57	24.64	24.69	.20	30.4	30.5	30.4	1.71	.04	1.48	.05	—	24.48
.0138	24.73	24.82	24.86	.19	29.8	29.8	29.7	1.57	.04	1.38	.06	—	24.62
.1792	24.67	24.75	24.79	.20	29.3	29.2	29.2	1.56	.04	1.37	.06	—	24.65
2.3254	24.75	24.81	24.85	.23	28.9	29.1	28.9	1.54	.05	1.35	.06	—	24.75
30.1795	25.60	25.66	25.69	.13	27.3	27.3	27.2	1.40	.04	1.23	.05	7.58	25.48
179.4888	25.51	25.60	25.63	.14	28.1	29.3	25.4	1.32	.14	1.23	.08	7.55	25.13
217.9501	25.64	25.75	25.76	.14	25.1	27.0	24.1	1.30	.14	1.22	.08	7.61	24.97
256.4115	25.61	25.71	25.75	.14	35.6	29.5	24.9	1.29	.13	1.22	.08	7.62	24.87
282.0524	25.41	25.52	25.55	.15	26.5	37.0	35.0	1.27	.12	1.22	.09	7.63	24.88
307.6933	25.35	25.45	25.47	.16	29.8	28.6	28.7	1.25	.12	1.21	.09	7.64	24.85
346.1546	25.46	25.57	25.60	.15	32.0	27.3	28.4	1.23	.10	1.21	.10	7.64	24.61
384.6160	25.39	25.51	25.53	.17	27.5	27.8	24.6	1.20	.09	1.23	.12	7.62	24.58
423.0773	25.46	25.57	25.60	.19	22.7	23.7	24.8	1.17	.08	1.28	.16	7.59	24.57
461.5387	25.41	25.52	25.57	.23	22.5	31.6	19.6	1.17	.07	1.39	.22	7.57	24.43
500.0000	25.04	25.17	25.21	.31	25.0	22.7	22.5	1.16	.07	1.56	.29	7.53	24.37

σ equals standard deviation, see Amplifier terms

ZHL-1A





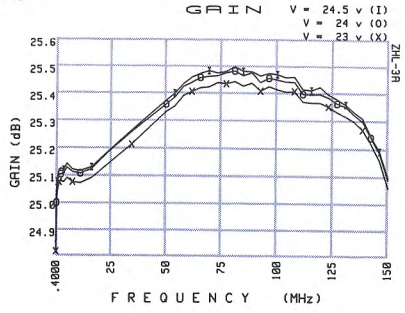


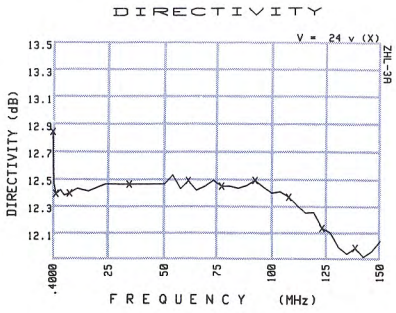
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
2.0	17.10	17.13	17.15	.08	12.5	12.5	12.5	1.28	.09	1.27	.04	—	30.24
4.0	17.12	17.15	17.17	.09	12.5	12.5	12.4	1.28	.09	1.26	.05	—	30.24
11.0	17.12	17.15	17.15	.08	12.5	12.5	12.5	1.28	.09	1.26	.05	8.25	29.99
30.6	17.10	17.13	17.14	.07	12.6	12.7	12.5	1.30	.10	1.26	.04	8.21	30.13
85.0	17.15	17.19	17.20	.17	12.8	12.9	12.8	1.40	.10	1.28	.04	8.26	29.66
180.8	17.50	17.56	17.56	.19	13.6	13.5	13.5	1.66	.12	1.30	.07	8.02	29.08
219.1	17.55	17.61	17.64	.16	14.4	14.3	14.2	1.72	.13	1.31	.10	8.01	29.17
257.4	17.58	17.65	17.67	.17	14.8	14.8	14.7	1.70	.13	1.31	.10	8.05	29.86
282.9	17.50	17.55	17.59	.22	15.1	14.8	15.0	1.67	.11	1.27	.14	8.11	30.31
308.5	17.36	17.41	17.45	.30	15.1	15.2	15.1	1.64	.09	1.22	.15	8.17	30.39
346.8	17.41	17.49	17.52	.33	14.4	14.5	14.3	1.59	.07	1.19	.11	8.20	30.68
385.1	17.53	17.60	17.63	.43	13.3	13.2	13.2	1.57	.13	1.14	.07	8.18	30.68
423.4	17.55	17.63	17.66	.45	12.0	12.0	12.1	1.62	.19	1.18	.05	8.18	30.78
461.7	17.42	17.51	17.54	.45	11.3	11.2	11.3	1.68	.18	1.30	.11	8.27	30.37
500.0	16.99	17.09	17.11	.43	11.5	11.3	11.3	1.73	.13	1.41	.22	8.51	29.64

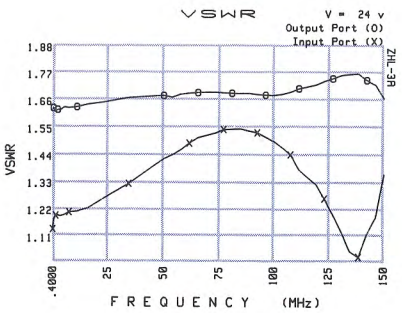
σ equals standard deviation, see Amplifier terms

Amplifiers

ZHL-3A



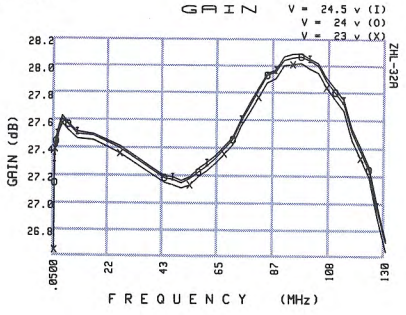


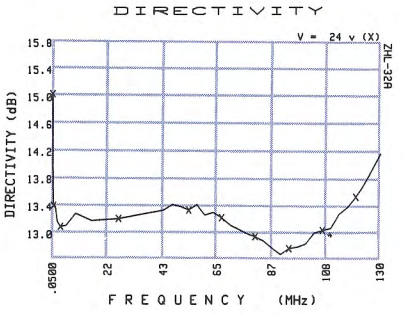


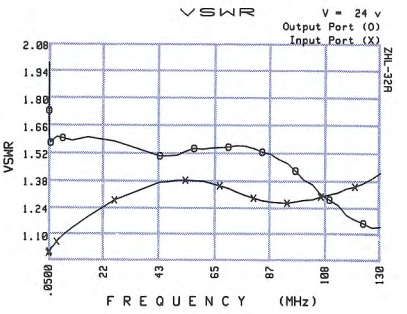
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.4	24.85	24.87	24.88	1.11	12.8	12.8	12.9	1.14	.03	1.63	.01	—	31.24
.8	25.06	25.08	25.10	.97	12.5	12.4	12.5	1.18	.02	1.63	.01	—	31.65
2.6	25.10	25.13	25.15	.95	12.5	12.4	12.3	1.20	.02	1.63	.01	—	31.74
7.8	25.10	25.14	25.15	.95	12.4	12.4	12.4	1.21	.02	1.64	.02	—	32.08
23.9	25.17	25.21	25.21	.97	12.5	12.4	12.4	1.27	.02	1.66	.03	5.11	32.17
54.1	25.38	25.41	25.43	1.00	12.5	12.5	12.4	1.45	.07	1.68	.08	5.21	31.97
65.6	25.45	25.48	25.50	.99	12.5	12.4	12.4	1.51	.09	1.70	.10	5.22	31.74
77.1	25.46	25.50	25.51	1.00	12.5	12.4	12.4	1.55	.13	1.69	.12	5.25	31.98
84.8	25.45	25.49	25.51	1.01	12.5	12.4	12.4	1.55	.14	1.69	.12	5.29	31.77
92.5	25.43	25.46	25.49	1.01	12.5	12.5	12.4	1.53	.17	1.69	.13	5.33	31.76
104.0	25.43	25.47	25.48	1.03	12.4	12.4	12.4	1.48	.20	1.69	.14	5.42	31.53
115.5	25.39	25.42	25.44	1.08	12.3	12.2	12.3	1.35	.22	1.72	.14	5.57	31.73
127.0	25.36	25.39	25.40	1.12	12.0	12.1	12.1	1.20	.13	1.75	.14	5.84	31.61
138.5	25.29	25.32	25.33	1.18	11.9	12.0	11.9	1.03	.25	1.77	.15	6.27	31.78
150.0	25.08	25.11	25.12	1.34	12.0	12.0	12.0	1.36	.32	1.67	.14	6.88	31.01

σ equals standard deviation, see Amplifier terms

ZHL-32A







FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
.050	26.65	26.67	26.69	.45	15.1	15.1	15.1	1.02	.10	2.00	.32	—	32.21
.142	27.27	27.30	27.31	.28	13.8	13.8	13.8	1.03	.03	1.65	.24	—	32.68
.675	27.41	27.44	27.45	.26	13.5	13.5	13.4	1.04	.01	1.58	.22	—	32.83
3.214	27.57	27.60	27.63	.20	13.1	13.1	13.2	1.08	.01	1.62	.23	—	32.99
15.315	27.45	27.48	27.49	.26	13.3	13.2	13.2	1.20	.03	1.61	.20	5.85	32.76
46.699	27.12	27.16	27.18	.55	13.5	13.5	13.4	1.38	.06	1.52	.11	6.00	31.88
56.695	27.18	27.21	27.24	.54	13.4	13.5	13.4	1.39	.08	1.56	.12	6.04	31.83
66.691	27.35	27.38	27.40	.48	13.2	13.3	13.3	1.36	.10	1.56	.12	6.04	31.43
73.355	27.55	27.59	27.60	.38	13.0	13.1	13.1	1.33	.13	1.57	.13	6.02	31.30
80.019	27.76	27.81	27.83	.29	13.0	13.0	12.9	1.30	.15	1.56	.13	5.99	31.33
90.015	28.00	28.04	28.06	.23	12.9	12.7	12.8	1.28	.18	1.50	.14	6.00	30.98
100.012	27.97	28.03	28.05	.26	12.9	12.9	13.0	1.29	.19	1.39	.18	6.08	30.47
110.008	27.75	27.80	27.83	.32	13.2	13.1	13.2	1.32	.19	1.29	.24	6.19	30.06
120.004	27.32	27.37	27.40	.44	13.6	13.6	13.5	1.36	.19	1.19	.30	6.31	30.17
130.000	26.64	26.71	26.72	.64	14.2	14.2	14.2	1.43	.17	1.15	.33	6.45	29.82

σ equals standard deviation, see Amplifier terms

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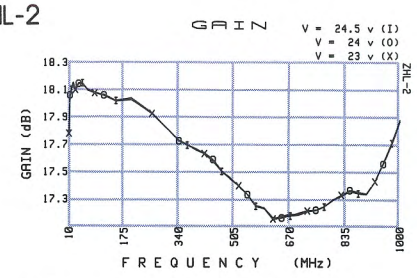
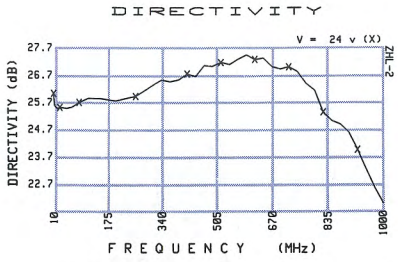
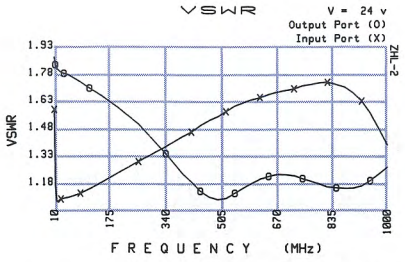
ZHL-2



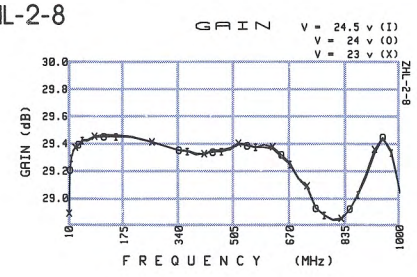


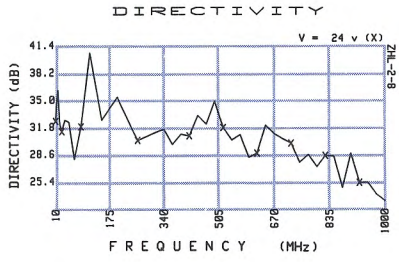


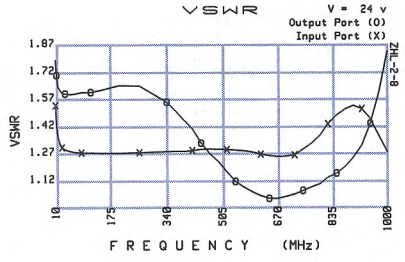
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	17.75	17.77	17.76	.31	26.1	26.0	26.1	1.58	.09	1.87	.07	9.19	30.71
22.6	18.12	18.13	18.12	.34	25.4	25.5	25.4	1.08	.02	1.80	.07	8.56	30.73
66.8	18.07	18.07	18.07	.35	25.7	25.5	25.6	1.11	.02	1.76	.07	7.95	30.87
197.6	18.00	18.01	18.00	.31	25.7	25.8	25.7	1.23	.02	1.59	.06	8.11	31.07
390.8	17.63	17.63	17.64	.27	26.6	26.5	26.5	1.43	.02	1.22	.04	8.46	30.68
492.3	17.42	17.42	17.43	.30	27.0	27.0	26.9	1.54	.03	1.09	.04	8.54	30.19
619.2	17.13	17.13	17.12	.39	27.4	27.3	27.4	1.65	.07	1.20	.05	8.58	29.67
746.2	17.19	17.19	17.19	.52	26.6	26.8	26.7	1.71	.05	1.20	.04	8.69	29.40
873.1	17.31	17.32	17.31	.44	24.9	24.9	24.8	1.70	.03	1.15	.03	9.06	29.40
1000.0	17.84	17.83	17.85	.36	21.9	22.0	21.8	1.39	.05	1.26	.03	9.69	29.28

σ equals standard deviation, see Amplifier terms

ZHL-2-8



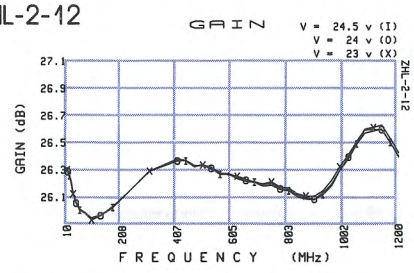


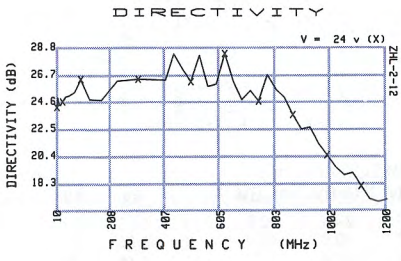


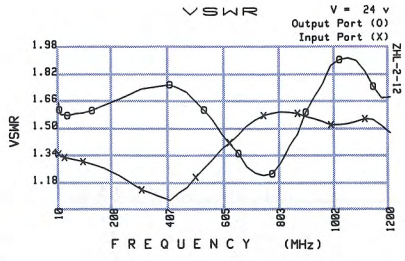
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	28.91	28.90	28.90	.15	32.5	32.5	33.9	1.52	.07	1.77	.02	6.17	30.73
22.6	29.36	29.36	29.36	.11	35.4	32.2	31.7	1.31	.08	1.61	.01	5.73	31.05
66.8	29.45	29.44	29.44	.10	34.9	28.0	34.7	1.26	.08	1.58	0.00	5.26	31.27
197.6	29.47	29.46	29.47	.11	31.2	35.3	33.0	1.26	.08	1.63	.01	5.22	31.10
390.8	29.34	29.33	29.34	.16	36.4	30.9	32.6	1.27	.06	1.44	.04	5.27	30.40
492.3	29.38	29.37	29.37	.19	30.5	34.8	32.5	1.28	.05	1.21	.05	5.32	30.02
619.2	29.39	29.38	29.38	.19	28.5	28.7	30.8	1.25	.05	1.02	.05	5.38	29.65
746.2	28.95	28.94	28.94	.16	27.6	27.6	27.9	1.28	.06	1.05	.10	5.51	29.56
873.1	29.05	29.03	29.03	.18	26.3	24.6	25.9	1.50	.07	1.18	.10	5.74	29.69
1000.0	29.06	29.05	29.05	.15	21.7	23.1	22.2	1.26	.05	1.82	.13	6.09	29.32

σ equals standard deviation, see Amplifier terms

ZHL-2-12





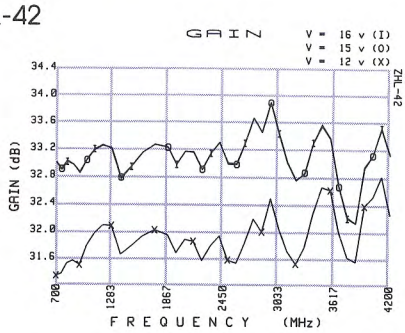


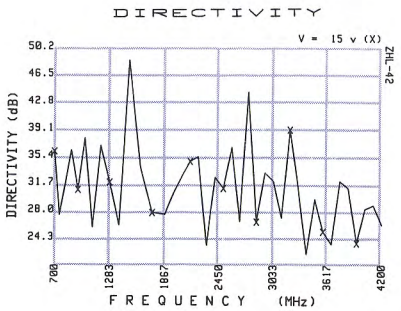
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	26.29	26.30	26.30	.37	25.0	24.2	25.0	1.33	.01	1.64	.02	10.92	31.53
23.5	26.21	26.21	26.21	.37	24.3	24.3	25.1	1.32	.01	1.56	.04	10.57	31.76
73.5	25.97	25.97	25.97	.44	25.4	25.3	25.5	1.30	.02	1.57	.05	10.11	31.76
230.0	26.12	26.12	26.12	.53	26.1	26.2	25.7	1.20	.03	1.66	.08	9.88	31.63
467.7	26.31	26.32	26.30	.41	26.8	27.1	25.1	1.14	.03	1.69	.12	9.41	30.46
589.7	26.25	26.25	26.25	.36	27.8	25.9	25.1	1.36	.06	1.45	.12	9.22	29.55
742.3	26.19	26.18	26.17	.39	24.8	24.6	26.6	1.56	.11	1.20	.07	8.98	29.35
894.9	26.08	26.06	26.06	.51	22.7	22.4	23.9	1.55	.10	1.58	.16	9.20	29.57
1047.4	26.49	26.47	26.47	.64	19.9	18.9	19.7	1.51	.08	1.90	.23	9.55	30.36
1200.0	26.40	26.38	26.37	.66	17.6	17.0	16.7	1.45	.05	1.66	.27	9.97	29.89

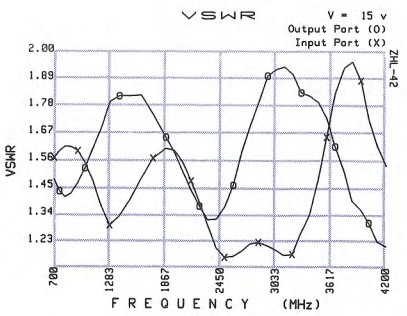
σ equals standard deviation, see Amplifier terms

Amplifiers

ZHL-42



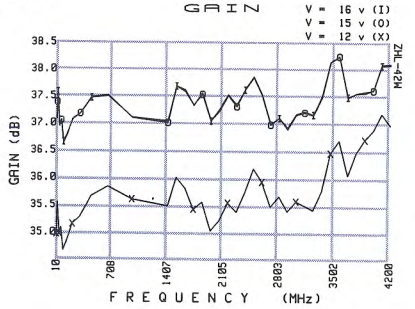


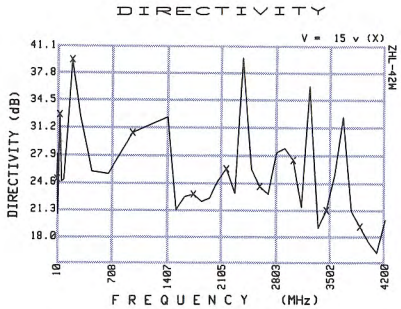


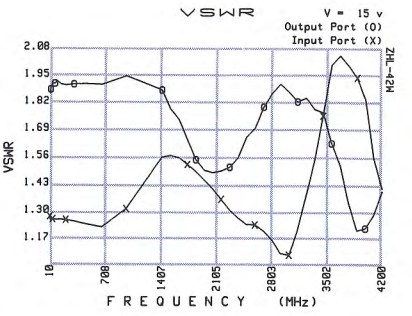
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
700.0	31.34	33.00	32.99	1.07	34.7	35.9	41.9	1.55	.03	1.47	.09	8.63	28.60
814.0	31.52	33.02	33.00	.96	34.3	31.4	23.7	1.60	.03	1.40	.06	8.12	28.78
1020.8	31.78	33.03	33.04	.80	34.5	37.7	35.4	1.53	.03	1.51	.04	7.74	29.48
1280.1	32.07	33.21	33.20	.74	34.6	31.7	32.4	1.28	.02	1.78	.10	7.54	29.71
1605.2	31.92	33.15	33.14	.95	32.2	33.8	41.8	1.47	.02	1.81	.14	7.49	30.02
1956.4	31.68	32.97	32.96	.94	28.0	30.3	29.7	1.58	.03	1.58	.14	7.67	29.81
2225.6	31.57	32.90	32.89	.99	49.4	35.1	30.3	1.38	.05	1.36	.10	7.58	29.28
2494.9	31.58	32.98	32.99	1.00	29.3	30.8	24.8	1.15	.06	1.36	.07	7.55	28.32
2674.4	31.83	33.29	33.29	1.11	33.8	26.3	22.8	1.18	.05	1.58	.07	7.54	28.40
2853.8	31.99	33.45	33.46	1.19	31.2	26.3	42.0	1.21	.05	1.78	.09	7.55	29.02
3123.1	31.71	33.00	33.01	1.01	30.0	26.8	28.5	1.16	.05	1.92	.08	7.59	29.90
3392.3	32.27	33.29	33.30	.97	33.3	21.9	35.8	1.32	.06	1.80	.09	7.58	29.85
3661.5	31.99	32.65	32.64	1.21	35.5	23.3	29.6	1.82	.09	1.60	.16	7.41	29.43
3930.8	32.37	32.95	32.93	1.05	28.1	23.4	31.2	1.87	.08	1.35	.17	7.53	28.30
4200.0	32.24	33.12	33.13	1.04	28.1	25.9	21.5	1.52	.09	1.20	.08	7.52	28.61

σ equals standard deviation, see Amplifier terms

ZHL-42W







FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	34.97	37.07	37.10	1.13	29.8	24.9	32.9	1.27	.05	1.86	.17	10.35	27.85
21.4	35.54	37.56	37.57	1.18	33.7	20.6	45.0	1.26	.05	1.90	.18	10.07	28.46
67.0	35.09	37.04	37.06	1.28	43.1	24.6	32.2	1.26	.05	1.91	.16	8.96	28.48
209.9	35.15	37.07	37.06	1.32	35.5	39.3	31.2	1.26	.05	1.90	.14	7.51	28.43
657.2	35.83	37.51	37.49	1.43	26.9	25.5	33.1	1.22	.04	1.90	.07	7.10	28.93
1514.1	36.00	37.68	37.68	1.54	23.2	21.1	25.6	1.56	.09	1.79	.18	7.14	29.83
1836.4	35.56	37.53	37.56	1.54	34.5	22.1	23.8	1.49	.11	1.54	.10	7.35	30.08
2158.7	35.54	37.51	37.53	1.55	20.6	26.1	26.1	1.35	.09	1.49	.15	7.23	29.98
2373.6	35.73	37.62	37.61	1.37	18.7	39.5	21.0	1.27	.08	1.55	.16	7.14	29.32
2588.5	35.92	37.53	37.51	1.14	18.1	24.0	27.0	1.23	.07	1.69	.16	7.08	29.09
2910.8	35.39	36.89	36.92	1.07	31.3	28.5	26.1	1.10	.07	1.90	.13	6.99	28.79
3233.1	35.41	37.14	37.16	1.11	23.1	36.0	17.8	1.37	.08	1.84	.15	7.05	28.87
3555.4	36.69	38.23	38.23	1.49	26.3	25.3	24.3	2.00	.15	1.62	.12	6.87	28.82
3877.7	36.70	37.58	37.55	1.81	27.8	19.0	18.9	1.93	.24	1.21	.15	6.91	28.42
4200.0	36.96	38.09	38.07	1.70	30.2	19.8	35.4	1.40	.25	1.39	.34	6.97	28.13

σ equals standard deviation, see Amplifier terms

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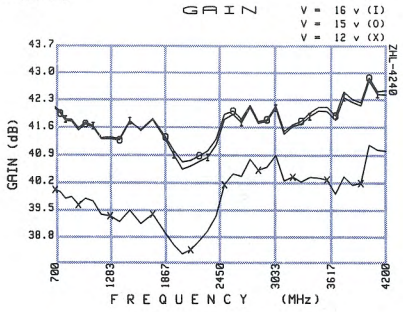
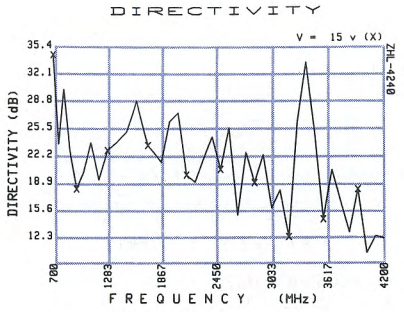
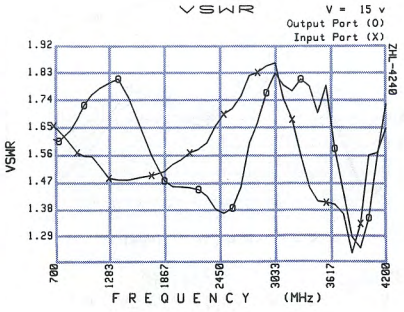
ZHL-4240



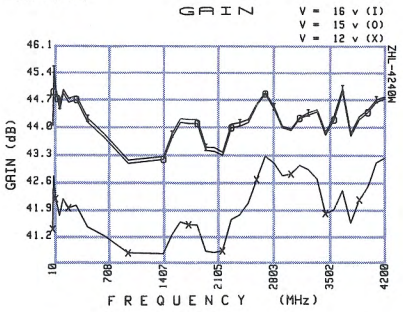


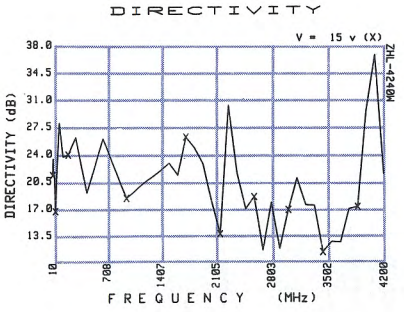


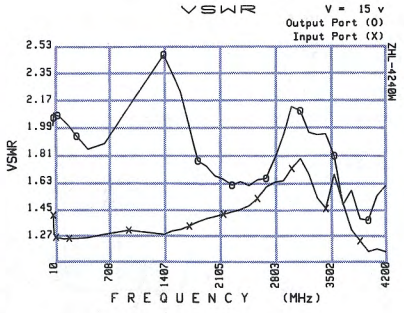
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
700.0	39.92	42.00	42.04	1.65	19.2	34.2	28.7	1.65	.28	1.60	.10	8.85	29.80
814.0	39.70	41.68	41.72	1.77	24.9	30.0	22.5	1.61	.25	1.61	.03	8.69	30.21
1020.8	39.70	41.60	41.64	1.89	31.0	19.9	28.9	1.55	.20	1.71	.14	8.54	31.22
1280.1	39.25	41.22	41.26	2.11	39.9	22.6	19.8	1.47	.18	1.79	.19	8.34	31.45
1605.2	39.05	41.46	41.43	1.99	24.3	28.6	15.4	1.47	.13	1.65	.22	8.19	31.59
1956.4	38.51	40.92	40.81	1.97	28.9	26.1	30.5	1.52	.07	1.44	.16	8.30	31.27
2225.6	38.61	40.79	40.64	1.84	17.4	18.7	27.3	1.57	.06	1.43	.16	8.20	31.16
2494.9	40.04	41.85	41.71	1.63	19.4	20.3	20.9	1.68	.11	1.36	.23	8.01	30.04
2674.4	40.26	41.72	41.63	1.73	14.0	14.7	26.2	1.74	.14	1.44	.30	7.98	30.19
2853.8	40.42	41.66	41.62	1.78	22.8	18.7	14.1	1.82	.15	1.66	.35	8.05	30.69
3123.1	40.14	41.41	41.35	1.78	26.4	17.7	29.2	1.73	.09	1.78	.26	8.07	31.55
3392.3	40.23	41.88	41.79	1.93	27.1	33.2	22.6	1.44	.08	1.78	.09	8.04	31.58
3661.5	39.81	41.80	41.70	2.36	21.0	20.2	16.8	1.39	.13	1.57	.12	7.99	31.25
3930.8	40.08	42.14	42.07	1.95	25.1	17.9	14.0	1.32	.14	1.24	.07	7.95	30.29
4200.0	40.90	42.45	42.34	1.62	20.2	11.9	22.1	1.64	.18	1.72	.30	8.14	30.37

σ equals standard deviation, see Amplifier terms

ZHL-4240W





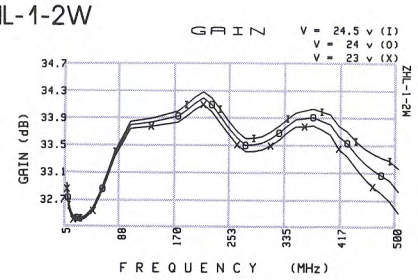


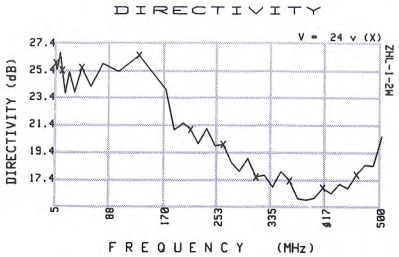
FREQUENCY (MHz)	GAIN (dB) 12.0V	15.0V	16.0V	σ1	DIRECTIVITY (dB) 12.0V	15.0V	16.0V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
10.0	41.37	44.02	44.14	.75	24.0	21.3	29.4	1.40	.06	2.00	.35	16.72	28.41
21.4	42.72	45.38	45.47	1.09	27.5	21.4	16.9	1.27	.04	2.08	.21	16.09	28.74
67.0	41.99	44.71	44.80	1.07	27.3	22.5	14.5	1.25	.02	2.06	.06	13.57	28.88
209.9	41.91	44.62	44.72	.91	26.3	23.9	23.2	1.25	.02	1.99	.05	9.58	28.71
657.2	41.20	43.72	43.81	.59	20.7	25.9	25.7	1.27	.02	1.87	.08	7.79	29.29
1514.1	41.22	43.71	43.80	.94	31.7	22.8	20.3	1.30	.04	2.34	.08	7.49	29.33
1836.4	41.48	44.08	44.18	.98	18.7	24.7	14.7	1.36	.06	1.76	.08	7.54	29.66
2158.7	40.82	43.27	43.34	.84	17.9	13.7	16.6	1.41	.09	1.64	.16	7.56	30.07
2373.6	41.74	44.01	44.10	.82	24.6	21.5	12.5	1.44	.10	1.62	.19	7.42	29.52
2588.5	42.64	44.55	44.59	1.07	20.9	18.5	17.8	1.51	.08	1.63	.21	7.35	29.50
2910.8	42.74	43.97	44.01	.79	18.3	11.8	23.9	1.62	.09	1.92	.38	7.43	29.60
3233.1	42.90	44.30	44.36	.65	18.8	17.4	13.7	1.67	.14	1.94	.21	7.32	30.49
3555.4	41.87	44.18	44.28	.48	32.5	12.6	19.0	1.67	.21	1.79	.18	7.28	29.32
3877.7	42.12	44.19	44.26	.98	19.7	17.1	18.2	1.23	.09	1.37	.13	7.26	28.67
4200.0	43.19	44.71	44.76	1.00	15.8	21.3	17.5	1.16	.17	1.59	.20	7.29	28.48

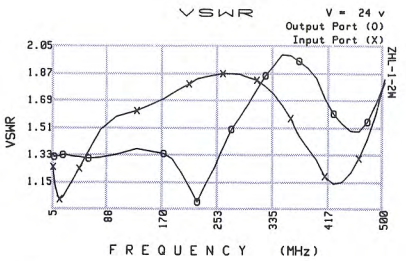
σ equals standard deviation, see Amplifier terms

Amplifiers

ZHL-1-2W



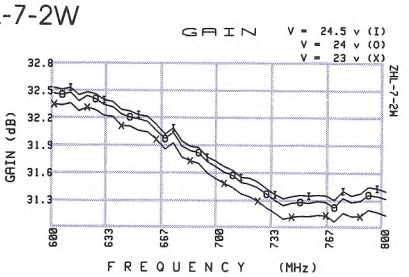


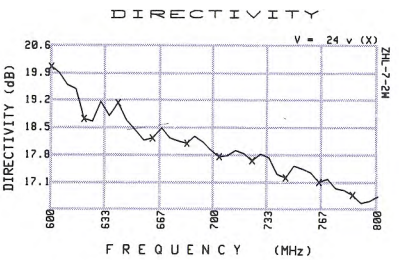


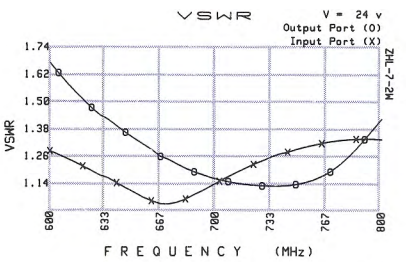
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
5.0	32.84	32.87	32.92	.45	25.3	26.0	26.1	1.25	.03	1.33	.01	—	34.98
11.3	32.45	32.47	32.50	.38	25.9	26.7	26.0	1.07	.08	1.32	.05	6.11	35.08
33.4	32.41	32.42	32.45	.37	25.8	23.8	24.3	1.16	.05	1.32	.05	6.06	35.42
98.8	33.72	33.78	33.83	.40	24.9	25.4	22.6	1.58	.09	1.33	.01	5.63	35.07
195.4	34.00	34.10	34.19	.62	21.9	21.6	22.5	1.77	.13	1.22	.06	5.82	34.36
246.2	33.64	33.73	33.84	.91	20.0	19.9	19.5	1.86	.16	1.24	.11	5.95	34.34
309.6	33.47	33.57	33.67	.82	17.1	17.7	18.0	1.82	.17	1.76	.11	6.09	34.54
373.1	33.77	33.89	34.02	.92	15.9	16.1	17.6	1.46	.17	1.95	.11	6.45	34.85
436.5	33.15	33.35	33.54	.76	17.6	17.2	17.6	1.15	.12	1.54	.13	6.98	34.71
500.0	32.49	32.80	33.14	.44	22.5	20.6	20.8	1.83	.21	1.81	.26	7.28	33.90

σ equals standard deviation, see Amplifier terms

ZHL-7-2W



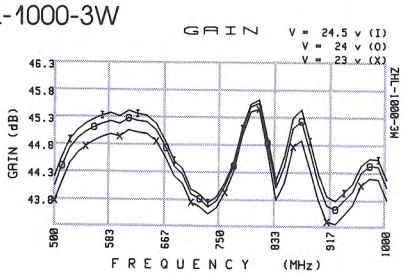


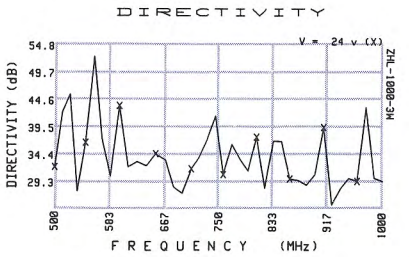


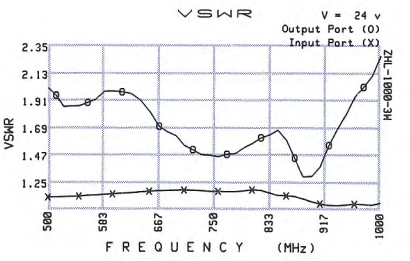
FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	σ1	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	σ2	OUT	σ3	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
600.0	32.36	32.48	32.54	.55	19.8	20.1	19.8	1.28	.15	1.67	.09	4.42	33.17
614.8	32.29	32.39	32.46	.51	19.5	19.5	19.9	1.23	.14	1.54	.09	4.44	33.29
635.0	32.22	32.33	32.38	.53	18.8	18.8	19.2	1.16	.17	1.42	.08	4.48	33.43
655.9	32.05	32.17	32.22	.51	18.3	18.2	18.4	1.08	.19	1.31	.09	4.50	33.62
676.9	31.78	31.90	31.96	.43	17.9	18.2	18.1	1.05	.18	1.22	.12	4.54	33.87
697.4	31.54	31.67	31.73	.36	18.2	18.0	18.1	1.13	.12	1.16	.15	4.55	34.03
723.1	31.30	31.44	31.50	.29	18.0	17.7	17.4	1.22	.05	1.13	.19	4.57	33.97
748.7	31.13	31.29	31.36	.29	17.7	17.6	17.2	1.29	.05	1.13	.24	4.65	33.86
774.4	31.17	31.33	31.41	.33	17.0	17.0	16.9	1.33	.11	1.22	.28	4.74	33.72
800.0	31.14	31.32	31.40	.36	16.8	16.8	16.9	1.33	.22	1.42	.25	4.93	33.71

σ equals standard deviation, see Amplifier terms

ZHL-1000-3W







FREQUENCY (MHz)	GAIN (dB) 23.0V	24.0V	24.5V	DIRECTIVITY (dB) 23.0V	24.0V	24.5V	SWR IN	OUT	N.F. (db)	P_{out}(dBm) (@1dBCOMPR)
500.0	43.81	44.09	44.26	30.3	32.4	45.8	1.15	2.02	10.53	36.49
534.3	44.69	44.96	45.11	30.3	27.9	35.3	1.15	1.88	10.15	36.58
583.8	45.04	45.27	45.42	33.1	30.7	30.9	1.17	2.00	8.99	36.32
637.8	45.04	45.26	45.38	45.2	32.7	33.6	1.19	1.93	8.55	36.64
692.3	44.13	44.30	44.40	33.6	27.6	26.1	1.21	1.65	8.42	37.12
743.6	43.70	43.83	43.90	37.8	42.1	30.9	1.20	1.49	8.78	37.28
807.7	45.51	45.62	45.68	28.8	38.1	29.4	1.21	1.58	9.97	36.90
871.8	44.93	45.29	45.50	43.3	30.0	34.4	1.16	1.47	8.37	35.77
935.9	43.58	43.84	43.98	46.1	28.5	31.2	1.09	1.71	8.13	35.81
1000.0	43.85	44.08	44.22	33.9	29.9	42.1	1.11	2.29	8.13	35.49

σ equals standard deviation, see Amplifier terms

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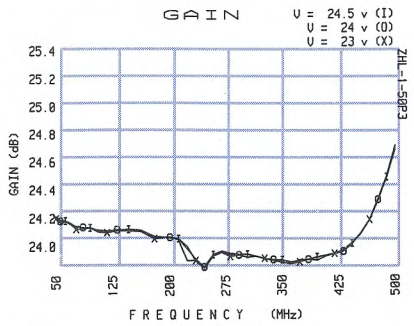
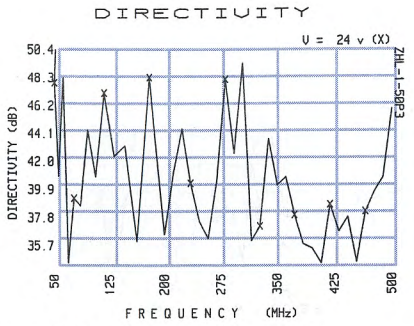
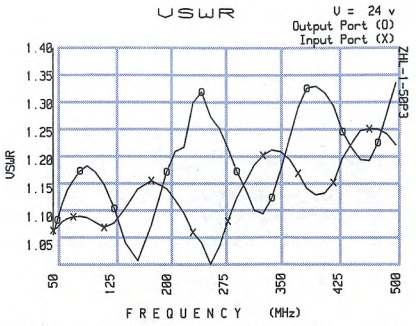
ZHL-1-50P3



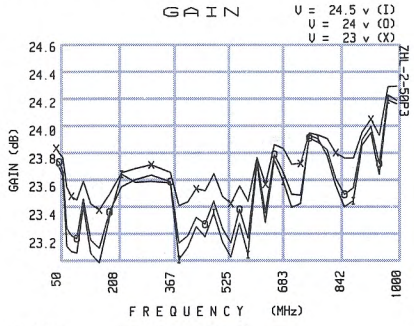


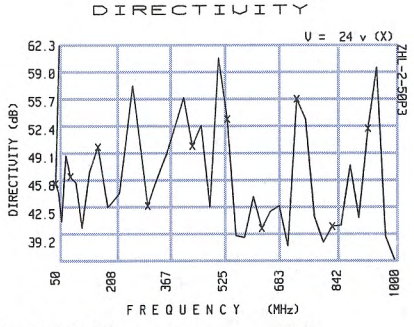


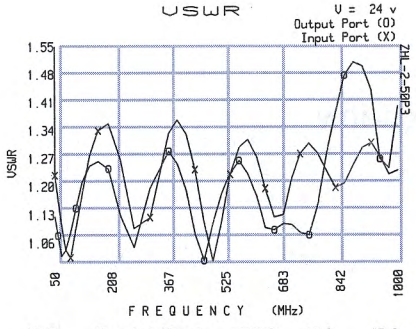
FREQ	GAIN (dB)				DIRECTIVITY			SWR				N.F.	Pout (dBm)	FREQ	IP2	IP3
MHz	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(dB)	(@1dB COMPR)	(MHz)	(dBm)	(dBm)
50.0	24.17	24.18	24.19	.07	37.9	48.0	39.8	1.08	.01	1.07	.01	6.66	34.05	80	95.0	55.0
61.9	24.15	24.16	24.16	.07	39.6	48.4	40.1	1.10	.02	1.13	.02	6.46	34.23	90		
76.6	24.10	24.11	24.12	.07	36.7	39.3	40.3	1.10	.02	1.17	.02	6.30	34.45			
94.8	24.11	24.11	24.11	.07	43.4	44.4	38.9	1.10	.02	1.19	.02	6.29	34.66			
117.3	24.07	24.08	24.09	.07	50.6	47.2	39.7	1.09	.02	1.16	.02	6.27	34.90			
145.2	24.09	24.09	24.10	.07	39.5	43.2	37.0	1.12	.02	1.06	.03	6.19	34.68	280	93.4	56.0
179.8	24.03	24.04	24.04	.08	50.6	48.4	44.3	1.17	.02	1.09	.04	6.08	34.76	290		
211.5	24.02	24.03	24.03	.08	41.2	41.2	43.3	1.13	.06	1.22	.06	5.99	34.92			
234.6	23.87	23.88	23.87	.12	43.3	40.4	37.3	1.08	.04	1.31	.08	6.40	33.92			
269.2	23.93	23.94	23.94	.10	38.2	40.6	42.4	1.05	.05	1.26	.05	6.48	33.95			
292.3	23.91	23.91	23.92	.11	41.6	42.6	43.6	1.14	.05	1.18	.04	6.42	33.77	480	88.0	52.0
315.4	23.90	23.90	23.90	.12	39.6	36.1	40.9	1.20	.03	1.12	.05	6.50	33.53	490		
338.5	23.87	23.88	23.88	.13	42.0	43.7	40.3	1.22	.04	1.14	.04	6.61	33.02			
361.5	23.85	23.86	23.85	.13	39.5	40.8	43.2	1.21	.05	1.24	.07	6.69	32.52			
384.6	23.88	23.88	23.88	.16	40.9	35.8	43.6	1.15	.07	1.33	.11	6.60	31.89			
407.7	23.90	23.91	23.91	.19	34.9	34.4	35.6	1.15	.05	1.32	.11	6.50	31.45	Pout at +15dBm		
430.8	23.95	23.93	23.94	.22	33.6	36.7	38.3	1.21	.02	1.25	.07	6.66	31.13			
453.8	24.06	24.06	24.06	.23	37.3	34.4	38.0	1.26	.05	1.20	.05	7.09	30.85			
476.9	24.30	24.30	24.29	.24	36.6	39.7	40.0	1.26	.08	1.23	.08	7.50	30.74			
500.0	24.68	24.66	24.65	.30	41.6	45.9	39.1	1.23	.08	1.34	.08	7.75	30.42			

σ equals standard deviation, see amplifier terms.

ZHL-2-50P3





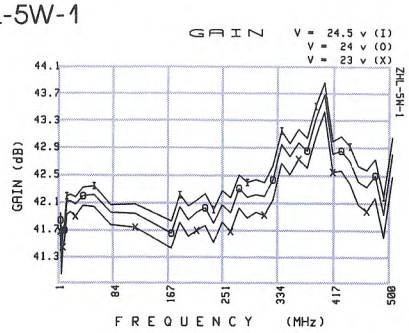


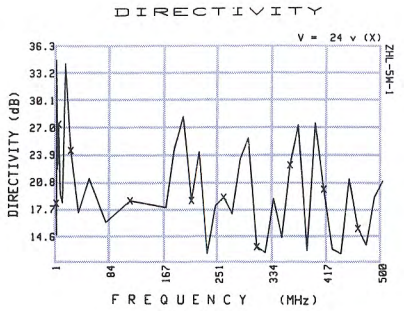
FREQ	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	Pout (dBm)	FREQ	IP2	IP3
MHz	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(dB)	(@1dB COMPR)	(MHz)	(dBm)	(dBm)
50.0	23.89	23.81	23.78	.44	41.6	46.1	41.3	1.23	.04	1.13	.03	7.33	25.67	80	70.0	45.0
67.9	23.83	23.73	23.70	.43	43.6	41.7	41.7	1.11	.01	1.03	.04	7.02	25.80	90		
92.3	23.55	23.27	23.16	.61	52.8	46.8	43.7	1.03	.01	1.09	.02	6.71	25.88			
125.4	23.66	23.53	23.48	.48	43.2	40.9	42.2	1.19	.05	1.22	.03	6.50	26.04			
170.4	23.45	23.18	23.08	.60	54.2	50.4	37.5	1.34	.09	1.27	.07	6.37	26.49			
231.5	23.72	23.62	23.71	.41	45.5	44.9	40.0	1.27	.06	1.13	.09	6.39	26.82	450	64.0	48.0
314.6	23.78	23.70	23.66	.38	43.4	43.4	48.8	1.13	.03	1.20	.13	6.41	27.36	500		
391.0	23.48	23.22	23.10	.56	44.6	52.8	58.2	1.37	.10	1.26	.16	6.61	27.83			
464.1	23.59	23.35	23.26	.46	40.7	52.9	48.9	1.12	.11	1.02	.19	6.86	27.51			
512.8	23.55	23.32	23.23	.45	49.8	60.8	44.1	1.12	.06	1.19	.25	6.95	27.88			
561.5	23.62	23.45	23.36	.40	42.6	39.9	44.5	1.30	.12	1.27	.27	7.15	27.38	980	77.0	44.0
610.3	23.82	23.81	23.78	.28	45.3	44.5	37.6	1.28	.11	1.18	.16	7.38	27.37	990		
659.0	23.91	23.84	23.81	.20	42.3	42.8	40.1	1.13	.12	1.09	.21	7.29	27.85			
707.7	23.77	23.56	23.47	.27	39.4	38.7	43.1	1.22	.10	1.11	.28	7.12	28.13			
756.4	24.00	23.96	23.98	.25	42.4	53.6	47.1	1.31	.15	1.08	.26	7.13	27.71			
805.1	23.95	23.88	23.83	.20	50.8	39.1	42.6	1.24	.11	1.28	.15	7.00	27.87	Pout at +15dBm		
853.8	23.82	23.56	23.47	.18	52.2	41.1	55.2	1.21	.08	1.48	.08	6.98	28.22			
902.6	24.00	23.94	23.90	.22	43.2	42.0	43.4	1.30	.12	1.50	.15	7.24	28.26			
951.3	23.97	23.77	23.70	.16	38.7	59.6	39.6	1.27	.13	1.27	.23	7.28	28.01			
1000.0	24.32	24.22	24.20	.55	38.4	37.1	35.3	1.24	.11	1.40	.13	7.26	27.96			

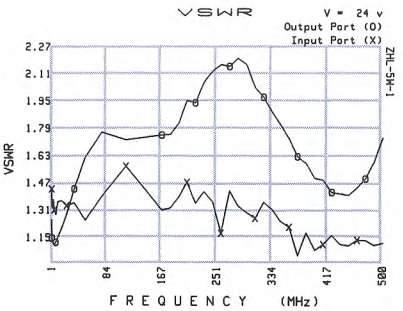
σ equals standard deviation, see amplifier terms.

Amplifiers

ZHL-5W-1



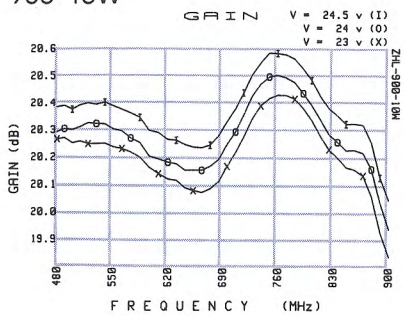


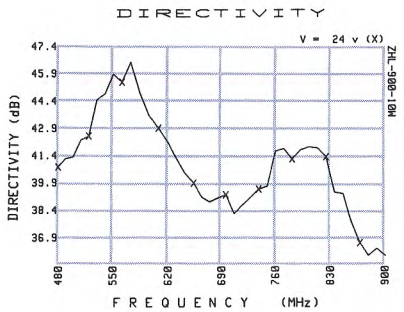


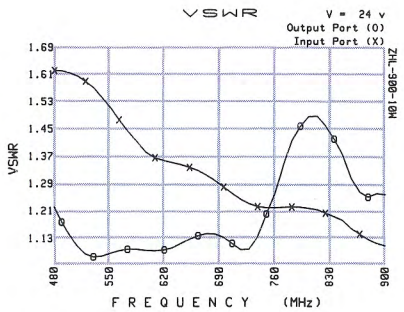
FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
1.0	41.68	41.83	41.95	.72	13.2	18.5	16.7	1.43	.11	1.26	.10	—	37.73
2.2	41.42	41.60	41.66	.66	18.7	34.8	25.5	1.34	.10	1.13	.04	—	38.66
7.2	41.54	41.70	41.78	.51	25.2	19.5	32.9	1.28	.07	1.12	.09	—	38.73
23.4	41.90	42.08	42.19	.97	22.1	24.5	20.3	1.34	.10	1.28	.06	10.25	39.34
76.1	41.78	41.96	42.07	.90	11.9	16.3	21.6	1.39	.04	1.77	.05	9.60	39.29
180.1	41.82	42.04	42.22	.97	18.0	24.7	19.1	1.32	.08	1.75	.11	8.59	37.67
218.5	41.77	42.03	42.23	.94	15.6	24.3	15.6	1.35	.08	1.94	.17	8.42	37.39
256.9	41.69	41.96	42.18	.98	18.8	19.1	24.9	1.18	.03	2.16	.15	8.22	37.95
282.5	41.88	42.19	42.40	1.02	16.8	23.4	27.9	1.34	.12	2.20	.15	8.05	37.63
308.1	41.93	42.20	42.40	1.18	28.4	13.5	9.9	1.26	.07	2.03	.10	7.88	37.80
346.5	42.52	42.78	42.97	1.47	12.0	14.5	24.1	1.25	.13	1.81	.05	7.62	38.04
384.8	43.08	43.34	43.53	1.39	10.8	13.0	18.9	1.18	.04	1.59	.02	7.43	37.81
423.2	42.58	42.87	43.08	1.05	18.3	13.1	14.6	1.16	.06	1.41	.07	7.34	38.01
461.6	41.98	42.34	42.59	.98	15.5	15.5	18.0	1.14	.04	1.44	.15	7.33	36.80
500.0	42.49	42.82	43.07	.74	14.1	20.8	20.3	1.12	.06	1.73	.20	7.39	37.82

σ equals standard deviation, see Amplifier terms

ZHL-900-10W







FREQUENCY	GAIN (dB)				DIRECTIVITY (dB)			SWR				N.F.	P_{out}(dBm)
(MHz)	23.0V	24.0V	24.5V	σ1	23.0V	24.0V	24.5V	IN	σ2	OUT	σ3	(db)	(@1dBCOMPR)
480.0	20.26	20.29	20.38	.45	40.1	40.8	40.0	1.63	.15	1.23	.08	7.82	40.07
499.3	20.25	20.29	20.37	.50	41.0	41.3	41.1	1.62	.16	1.14	.06	7.81	40.08
529.7	20.24	20.32	20.39	.51	43.2	44.5	43.4	1.57	.16	1.08	.03	7.84	40.10
561.9	20.23	20.29	20.37	.48	45.6	45.4	45.5	1.48	.12	1.10	.05	7.88	39.98
596.1	20.16	20.20	20.29	.48	45.7	43.6	44.2	1.39	.06	1.10	.06	7.89	39.88
630.8	20.11	20.17	20.26	.48	40.8	41.3	41.1	1.36	.08	1.11	.06	7.91	39.70
663.1	20.07	20.15	20.23	.53	39.5	39.1	39.7	1.33	.09	1.14	.06	7.91	40.00
695.4	20.16	20.24	20.32	.57	38.8	39.2	38.7	1.28	.07	1.14	.06	7.89	39.97
716.9	20.27	20.35	20.43	.60	38.9	38.7	39.2	1.25	.07	1.10	.07	7.84	40.14
738.5	20.38	20.46	20.54	.61	38.7	39.5	39.4	1.23	.10	1.14	.03	7.74	40.56
770.8	20.42	20.49	20.57	.63	41.3	41.8	41.1	1.22	.12	1.35	.12	7.56	40.42
803.1	20.33	20.38	20.48	.68	41.8	41.9	42.1	1.22	.10	1.49	.17	7.49	40.52
835.4	20.19	20.25	20.35	.83	39.6	39.4	39.3	1.20	.07	1.43	.13	7.68	40.37
867.7	20.13	20.21	20.31	.72	37.0	36.6	36.6	1.15	.08	1.27	.07	8.02	39.71
900.0	19.83	19.93	20.04	.48	35.7	35.9	35.8	1.11	.12	1.26	.17	8.28	39.58

σ equals standard deviation, see Amplifier terms

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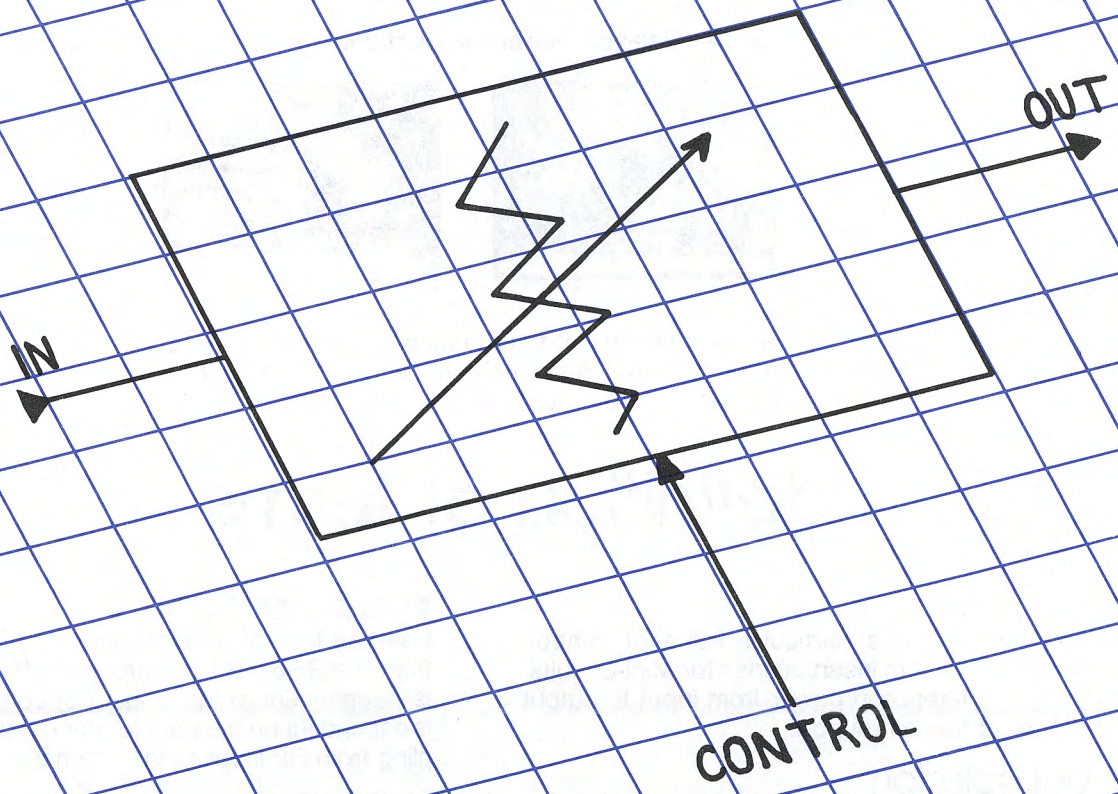
SECTION 4

BI-PHASE ELECTRONIC ATTENUATORS



contents of this section

technical

introduction, definition of terms 4-2
most often asked questions 4-3
specifications check list
a guide form for requirements 4-10

product specifications

1 MHz to 2000 MHz models 4-4, 4-5

computer data and curves . . . . . 4-6 thru 4-9

Electronic Attenuators

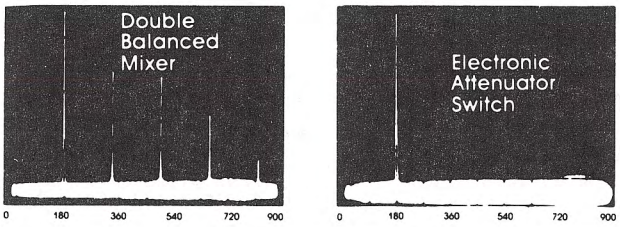
An electronic attenuator may be viewed as a variable resistor controlled by current through its control port. If a pure signal is applied at its input, harmonics will not be generated over most of the device's operating frequency range; however, some amount of harmonics will appear at the very low frequency end of the band with the amplitude determined by input power level and frequency. The minimum insertion loss of an electronic attenuator will occur at the highest value of control current, 20mA for Mini-Circuits' models. The minimum insertion loss value will increase as frequency rises so that, for example, the 1-200 MHz PAS model will have a 1.4dB insertion loss while the 100-2000 MHz PAS-2000 will have a 4dB spec. Generally speaking, the return loss is a function of control current. The higher the control current, the higher the return loss (closer to50 ohms); as current decreases, return loss drops, resulting in ahigher VSWR.

A useful feature of Mini-Circuits' electronic attenuators is the ability for either a positive or negative control current to provide the same amount of attenuation between input and output; this makes it useful for biphase modulation applications. The computer-automated performance data (CAPD) included for Mini-Circuits' electronic attenuators charts the phase difference between plus and minus modulation as a function of RF frequency.

The attenuator/switches are economically priced while covering the very broad frequency range from 1 to 2000 MHz. They offer low insertion loss (1.4 dB) high isolation (65 dB), and exceptional unit-to-unit matched performance.

Applications include power leveling and bi-phase modulation as well as current-controlled attenuation.

Double Balanced Mixer Vs. Electronic Attenuator



A comparison of the harmonics generated at a mixer's output is shown compared to the output of an electronic attenuator.

modern definition of terms

insertion loss:

must be defined at a particular value of control-current. The minimum insertion loss for Mini-Circuits' units is the difference in power from input to output with 20mA at thecontrol port.

in-out isolation:

insertion loss of the attenuator from input to output port when there is no current applied to the control port.

in-control isolation:

insertion loss of an electronic attenuator measured from the RF input to control port. This insertion loss is independent of the amount of control current and is dependent on the transformer used to provide coupling from RF input to the internal diodes.

return loss:

the amount of reflected power at the input relative to the amount of incident power at the input for a specified control current. At very high control current, return loss is very high; at low control current levels, return loss is very small.

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most often asked questions about electronic attenuators

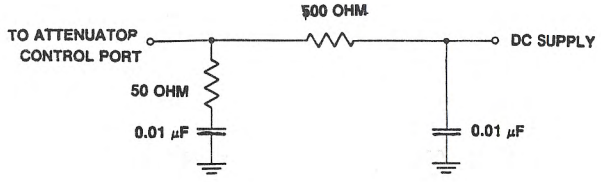
Q. *As per the schematic of an electronic attenuator, it appears the device is just an application of a conventional mixer. Why should I have to use this device, when your conventional mixer is much cheaper?*

A. The electronic attenuator is a special mixer design to produce low harmonics, high compression, and better intermodulation performance.

Mini-Circuits' electronic attenuator/switches use extremely well-matched PIN diodes, since matching of the diodes is the key to producing excellent performance.

Q. *Does a switch/attenuator require a control port biasing configuration? If yes, what is a suggested configuration?*

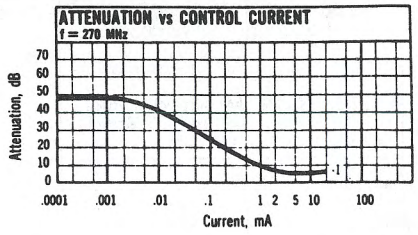
A. For improved rf performance, the control port should provide a proper 50-ohm match at the rf frequency. A simple circuit is shown below.



At RF frequencies greater than 1 MHz, the capacitors act like a short and the 50 and 500 ohm resistors appear in parallel, which is almost 50 ohm. For dc and low frequencies, the capacitor is nearly an open. Hence, dc current is applied through 500 ohms from the dc power supply.

Q. *What is the attenuation linearity vs control current?*

A. Attenuation is not linear as control current is varied, as shown in below.



Attenuation vs frequency is a function of the control current; the higher the control current level, the flatter the response.

Q. *What is the significance of input-control isolation of the switch attenuator?*

A. In-control isolation is a measure of the amount of rf signal leaking into the IF port. The amount that can be tolerated is dictated by system requirements for leakage.

Q. *All of Mini-Circuits' switch attenuators are tested and specified at 50-ohms impedance, can I use them at 75 ohms?*

A. Yes. The electronic attenuators are designed and tested for approximately a 50 ohm system. In many cases, the actual impedance is higher than 50 ohms, therefore enabling a match to 75 termination impedances. However, due to the higher impedance, the frequency response will be reduced by approximately 30%. For situations where critical specs in a 75 ohm system is required, please contact our applications department. Our engineering staff would be able to redesign the internal components of the unit to meet the specific requirements.

Q. *Can Mini-Circuits provide surface-mount switch/attenuators?*

A. Yes. We provide surface-mount TFAS-5 and SYAS-models. The specification sheet gives frequency range and features.

low current, bi-phase

Electronic Attenuators/Switches

1 MHz to 2.0 GHz

case style selection

outline drawings see Table of Contents


LRAS


TFAS


SYAS


PAS
GAS

	MODEL NO.	FREQUENCY MHz IN f_L–f_U	CON	INSERTION LOSS dB (±20 mA) Mid-Band m Typ.	Mid-Band m Max.	Total Range Typ.	Total Range Max.	MAX. INPUT POWER dBm (±20 mA) 1 dB comp.	no danage	IN-OUT ISOLATION dB (0 mA) L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	BI-PHASE X̄ (±20 mA) Δ AMP (dB) m	Δ AMP (dB) Total Range	Phase Deviation From 180° m	Phase Deviation From 180° Total Range	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PAS	•PAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	20	30	65	50	45	35	35	25	0.1	0.1	0.5	1.2	33.95	•	•
case A01	•PAS-2	10-1000	DC-0.05	4.0	6.0	6.5	8.5	20	30	50	40	40	30	35	25	0.1	0.3	0.5	1.0	47.95	•	•
	•PAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	15	30	65	50	50	40	50	35	0.1	0.1	0.5	1.0	34.95	•	•
	⁝PAS-2000	100-2000	DC-0.5	4.2	6.5	5.4	7.5	19..	25	30	22	—	—	26	30	0.3	0.4	5.0	8.0	24.95	•	•
□TFAS	•TFAS-1	2-400	DC-0.05	1.4	2.0	1.6	3.0	20▽	25	65	45	45	33	35	25	0.1	0.1	1.0	2.0	13.95	•	•
case B02	⁝TFAS-2	10-1000	DC-0.5	3.7	4.5	5	8	17.∴	25	50	30	42	20	31	20	0.1	0.2	2.0	3.0	17.95	•	•
	⁝TFAS-860	500-1000	DC-0.5	—	—	1.5	5.4	14	25	30 (typ.)		20 (min.)		—	0.3	—	4.0	19.95	•	•		
o□SYAS	•SYAS-1	2-400	DC-0.05	1.4	2.0	1.6	3.0	20▽	25	65	45	45	33	35	25	0.1	0.1	1.0	2.0	9.95	•	•
case TTT167	⁝SYAS-2	10-1000	DC-0.05	4.0	6.0	4.5	7.0	17.∴	25	59	40	42	28	28	20	0.1	0.3	2.0	3.0	13.95	•	•
case TTT166	⁝SYAS-860	600-1000	DC-0.5	—	—	2.7	5.7	14	25	—	—	25	18	—	—	—	0.5	—	4.0	15.95	•	•
ZFAS	⁝ZFAS-2000	100-2000	DC-0.5	4.2	6.5	5.4	7.5	19..	25	30	22	—	—	26	20	0.3	0.4	5.0	8.0	64.95	•	
case K18																						

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)
m=mid band (2f_L to f_U/2)

pin and coaxial connections

see case style outline drawings

Series	PAS			L/RAS	SYAS	TFAS	ZFAS	ZAS ZMAS
Models	−1 −3	−2	−2000	all models	all models	all models	all models	all models
OUT	8	8	8	4	2	4	1	1
IN	1	1	1	1	1	1	2	3
CONTROL	*3,4	*3,4	3	5	3	2	3	2
GND◆	2,5,6,7	2,5,6,7	—	2,3,6	4,5,6	—	—	—
CASE GND	2	2,5,6,7	2,5,6,7	—	—	3	—	—
NOT USED	—	—	4	—	—	—	—	—

* pins 3 and 4 must be connected together externally
◆ Ground externally. All measurements made with GND pin(s) grounded externally.

NOTES:

- • Recommended for electronic attenuator.
- ⁝ Recommended for bi-phase modulator.
- .. +15 dBm from 100-800 MHz.
- ▽ +15 dbm from 2-10 MHz.
- ∴ +13 dBm from 10-500 MHz
- □ **NON-HERMETIC,** TFAS units available in surface-mount, add suffix SM to part no., see case NNN-150
- o Available on tape and reel. Please consult factory.

1. Refer to Table of Contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing.
2. For connector types and case mounting options, see case style outline drawings.
3. Prices and specifications subject to change without notice.

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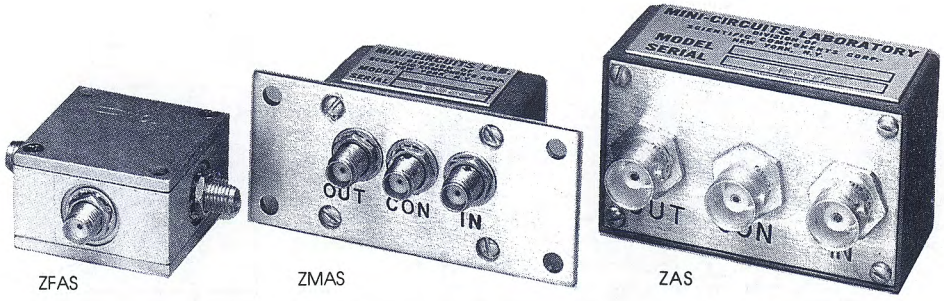
Mini-Circuits

case style selection

outline drawings see Table of Contents

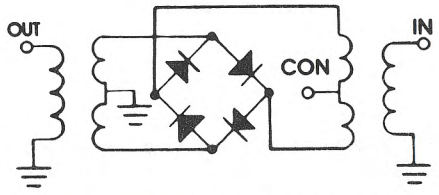


ZFAS ZMAS ZAS

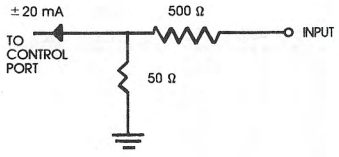
MODEL NO.		FREQUENCY MHz IN f_L–f_U	CON	INSERTION LOSS dB (±20 mA) Mid-Band m Typ.	Mid-Band m Max.	Total Range Typ.	Total Range Max.	MAX. INPUT POWER dBm (±20 mA) 1 dB comp.	no danage	IN-OUT ISOLATION dB (0 mA) L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	BI-PHASE $\overline{X}$ (±20 mA) Δ AMP (dB) m	Δ AMP (dB) Total Range	Phase Deviation From 180° m	Phase Deviation From 180° Total Range	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZMAS	•ZMAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	20	30	65	50	55	45	35	25	0.1	0.1	0.5	1.2	66.95	●	
case M21	•ZMAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	15	30	65	50	50	40	50	35	0.1	0.1	0.5	1.0	67.95	●	
ZAS	•ZAS-1	5-450	DC-0.05	3.5	4.0	3.5	4.7	20	30	65	50	55	45	35	25	0.1	0.1	0.5	1.2	59.95	●	
case M22	•ZAS-3	1-200	DC-0.05	1.4	2.0	1.6	2.5	15	30	65	50	50	40	50	35	0.1	0.1	0.5	1.0	59.95	●	
□GAS	•GAS-1	5-450	DC-0.05	3.3	4.0	3.5	5.0	20	25	60	48	45	35	35	25	0.1	0.1	1.0	1.5	13.95	●	●
case A05	•GAS-2	10-1000	DC-0.05	4.3	6.0	5.2	8.5	20	25	55	40	35	25	28	20	0.1	0.3	1.5	3.0	15.95	●	●
	•GAS-3	5-200	DC-0.05	1.2	2.0	1.4	2.5	20	25	50	45	45	35	40	30	0.1	0.1	0.5	1.0	14.95	●	●
○□RAS	•RAS-2-75	10-1000	DC-0.05	4.1	6.0	4.5	7.5	20	25	58	40	42	28	39	20	0.15	0.3	1.5	3.0	9.95	●	●
case TT100																						
○□LRAS	•LRAS-2-75	10-1000	DC-0.05	4.1	6.0	4.5	7.5	20	25	58	40	42	28	39	20	0.15	0.3	1.5	3.0	9.95	●	●
case QQQ130																						

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)
m=mid band (2f_L to f_U/2)

schematic



suggested control port biasing configuration



NSN GUIDE

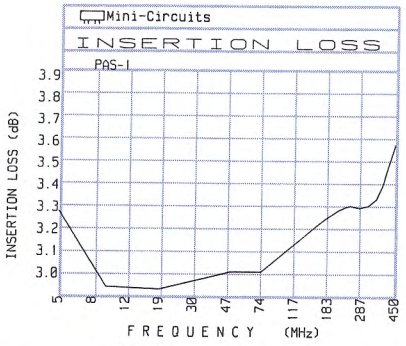
MCL NO.	NSN
PAS-1	5985-01-282-2105
PAS-2	5985-01-192-0100
PAS-3	5895-01-067-3035
ZAS-3B	5985-01-267-2832
ZMAS-1	5985-01-140-4291

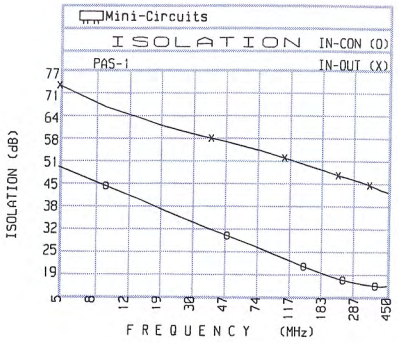
low current, bi-phase

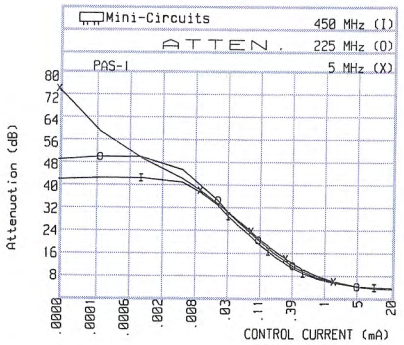
Electronic Attenuators/Switches

PAS-1, ZAS-1, ZMAS-1, GAS-1

5 to 450 MHz





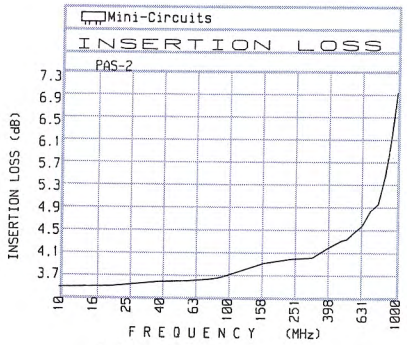


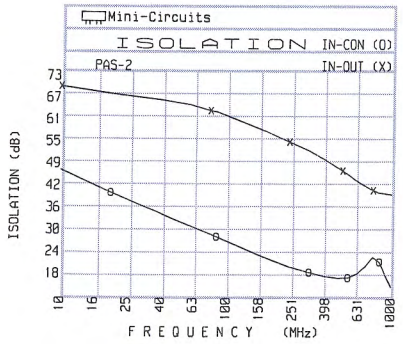
FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
5.0	3.27	.025	.02	179.9	74	50	11.8
9.5	2.93	.019	.02	179.9	68	44	13.4
19.5	2.92	.017	.02	179.9	62	38	14.3
35.0	2.97	.017	.02	179.9	59	33	14.5
39.5	2.98	.017	.03	179.9	59	32	14.5
49.5	3.00	.017	.03	179.9	57	30	14.4
74.0	3.00	.019	.04	179.8	55	27	14.1
75.1	3.00	.018	.03	179.8	55	26	14.1
107.4	3.10	.019	.04	179.7	53	23	14.3
141.8	3.18	.019	.04	179.7	51	21	14.6
176.3	3.24	.021	.04	179.6	49	19	14.5
210.8	3.28	.021	.04	179.5	48	18	14.6
225.3	3.29	.023	.04	179.5	48	18	14.7
244.2	3.30	.024	.04	179.4	47	17	14.8
278.7	3.29	.024	.04	179.3	46	16	15.1
313.2	3.30	.026	.05	179.2	46	16	15.1
347.7	3.33	.029	.05	179.1	45	16	14.8
381.0	3.40	.034	.05	179.1	44	15	15.0
415.5	3.50	.041	.06	179.0	43	15	14.7
450.0	3.58	.044	.06	178.9	43	15	13.7

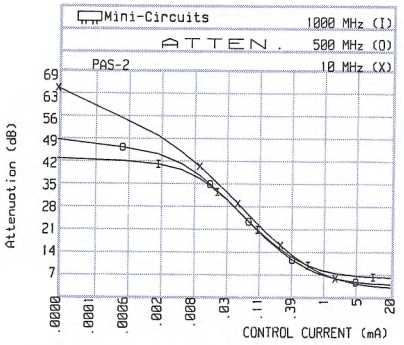
CONTROL CURRENT (mA)	ATTENUATION (dB) 5 MHz	225 MHz	450 MHz	PHASEΔ, REF AT 15mA CTRL 5 MHz (deg)	225 MHz (deg)	450 MHz (deg)	INPUT VSWR 5 MHz	225 MHz	450 MHz
0.0000	68.1	50.0	41.3	-52.4	124.7	108.2	2.9	2.9	2.6
0.0001	62.8	49.6	41.6	-9.9	119.7	103.2	2.9	2.9	2.6
0.0002	56.7	49.9	41.3	-18.0	114.6	102.4	2.9	2.9	2.6
0.0006	51.7	50.5	41.3	-20.7	101.4	95.5	2.9	2.9	2.6
0.0032	46.6	47.3	40.4	-10.7	58.4	76.3	2.9	2.9	2.6
0.0058	43.8	44.3	39.0	-6.4	45.6	60.3	2.9	2.9	2.6
0.0116	39.8	39.6	36.0	-0.4	29.9	43.3	2.8	2.9	2.6
0.0184	36.6	36.1	33.2	3.3	24.8	33.3	2.8	2.8	2.5
0.0327	32.6	31.6	29.1	5.9	18.3	23.7	2.8	2.7	2.4
0.0486	29.5	28.4	26.2	6.9	15.6	19.4	2.7	2.7	2.4
0.0787	25.9	24.6	22.6	7.6	13.3	14.8	2.6	2.5	2.2
0.1081	23.5	22.2	20.3	7.9	12.2	12.8	2.5	2.4	2.1
0.1975	19.1	17.8	16.1	7.8	10.0	9.7	2.2	2.2	1.9
0.3085	16.0	14.8	13.3	7.4	8.7	7.9	2.0	1.9	1.7
0.5100	12.9	11.7	10.6	6.5	7.3	6.0	1.7	1.7	1.4
0.8548	10.1	9.2	8.4	5.3	5.5	4.4	1.5	1.4	1.2
1.7555	7.2	6.6	6.1	3.3	3.4	2.5	1.3	1.2	1.1
2.6670	5.4	5.1	4.9	2.0	2.0	1.3	1.3	1.2	1.2
8.1232	4.0	4.0	4.0	0.5	0.5	0.4	1.5	1.4	1.4
15.1218	3.5	3.6	3.6	-0.1	-0.0	0.0	1.6	1.5	1.4

PAS-2, GAS-2

10 to 1000 MHz







FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
10.0	3.50	.025	.01	180.0	70	47	12.3
19.9	3.52	.015	.01	180.0	68	40	12.7
39.7	3.61	.008	.01	179.9	67	35	12.6
59.5	3.63	.006	.01	179.9	65	31	12.5
79.3	3.66	.006	.01	179.9	64	29	12.5
86.7	3.68	.006	.01	179.9	63	28	12.5
99.1	3.73	.006	.01	179.9	62	27	12.4
163.5	3.95	.006	.01	179.8	58	23	12.3
237.7	4.03	.007	.01	179.7	55	20	12.1
314.4	4.05	.008	.01	179.7	52	18	12.0
391.2	4.23	.012	.02	179.6	50	17	12.1
467.9	4.36	.017	.04	179.6	48	17	12.3
500.1	4.38	.021	.04	179.6	47	17	12.4
542.1	4.48	.027	.06	179.5	46	17	12.5
618.9	4.63	.040	.10	179.5	44	18	12.6
695.6	4.90	.053	.13	179.6	43	20	12.1
772.3	5.02	.064	.16	179.8	41	23	10.8
846.6	5.51	.073	.16	179.7	41	21	9.1
923.3	6.21	.087	.21	179.8	40	17	7.5
1000.0	7.06	.093	.36	180.4	40	14	6.3

CONTROL CURRENT (mA)	ATTENUATION (dB) 10 MHz	500 MHz	1000 MHz	PHASEΔ, REF AT 15mA CTRL 10 MHz (deg)	500 MHz (deg)	1000 MHz (deg)	INPUT VSWR 10 MHz	500 MHz	1000 MHz
0.0000	71.8	43.8	38.2	-37.1	96.0	63.6	3.6	2.9	7.5
0.0003	63.7	44.2	38.1	-34.3	93.2	62.4	3.6	2.9	7.5
0.0004	55.7	43.8	38.1	-12.5	86.0	57.8	3.6	2.9	7.5
0.0016	51.2	43.3	38.1	-8.5	80.1	52.8	3.6	2.8	7.4
0.0057	45.4	41.1	36.8	-4.6	55.5	35.7	3.6	2.8	7.3
0.0105	41.5	38.6	35.6	-1.2	42.6	23.4	3.5	2.8	7.1
0.0161	38.3	36.0	33.7	1.5	34.4	12.9	3.5	2.8	6.9
0.0286	33.9	31.8	30.1	3.6	24.5	0.6	3.4	2.7	6.6
0.0437	30.3	28.4	27.1	4.3	20.7	-5.6	3.3	2.6	6.2
0.0734	26.2	24.4	23.2	5.1	16.3	-9.9	3.1	2.4	5.6
0.1029	23.6	21.8	20.8	5.0	14.4	-11.4	2.9	2.3	5.2
0.1510	20.7	19.1	18.2	5.0	12.8	-11.9	2.7	2.1	4.7
0.2540	17.1	15.6	15.1	4.6	10.4	-11.1	2.4	1.8	4.0
0.3743	14.6	13.3	13.1	4.3	9.0	-9.9	2.1	1.6	3.6
0.6438	11.5	10.6	10.8	3.5	6.9	-7.5	1.7	1.3	3.1
0.9350	9.7	9.1	9.6	3.0	5.4	-6.0	1.5	1.2	2.9
1.7496	7.2	7.2	8.2	2.0	3.6	-3.6	1.2	1.1	2.7
2.6537	5.5	5.9	7.3	1.3	1.9	-1.8	1.2	1.3	2.7
7.3043	4.3	4.9	6.7	0.5	0.6	-0.7	1.4	1.5	2.6
15.1437	3.6	4.5	6.4	0.1	0.1	-0.1	1.5	1.6	2.6

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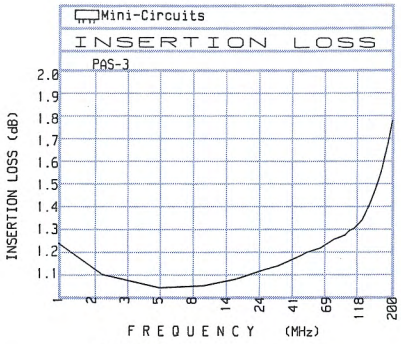
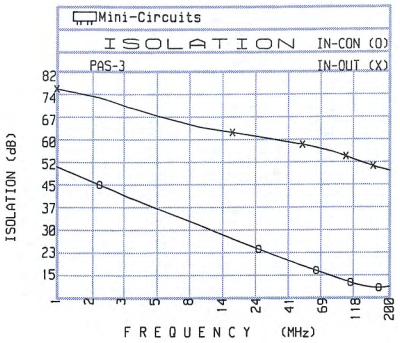
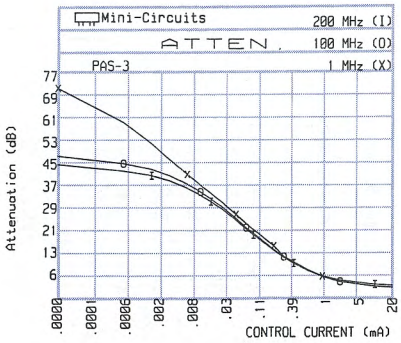
Mini-Circuits

PAS-3, ZAS-3, ZMAS-3, GAS-3

1 to 200 MHz



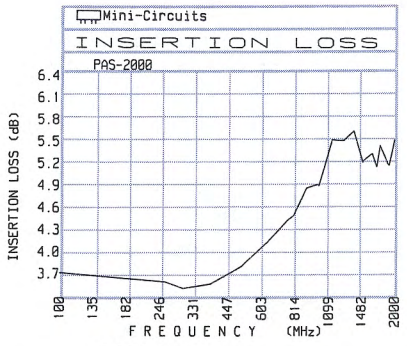


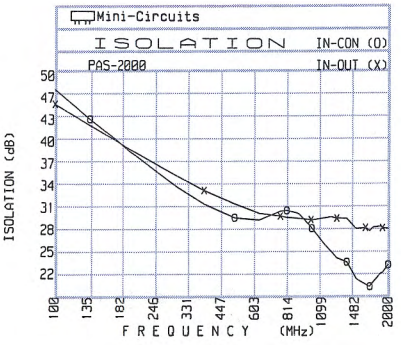


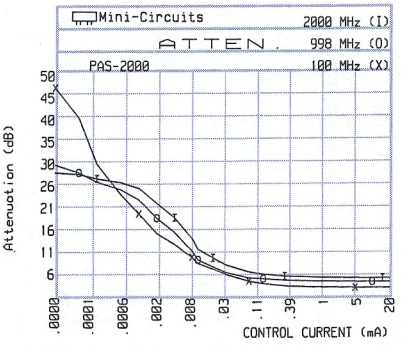
FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄	CONTROL CURRENT (mA)	ATTENUATION (dB) 1 MHz	100 MHz	200 MHz	PHASEΔ, REF AT 15mA CTRL 1 MHz (deg)	100 MHz (deg)	200 MHz (deg)	INPUT VSWR 1 MHz	100 MHz	200 MHz
1.0	1.28	.002	.01	180.0	78	52	23.5	0.0000	50.3	47.8	41.7	26.3	69.1	69.7	13.6	11.6	8.1
2.0	1.14	.002	.01	180.0	75	45	28.1	0.0004	47.0	47.3	41.2	19.0	65.6	65.4	13.5	11.6	8.1
5.0	1.08	.002	.01	180.0	69	38	35.4	0.0013	43.6	45.7	40.5	10.3	50.0	58.2	13.3	11.5	8.0
10.0	1.09	.002	.01	180.0	65	32	43.0	0.0032	40.7	43.3	39.0	5.7	36.8	46.4	12.9	11.3	7.9
16.4	1.12	.002	.01	179.9	63	28	42.7	0.0085	36.7	38.0	35.6	6.3	20.9	29.7	12.5	10.9	7.7
24.9	1.16	.002	.01	179.9	62	24	37.5	0.0162	33.0	33.5	32.0	6.6	12.3	19.1	11.7	10.3	7.4
31.8	1.18	.002	.01	179.9	61	22	35.2	0.0336	28.2	27.9	27.0	7.2	7.0	10.3	10.5	9.2	6.8
46.8	1.23	.001	.02	179.8	59	19	31.6	0.0567	24.5	23.9	23.1	7.5	4.7	6.0	9.3	8.1	6.1
49.8	1.24	.001	.02	179.8	59	19	31.0	0.0807	22.0	21.2	20.5	7.7	3.9	4.3	8.3	7.3	5.6
62.2	1.26	.002	.02	179.8	58	17	28.7	0.1215	19.1	18.2	17.5	7.5	3.0	2.9	7.1	6.2	4.9
77.6	1.30	.001	.02	179.7	57	15	26.4	0.1860	16.1	15.2	14.6	7.1	2.4	1.8	5.8	5.1	4.2
93.0	1.32	.001	.02	179.6	56	14	24.4	0.2459	14.2	13.3	12.8	6.5	2.1	1.4	5.0	4.5	3.7
100.0	1.34	.001	.02	179.6	55	13	23.5	0.3285	12.5	11.5	11.1	6.3	1.8	1.1	4.3	3.8	3.2
108.0	1.35	.001	.02	179.6	55	13	22.6	0.4365	10.8	9.9	9.6	5.7	1.6	0.9	3.6	3.3	2.8
123.4	1.39	.001	.02	179.5	54	12	21.0	0.5714	9.3	8.5	8.2	5.1	1.4	0.7	3.1	2.8	2.5
138.8	1.46	.001	.02	179.5	53	12	19.5	1.3114	5.6	5.2	5.1	3.3	0.8	0.3	2.0	1.9	1.7
154.2	1.54	.001	.02	179.4	52	11	18.2	2.0989	4.2	3.9	3.9	2.3	0.6	0.3	1.6	1.6	1.5
169.2	1.62	.001	.02	179.5	51	11	17.0	3.7220	2.9	2.8	2.9	1.3	0.3	0.1	1.3	1.3	1.3
184.6	1.73	.001	.02	179.5	51	11	15.9	7.0357	2.0	2.0	2.2	0.5	0.2	0.0	1.2	1.2	1.2
200.0	1.84	.002	.03	179.6	50	11	14.8	15.1415	1.4	1.5	1.8	-0.0	-0.0	-0.0	1.1	1.1	1.1

PAS-2000, ZFAS-2000

100 to 2000 MHz







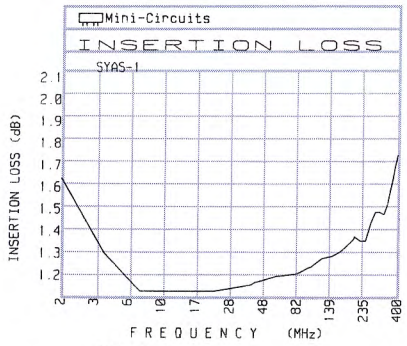
FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄	CONTROL CURRENT (mA)	ATTENUATION (dB) 100 MHz	1000 MHz	2000 MHz	PHASEΔ, REF AT 15mA CTRL 100 MHz (deg)	1000 MHz (deg)	2000 MHz (deg)	INPUT VSWR 100 MHz	1000 MHz	2000 MHz
100.0	3.76	0.006	0.02	179.4	46	48	9.5	0.0000	51.0	38.9	34.4	89.6	18.6	46.6	1.6	4.7	2.9
137.1	3.72	0.003	0.01	179.0	43	44	10.2	0.0001	48.5	37.0	33.9	91.3	12.9	42.2	1.6	4.7	2.9
301.5	3.55	0.001	0.03	178.2	36	34	11.0	0.0002	46.3	35.1	33.2	89.8	8.7	35.1	1.6	4.6	2.9
383.8	3.61	0.001	0.04	177.7	34	32	10.5	0.0003	44.1	33.6	32.7	85.5	5.8	31.0	1.5	4.6	2.9
503.4	3.85	0.010	0.08	177.1	32	30	9.3	0.0004	42.3	32.4	32.1	84.8	2.4	27.0	1.5	4.6	2.9
630.4	4.17	0.027	0.18	176.4	30	29	7.9	0.0005	39.1	30.8	31.2	78.5	-1.4	21.2	1.5	4.6	2.9
757.5	4.47	0.059	0.21	176.3	30	31	6.9	0.0006	36.5	29.7	30.6	71.5	-4.8	16.8	1.5	4.5	2.9
802.4	4.54	0.061	0.22	176.4	30	31	6.7	0.0007	30.2	26.8	28.7	53.5	-12.0	6.9	1.5	4.4	2.8
899.5	4.91	0.107	0.27	176.1	30	30	6.3	0.0008	25.5	24.0	26.3	43.0	-15.6	-0.9	1.4	4.2	2.7
996.7	4.96	0.114	0.28	175.9	29	28	6.2	0.0011	22.0	21.2	23.6	36.6	-16.4	-5.9	1.4	4.0	2.6
1004.2	4.94	0.118	0.28	175.8	29	28	6.2	0.0016	18.4	18.1	20.3	31.0	-16.0	-8.8	1.3	3.7	2.4
1131.3	5.57	0.162	0.36	175.7	30	26	6.4	0.0032	14.1	14.1	15.9	24.3	-13.7	-9.8	1.2	3.3	2.0
1258.3	5.56	0.105	0.36	175.5	30	24	7.0	0.0058	11.3	11.5	13.0	19.5	-11.1	-8.9	1.2	3.1	1.8
1377.9	5.69	0.045	0.37	175.5	30	24	7.7	0.0106	9.1	9.5	10.6	14.8	-8.6	-7.5	1.3	3.0	1.6
1497.5	5.26	0.053	0.33	175.2	28	21	8.7	0.0226	6.9	7.7	8.3	9.5	-5.5	-5.4	1.5	2.9	1.4
1632.1	5.38	0.045	0.27	174.7	28	20	10.0	0.0381	5.9	6.9	7.2	6.7	-4.0	-4.0	1.6	2.9	1.4
1699.4	5.2	0.068	0.29	174.2	28	20	10.8	0.1031	4.8	6.0	6.0	3.2	-2.0	-2.1	1.8	3.0	1.5
1751.7	5.49	0.068	0.27	174.2	28	21	11.3	0.3098	4.3	5.5	5.4	1.3	-0.9	-1.0	1.9	3.0	1.6
1901.2	5.22	0.090	0.23	173.0	28	22	12.4	1.5487	4.0	5.3	5.0	0.4	-0.4	-0.4	2.0	3.0	1.7
2000.0	5.57	0.156	0.25	172.7	28	23	12.5	15.1120	3.9	5.2	4.9	-0.1	-0.1	-0.0	2.0	3.1	1.7

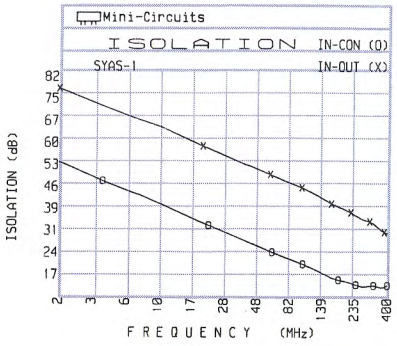
low current, bi-phase

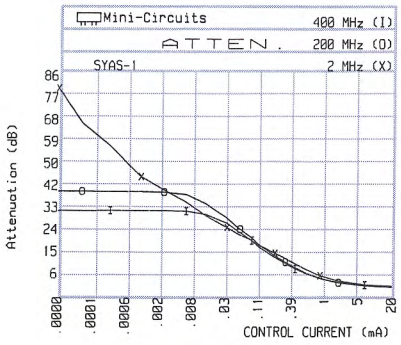
Electronic Attenuators/Switches

SYAS-1, TFAS-1, TFAS-1SM

2 to 400 MHz





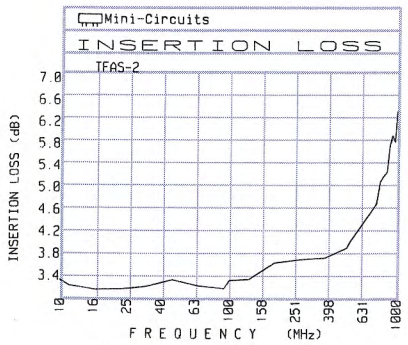


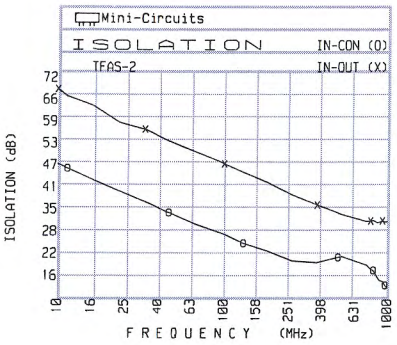
FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
2.0	1.67	0.000	0.01	179.9	78	54	18.1
7.0	1.16	0.001	0.00	180.0	68	43	25.4
10.0	1.16	0.001	0.00	180.0	66	40	27.6
21.9	1.16	0.001	0.00	180.0	58	33	31.0
39.8	1.19	0.001	0.00	180.1	53	28	31.9
59.7	1.23	0.001	0.00	180.1	50	25	32.1
61.7	1.23	0.001	0.00	180.1	50	25	32.1
81.6	1.24	0.001	0.00	180.2	47	22	32.2
99.5	1.27	0.001	0.00	180.2	46	21	32.3
121.4	1.31	0.001	0.01	180.3	44	19	32.4
141.3	1.32	0.001	0.01	180.4	42	18	32.4
181.1	1.37	0.001	0.01	180.6	39	16	32.2
200.0	1.40	0.001	0.01	180.6	39	15	32.0
220.9	1.39	0.001	0.01	180.8	38	15	31.6
240.8	1.39	0.001	0.01	180.9	36	14	30.3
280.6	1.52	0.001	0.05	181.1	35	13	26.6
300.5	1.52	0.001	0.04	181.1	35	14	24.8
340.3	1.56	0.001	0.03	181.4	33	13	21.4
360.2	1.64	0.002	0.06	181.6	32	13	19.8
400.0	1.78	0.003	0.09	181.7	31	14	17.1

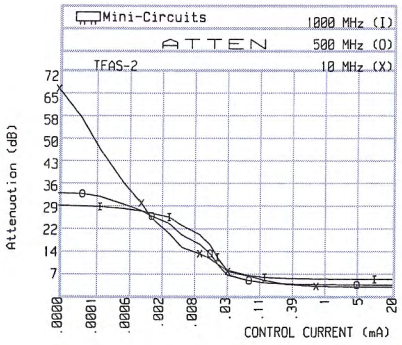
CONTROL CURRENT (mA)	ATTENUATION (dB) 2 MHz	200 MHz	400 MHz	PHASEΔ, REF AT 15mA CTRL 2 MHz (deg)	200 MHz (deg)	400 MHz (deg)	INPUT VSWR 2 MHz	200 MHz	400 MHz
0.0000	72.7	39.0	30.6	27.2	-87.7	-95.3	7.7	7.2	4.4
0.0003	64.4	39.2	30.7	22.2	-86.0	-94.6	7.7	7.2	4.4
0.0005	56.5	39.0	30.8	28.6	-84.3	-93.7	7.6	7.2	4.4
0.0012	50.4	39.0	30.7	17.4	-80.5	-92.0	7.6	7.2	4.4
0.0019	47.8	39.0	30.7	14.1	-77.4	-90.3	7.5	7.2	4.4
0.0054	42.5	37.9	30.6	8.2	-56.2	-79.9	7.4	7.0	4.3
0.0100	38.4	35.8	30.1	7.6	-37.3	-67.6	7.2	6.9	4.3
0.0157	35.1	33.1	29.0	8.8	-25.3	-55.1	7.1	6.7	4.2
0.0284	30.6	28.7	26.3	8.8	-12.8	-37.6	6.7	6.3	4.0
0.0433	27.3	25.3	23.7	9.2	-7.2	-26.9	6.3	5.9	3.8
0.0722	23.2	21.2	20.0	9.3	-3.1	-17.7	5.6	5.3	3.5
0.1012	20.7	18.6	17.6	9.0	-1.4	-13.2	5.2	4.9	3.3
0.1898	16.1	14.1	13.3	8.2	0.4	-8.0	4.1	3.9	2.8
0.3008	13.1	11.2	10.6	7.4	0.9	-5.5	3.4	3.2	2.4
0.4259	10.9	9.2	8.8	6.7	1.1	-4.2	2.9	2.7	2.1
0.7017	8.3	6.9	6.6	5.4	1.1	-2.8	2.2	2.1	1.7
0.9968	6.8	5.6	5.4	4.4	0.9	-2.1	1.9	1.8	1.5
1.7486	4.8	3.9	4.0	3.0	0.7	-1.3	1.5	1.5	1.3
5.6920	2.5	2.1	2.3	0.9	0.2	-0.3	1.2	1.1	1.2
15.1258	1.8	1.5	1.8	0.0	0.0	0.1	1.3	1.1	1.3

TFAS-2, TFAS-2SM, SYAS-2

10 to 1000 MHz







FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
10.0	3.34	0.009	0.00	180.0	69	47	11.4
11.4	3.24	0.006	0.01	180.0	67	46	11.6
16.1	3.17	0.004	0.01	180.1	64	43	12.2
23.2	3.18	0.003	0.00	180.1	59	40	12.5
46.5	3.35	0.002	0.01	180.3	54	34	12.5
65.8	3.24	0.002	0.01	180.5	51	31	12.4
93.1	3.19	0.003	0.01	180.7	48	28	12.4
100.2	3.34	0.003	0.01	180.7	47	28	12.4
131.8	3.36	0.004	0.01	180.9	45	25	12.4
186.6	3.66	0.005	0.02	181.3	42	23	12.3
373.8	3.75	0.008	0.02	182.1	36	20	11.4
500.8	3.93	0.015	0.03	182.5	34	21	11.3
529.1	4.06	0.018	0.04	182.5	33	21	11.2
748.8	4.72	0.055	0.10	182.6	31	19	10.7
791.0	5.13	0.050	0.15	182.8	31	18	10.3
820.5	5.21	0.052	0.15	182.4	32	18	10.1
899.0	5.75	0.063	0.20	182.4	31	15	9.5
932.5	5.97	0.089	0.27	182.0	31	15	9.3
967.2	5.85	0.077	0.24	181.8	31	13	9.1
1000.0	6.41	0.111	0.38	181.4	31	13	8.8

CONTROL CURRENT (mA)	ATTENUATION (dB) 10 MHz	500 MHz	1000 MHz	PHASEΔ, REF AT 15mA CTRL 10 MHz (deg)	500 MHz (deg)	1000 MHz (deg)	INPUT VSWR 10 MHz	500 MHz	1000 MHz
0.0000	51.3	24.7	27.2	76.7	40.6	0.5	3.3	2.3	4.2
0.0001	40.8	22.0	24.7	67.8	31.3	-6.7	3.2	2.2	4.0
0.0002	35.5	20.5	23.4	61.3	25.4	-10.4	3.2	2.2	3.8
0.0003	32.1	19.5	22.5	59.5	21.4	-12.8	3.1	2.1	3.7
0.0008	28.6	18.4	21.4	55.8	17.3	-14.7	3.0	2.0	3.6
0.0012	25.7	17.1	20.1	53.7	14.1	-15.8	2.9	1.9	3.4
0.0019	22.8	15.7	18.6	51.0	10.9	-16.0	2.7	1.9	3.2
0.0029	20.2	14.2	17.0	47.8	8.6	-15.1	2.6	1.7	3.1
0.0040	17.8	12.7	15.3	45.1	6.8	-13.6	2.4	1.6	2.9
0.0074	14.6	10.4	12.9	40.1	4.7	-10.7	2.1	1.5	2.7
0.0110	12.7	9.1	11.5	36.8	3.7	-8.7	1.9	1.4	2.6
0.0159	11.1	8.0	10.4	33.2	2.8	-7.2	1.7	1.4	2.6
0.0221	9.7	7.0	9.5	29.5	2.2	-5.3	1.5	1.4	2.5
0.0301	8.5	6.3	8.8	25.9	1.7	-4.3	1.3	1.4	2.6
0.0416	7.4	5.8	8.3	22.4	1.0	-3.4	1.2	1.5	2.6
0.0753	5.9	5.1	7.6	16.2	0.7	-2.1	1.2	1.6	2.6
0.1640	4.7	4.5	7.0	9.2	0.2	-1.4	1.4	1.8	2.7
0.3543	4.0	4.2	6.7	5.0	0.0	-0.8	1.6	1.9	2.7
1.2309	3.6	4.0	6.5	1.7	-0.1	-0.5	1.8	2.0	2.7
15.1064	3.4	3.8	6.3	0.0	-0.0	-0.1	1.9	2.0	2.7

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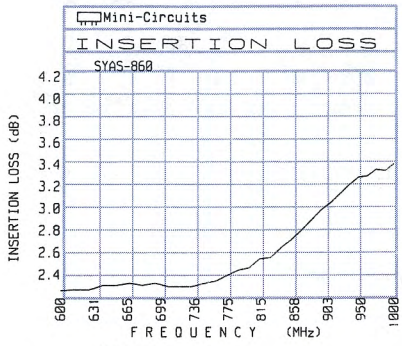
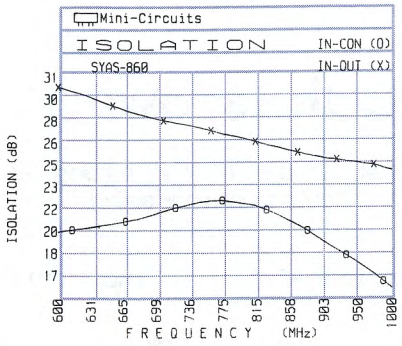
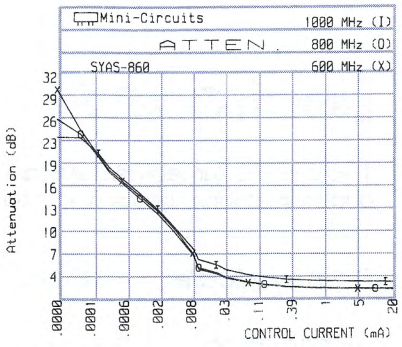
Mini-Circuits

SYAS-860

600 to 1000 MHz





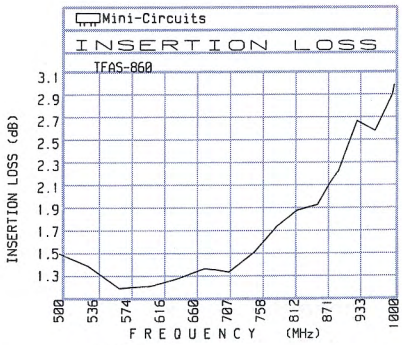


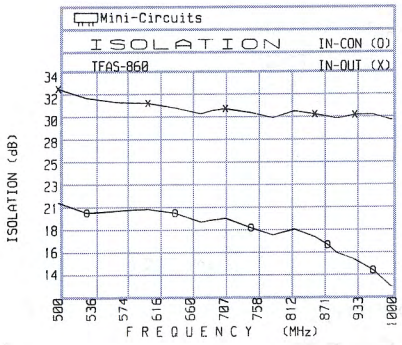
FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
600.0	2.30	0.015	0.07	182.1	30	20	10.8
627.0	2.31	0.013	0.06	182.4	30	20	11.2
640.0	2.35	0.011	0.06	182.4	29	20	11.3
667.0	2.37	0.007	0.06	182.6	29	21	11.4
680.0	2.35	0.005	0.07	182.8	29	21	11.4
707.0	2.34	0.005	0.08	182.7	28	21	11.2
720.0	2.34	0.007	0.10	182.9	28	22	11.1
747.0	2.37	0.008	0.13	183.0	28	22	10.7
773.0	2.44	0.009	0.16	183.2	27	22	10.2
787.0	2.49	0.011	0.19	183.2	27	22	10.0
813.0	2.59	0.014	0.20	183.3	26	22	9.5
827.0	2.60	0.018	0.24	183.6	26	22	9.2
853.0	2.76	0.021	0.26	183.7	26	21	8.6
880.0	2.94	0.032	0.33	183.8	26	20	8.1
893.0	3.03	0.037	0.35	183.8	25	20	7.9
920.0	3.18	0.040	0.40	183.9	25	19	7.4
933.0	3.26	0.047	0.43	183.9	25	18	7.2
960.0	3.34	0.049	0.48	183.8	25	17	6.7
973.0	3.40	0.051	0.49	183.8	25	17	6.6
1000.0	3.45	0.050	0.49	183.9	24	16	6.2

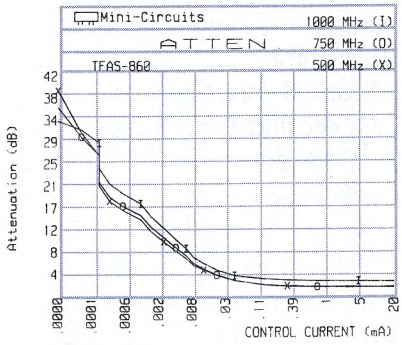
CONTROL CURRENT (mA)	ATTENUATION (dB) 600 MHz	800 MHz	1000 MHz	PHASEΔ, REF AT 15mA CTRL 600 MHz (deg)	800 MHz (deg)	1000 MHz (deg)	INPUT VSWR 600 MHz	800 MHz	1000 MHz
0.0000	35.3	29.9	28.6	-60.9	-101.2	-133.3	2.9	2.3	3.1
0.0001	28.3	28.3	29.9	11.7	-36.3	-80.9	2.9	2.3	3.0
0.0002	21.8	22.6	25.3	14.5	-18.8	-51.0	2.7	2.2	2.9
0.0003	18.4	19.2	21.9	11.1	-16.0	-41.8	2.5	2.1	2.7
0.0004	16.4	17.2	19.8	9.9	-13.7	-36.0	2.4	2.0	2.6
0.0008	14.1	14.9	17.2	9.4	-10.4	-28.8	2.2	1.8	2.4
0.0015	11.7	12.3	14.5	8.8	-7.2	-21.8	1.9	1.7	2.3
0.0029	9.3	9.9	11.8	7.8	-4.8	-15.9	1.7	1.5	2.2
0.0059	7.2	7.8	9.5	6.1	-3.3	-11.3	1.4	1.4	2.2
0.0095	5.6	6.2	7.8	4.4	-2.3	-7.9	1.2	1.4	2.3
0.0200	4.5	5.1	6.6	3.1	-1.7	-5.4	1.2	1.5	2.6
0.0344	3.7	4.3	5.8	2.0	-1.2	-3.8	1.3	1.7	2.9
0.0556	3.3	3.9	5.3	1.3	-1.0	-2.7	1.4	1.8	3.2
0.0814	3.0	3.6	5.0	0.8	-0.9	-2.0	1.5	1.9	3.4
0.1072	2.8	3.4	4.8	0.7	-0.9	-1.7	1.5	1.9	3.6
0.1926	2.6	3.2	4.6	0.3	-0.7	-1.1	1.6	2.0	3.8
0.2956	2.5	3.1	4.5	0.1	-0.6	-0.8	1.6	2.1	3.9
0.4662	2.4	3.0	4.4	0.0	-0.5	-0.5	1.7	2.1	4.0
2.0106	2.3	2.8	4.2	-0.0	-0.3	-0.2	1.7	2.2	4.2
15.0980	2.2	2.8	4.1	0.0	-0.1	0.1	1.7	2.2	4.3

TFAS-860, TFAS-860SM

500 to 1000 MHz







FREQ (MHz)	INSERTION LOSS (AT 20mA) (dB) x̄	(dB) σ	± CONTROL, 20mA ΔAMP (dB) x̄	ΔPHASE (deg) x̄	ISOLATION (IN-OUT) (dB) x̄	(IN-CON) (dB) x̄	INPUT R.LOSS (dB) x̄
500.0	1.46	0.009	0.09	182.1	33	21	9.5
530.5	1.35	0.008	0.08	182.2	32	20	10.8
565.5	1.15	0.006	0.06	182.4	32	20	12.4
580.0	1.16	0.007	0.05	182.4	32	21	13.3
604.0	1.17	0.010	0.04	182.4	32	21	14.0
639.0	1.24	0.012	0.04	182.6	31	20	15.0
674.0	1.33	0.022	0.03	182.8	31	19	15.2
690.0	1.32	0.023	0.03	182.7	31	20	14.9
709.0	1.30	0.024	0.04	182.6	31	20	14.6
747.5	1.48	0.054	0.05	182.8	31	19	13.4
782.5	1.71	0.082	0.10	183.0	30	18	12.2
817.5	1.86	0.103	0.15	182.8	31	19	11.0
852.5	1.91	0.152	0.13	182.9	31	18	9.9
875.0	2.11	0.202	0.17	183.0	30	17	9.4
891.0	2.22	0.244	0.20	183.0	30	16	8.8
901.5	2.36	0.291	0.22	183.1	30	16	8.5
926.0	2.67	0.380	0.26	183.0	31	15	8.0
961.0	2.58	0.341	0.26	182.8	31	14	7.3
996.0	2.91	0.658	0.33	183.2	30	13	6.7
1000.0	3.00	0.685	0.35	183.2	30	13	6.6

CONTROL CURRENT (mA)	ATTENUATION (dB) 500 MHz	750 MHz	1000 MHz	PHASEΔ, REF AT 15mA CTRL 500 MHz (deg)	750 MHz (deg)	1000 MHz (deg)	INPUT VSWR 500 MHz	750 MHz	1000 MHz
0.0000	27.1	25.3	26.4	83.7	62.3	54.7	5.1	2.8	4.7
0.0001	20.7	19.5	22.0	69.7	41.4	26.0	4.8	2.7	4.4
0.0002	16.3	15.8	18.8	51.4	25.7	9.2	4.1	2.5	3.8
0.0003	13.6	13.5	16.4	38.4	15.8	-0.3	3.6	2.3	3.3
0.0004	12.6	12.5	15.4	33.9	12.7	-3.1	3.4	2.2	3.1
0.0008	10.7	10.8	13.4	27.5	8.7	-6.0	3.0	2.0	2.8
0.0012	9.5	9.6	12.0	23.4	6.5	-6.8	2.7	1.8	2.6
0.0020	7.5	7.6	9.8	18.0	4.0	-6.9	2.3	1.6	2.3
0.0047	5.7	5.9	7.9	13.0	2.4	-5.9	2.0	1.4	2.2
0.0073	4.7	4.9	6.8	10.2	1.7	-4.9	1.8	1.3	2.2
0.0136	3.6	3.7	5.6	6.8	0.8	-3.6	1.7	1.2	2.4
0.0202	3.0	3.2	5.0	5.2	0.5	-2.8	1.7	1.2	2.5
0.0336	2.4	2.6	4.4	3.5	0.2	-2.0	1.7	1.3	2.7
0.0486	2.2	2.4	4.2	2.6	-0.0	-1.7	1.8	1.4	2.8
0.0752	1.9	2.1	3.9	1.8	-0.1	-1.3	1.8	1.4	3.0
0.1089	1.8	1.9	3.7	1.3	-0.1	-1.0	1.8	1.5	3.1
0.1787	1.6	1.8	3.6	0.8	-0.3	-0.7	1.9	1.5	3.2
0.2608	1.5	1.7	3.5	0.5	-0.2	-0.6	1.9	1.5	3.2
0.9689	1.4	1.5	3.3	0.1	-0.2	-0.2	1.9	1.6	3.3
14.8842	1.3	1.4	3.1	0.0	-0.1	-0.0	2.0	1.6	3.4

Mini-Circuits

SPECIFICATIONS CHECKLIST

Electronic Attenuators/Switches

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency range _____ MHz
Control current _____ mA max.
Insertion loss, @mA _____ , _____ dB max.
@mA ____ , ____ dB, ____ ±dB
@mA ____ , ____ dB, ____ ±dB
@mA ____ , ____ dB, ____ ±dB
Isolation (input to control) _____ dB min.
VSWR or return loss (dB)
Input _____ Output _____
☐ 50 ohms ☐ 75 ohms ☐ other
Bi-phase (+ to −) control current, _____ mA
△amp _____ dB △phase, 180° ± _____ °.

Switching time* _____ μsec max.
Rise time _____ μsec max.
Max. RF input power _____ dBm
Operating temperature _____ °C
* 50% control to 90% RF (on) to 10% RF (off)

Environmental requirements:

_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N

Special Requirements:

_____
_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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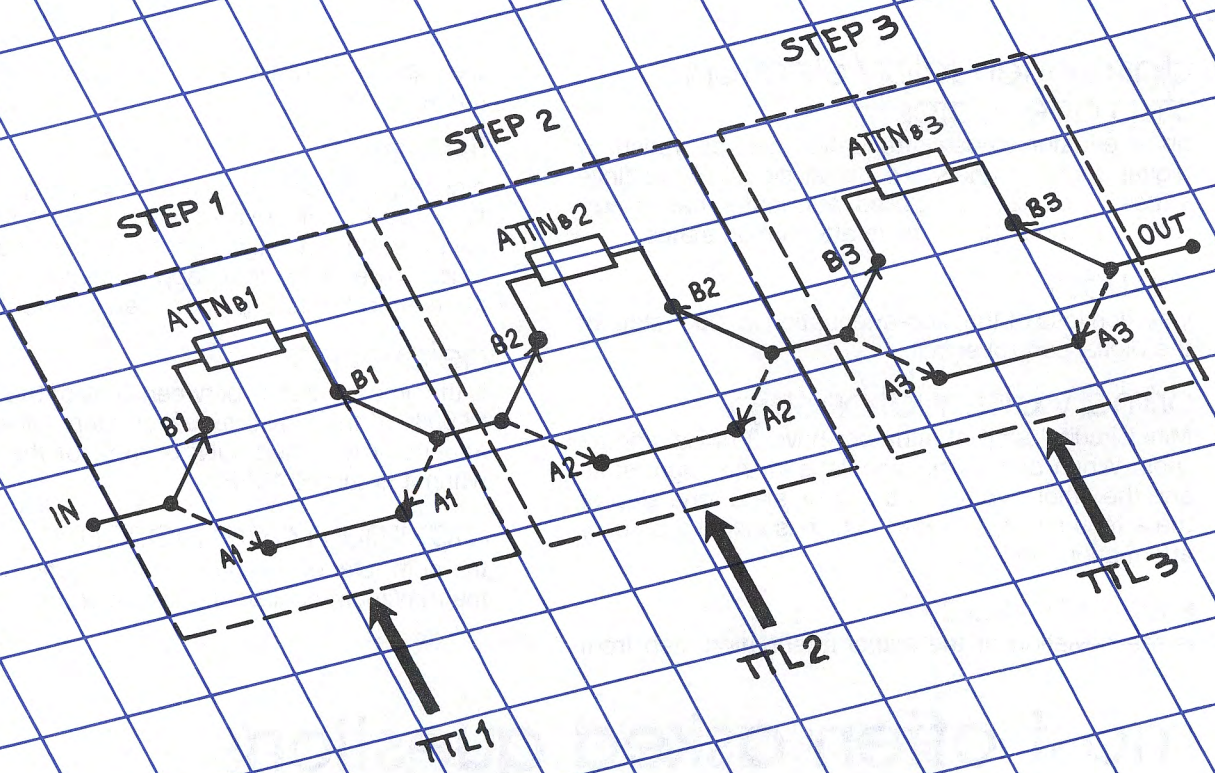
DIGITAL STEP ATTENUATORS



contents of this section

technical

introduction, definition of terms 5-2
most often asked questions 5-3
specifications check list
a guide form for requirements 5-5

product specifications

0.5 to 20 dB steps models 5-4

computer data and curves

CAPD information . . . . . 5-6 thru 5-10

Digital Step Attenuators

Precision TTL-controlled step attenuators, accurate over 10 to 1000 MHz and −55° to +100°C, are available from Mini-Circuits in hermetically-sealed TO-8 cases and SMA connectorized packages. In each package style, five models are offered, each with three internal discrete attenuators switchable to provide eight discrete and accurate levels up to 35 dB. Models can be cascaded to provide increased attenuation because of the excellent input/output return loss of each model; the final value of attenuation will equal the sum of the attenuations of the individual models. The accuracy of these step attenuators is comparable to precision fixed attenuators. Attenuation values are flat over the full frequency range and the full −55° to +100°C temperature range.

Three TTL lines are provided, one to correspond with each step of attenuation. To achieve 6-bit attenuation, merely cascade two models. Each step is switched on or off by a TTL signal, with the difference in insertion loss between the on and off state being the step attenuation. The 50 ohm TOAT- and ZFAT-series perform with 6 μsec switching speed and can handle power levels up to +10dBm above a few hundred MHz, and 0 dBm at 10 MHz.

modern definition of terms

digital attenuator/electronic step attenuator

an attenuator whose attenuation can be varied by digital control signals. As digital signals have finite states, a digitally controlled attenuator has a corresponding number of finite attenuation states.

thru loss

insertion loss of the step-attenuation in "000" state of the digital control signal.

primary attenuation step

Mini-Circuits' step attenuators have 3 digital control lines. When one of the signals is in the "high" state and the other two are in the "low" state, one step of the attenuator is activated, which is called a primary attenuation step.

step accuracy

is the deviation of the actual attenuation step from the specified value over the specified frequency range.

rise time

time required for the attenuator to change from 10% to 90% of its final value when one of the steps is switched on. The digital control signal should have a much lower rise time (approximately 1/10 of the attenuator) to make a good measurement.

delay time

is the time difference between 50% of the TTL signal to 90% of the final attenuation step value when the attenuator is turned "ON" or 10% of the step value when it is turned "OFF."

maximum attenuation

the sum total of the primary attenuation steps. It is the maximum achievable step attenuation.

most often asked questions about digital step attenuators

Q. *Suppose I don't work at less than the specified 1dB compression of a step attenuator, what are the consequences?*

A. Should you exceed the specified compression, typically given at 0dBm input, harmonics will be generated which may affect system operation. Also, when you measure the fundamental for attenuation, an error will appear because some of the fundamental's power has been transferred to the harmonic products.

Q. *What is meant by the "zero" value of a step attenuator?*

A. Step attenuators are referenced to the minimum

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most often asked questions cont.

insertion loss of the switch. If the switch in its"zero" position has an insertion loss of 3dB at 10MHz, it might be 3.5dB at 1GHz. All attenuation values are given relative to this "zero" reference.

Q. *Why do Mini-Circuits' ads on TTL-controlled step attenuators emphasize the word "precision"?*

A. Most step attenuators on the market have a relatively wide variation of attenuation over the specified frequency band; for example, a 3dB step could be off by as much as 1dB so that attenuation is anywhere from 2 to 4dB. With Mini-Circuits' step attenuators, the difference would be 0.3dB or less. The same situation occurs for temperature variation.

Further, when switching internal resistors to increase attenuation from say 3dB to 6dB, the sum may be off by as much as 2dB if return loss within the unit is poor. With Mini-Circuits' precision step attenuators, designed with 24dB return loss, the sum will be within 0.6dB of nominal.

Q. *What makes Mini-Circuits' step attenuators so precise?*

A. Along with the 24dB return loss criterion, extremely short lead lengths, resistors trimmed with high accuracy, and switches with low parasitics yield precision performance.

Q. *What happens when step attenuators are cascaded?*

A. Attenuation will be arithmetically additive provided return loss of each unit is extremely good, 20dB or better. Otherwise, the sum may be other than the total of the units. Mini-circuits' attenuators can be cascaded without loss of accuracy.

Q. *How fast is attenuation switched from one value to another?*

A. TTL switching from one value to another is specified by delay time, and is 6 μs max. Delay is defined as the time to achieve 90% of the resulting RF amplitude change.

Q. *If I exceed the maximum input level, will I burn out the step attenuator?*

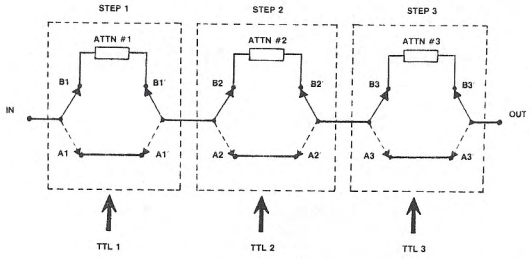
A. It's not recommended, but you can exceed the input power rating by 10dB without damage. The penalty would be the presence of distortion products and a decrease in attenuation accuracy.

Q. *What is the consequence of feeding pulses with excessive peak voltage into a step attenuator?*

A. Excessive voltage peaks will widen the pulse width.

Q. *Please sketch the configuration of a typical TTL-controlled step attenuator.*

A.



Each of the three steps is configured with two single-pole, double-throw switches and a fixed attenuator; see figure. Step 1 is shown with B1 and B1′ contacting Attn #1, Step 2 with B2 and B2′ contacting Atten #2, and Step 3 with B3 and B3′ contacting Atten #3. Thus, all steps are connected to their individual attenuators and are in cascade to provide maximum attenuation.

Q. *What are the TTL requirements for proper operation and how much latitude is allowable?*

A. For MCL attenuators, TTL"0" corresponds to 0 to 0.8V and TTL "1" corresponds to 2 to 5V.

Q. *Must the TTL input be 50-ohms? What if it is 75-ohms?*

A. TTL interfaces are defined in terms of voltages and currents, rather than impedance.

pin diode, precision

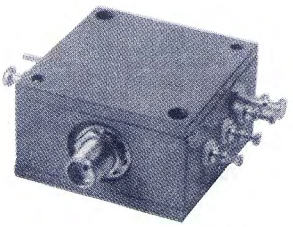
Digital Step Attenuators

with TTL Control Inputs

0.5 to 20 dB steps, up to 35 dB attenuation
10 MHz to 1 GHz



TOAT



ZFAT

	MODEL NO.	FREQUENCY RANGE (MHz) f_L	f_U	PRIMARY ATTN. STEPS (dB) @ TTL CONTROL PORT #1	#2	#3	ATTENUATION (dB) LOGIC STATE (1,1,1) Max.	(0,0,0) Min.	VSWR L	M	U	PRICE $ 1-9	DISTRIBUTOR FACTORY	LOCAL
TOAT	TOAT-R512	10	1000	0.5±0.18	1±0.25	2±0.25	3.5	4.0	1.6	1.4	1.5	59.95	●	●
case QQ96	TOAT-124	10	1000	1±0.25	2±0.25	4±0.3	7	4.0	1.6	1.4	1.5	59.95	●	●
	TOAT-3610	10	1000	3±0.3	6±0.4	10±0.4	19	4.0	1.6	1.4	1.5	59.95	●	●
	TOAT-51020	10	1000	5±0.4	10±0.4	20±0.5	35	4.0	1.6	1.4	1.5	59.95	●	●
	TOAT-4816	10	1000	4±0.4	8±0.4	16±0.5	28	4.0	1.6	1.4	1.5	59.95	●	●
ZFAT	ZFAT-R512	10	1000	0.5±0.18	1±0.25	2±0.25	3.5	4.0	1.6	1.4	1.5	89.95	●	
case SSS-173	ZFAT-124	10	1000	1±0.25	2±0.25	4±0.3	7	4.0	1.6	1.4	1.5	89.95	●	
	ZFAT-3610	10	1000	3±0.3	6±0.4	10±0.4	19	4.0	1.6	1.4	1.5	89.95	●	
	ZFAT-51020	10	1000	5±0.4	10±0.4	20±0.5	35	4.0	1.6	1.4	1.5	89.95	●	
	ZFAT-4816	10	1000	4±0.4	8±0.4	16±0.5	28	4.0	1.6	1.4	1.5	89.95	●	

L=10 to 100 MHz M=100 to 500 MHz U=500 to 1000 MHz

Additional Specifications

DC Voltage: +5V
DC Current: 10 mA MAX.
Rise Time (10% TO 90%): 6 μ sec. max
Delay Time (50% TTL TO 90% RF): 6 μ sec. max.
TTL Input High Threshold 2V MIN.
TTL Input Low Threshold 0.8V max.
TTL Toggle Rate: 100 KHz TYP.
1 dB Compression: 0 dBm

Max. Ratings:

Input Power: 15 dBm
DC Voltage: 5.5V max.
TTL PORT: 5.5V max.
Operating Temperature: −55° TO 100°C
Storage Temperature: −55° TO 125°C

Logic Function:

TTL High Activates Associated In-line Attenuation
TTL Low Bypasses this Attenuation

NOTES:

1. Step accuracy is specified for basic steps. For combination of steps, accuracy is additive.
2. Thru loss is minimum insertion loss with all attenuation elements bypassed (TTL control state 000).
3. Prices and specifications subject to change without notice.

pin connections

PIN	FUNCTION
1	TTL CONTROL #3
2	TTL CONTROL #1
3	TTL CONTROL #2
4	RF IN
11	RF OUT
12	+5V DC
5,6,7,8,9,10	CASE GROUND

features

- wide frequency band, 10-1000 MHz
- excellent step accuracy, 0.2 dB typ.
- excellent VSWR, 1.3 typ.
- low DC current, 6 mA typ.
- operates over −55° to 100°C
- small case, 0.6″ dia., TO-8

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Digital Step Attenuators

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency range _____ MHz
Primary attenuation steps _____ dB
Step accuracy (primary) _____ ±db
Thru loss _____ dB
VSWR/Return Loss (dB)
☐ 50 ohm ☐ 75 ohm ☐ Other
Input _____ Output _____
Supply voltage _____ V
Supply current _____ mA
LOGIC ☐ TTL ☐ CMOS ☐ Other
Rise time/fall time _____ μsec
Delay time (50% TTL to 90% RF) _____ μsec

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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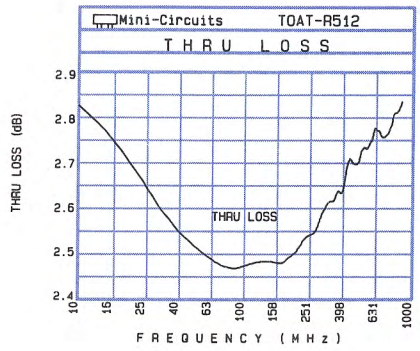
pin diode

Step Attenuators

with TTL Control Inputs

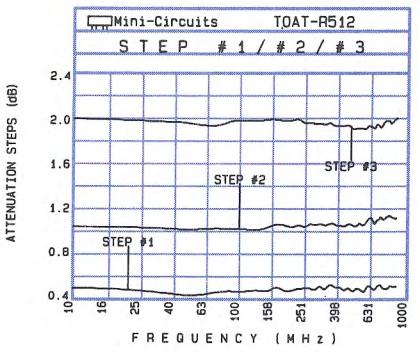
TOAT-R512, ZFAT-R512

10 - 1000 MHz



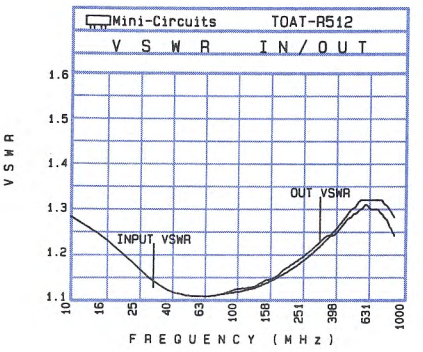
STEP ATTENUATION* AT TTL CONTROL STATE

FREQ. (MHz)	000 thru loss (dB)	001 .5 (dB)	010 1.0 (dB)	011 1.5 (dB)	100 2.0 (dB)	101 2.5 (dB)	110 3.0 (dB)	111 3.5 (dB)
10.000	2.82	.48	1.01	1.49	2.01	2.49	3.01	3.51
49.600	2.51	.47	1.02	1.51	2.00	2.49	3.06	3.53
148.600	2.49	.48	1.03	1.49	2.01	2.51	3.05	3.50
208.000	2.52	.49	1.02	1.51	2.00	2.50	3.03	3.48
247.600	2.57	.49	1.02	1.51	1.98	2.48	3.02	3.50
346.600	2.60	.50	1.05	1.54	1.98	2.49	3.02	3.51
406.000	2.67	.52	1.08	1.57	1.98	2.47	3.04	3.53
445.600	2.70	.48	1.03	1.55	1.97	2.48	3.02	3.51
544.600	2.73	.50	1.08	1.57	1.96	2.49	3.04	3.54
604.000	2.74	.53	1.09	1.60	1.96	2.52	3.07	3.57
703.000	2.78	.53	1.12	1.66	1.98	2.54	3.08	3.61
762.400	2.77	.54	1.09	1.62	1.97	2.50	3.06	3.57
821.800	2.77	.52	1.14	1.68	2.01	2.55	3.10	3.66
881.200	2.82	.55	1.14	1.70	2.02	2.57	3.12	3.70
940.600	2.84	.57	1.14	1.70	1.99	2.59	3.14	3.73
1000.000	2.81	.56	1.18	1.71	2.07	2.62	3.18	3.76



INPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.26	1.26	1.24	1.27	1.25	1.25	1.23
49.600	1.11	1.11	1.10	1.10	1.10	1.10	1.09
148.600	1.14	1.14	1.14	1.13	1.13	1.13	1.13
208.000	1.17	1.17	1.17	1.15	1.16	1.16	1.16
247.600	1.19	1.20	1.20	1.17	1.18	1.18	1.19
346.600	1.24	1.25	1.25	1.22	1.23	1.23	1.24
406.000	1.27	1.28	1.28	1.24	1.25	1.27	1.27
445.600	1.29	1.30	1.30	1.26	1.27	1.29	1.29
544.600	1.31	1.33	1.33	1.29	1.30	1.32	1.33
604.000	1.32	1.34	1.34	1.30	1.31	1.34	1.34
703.000	1.31	1.34	1.33	1.30	1.31	1.35	1.35
762.400	1.30	1.33	1.33	1.30	1.31	1.34	1.35
821.800	1.28	1.32	1.31	1.29	1.30	1.34	1.34
881.200	1.26	1.30	1.30	1.28	1.28	1.33	1.32
940.600	1.24	1.28	1.27	1.26	1.26	1.31	1.31
1000.000	1.21	1.25	1.25	1.23	1.25	1.29	1.29



OUTPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.30	1.27	1.27	1.22	1.21	1.20	1.20
49.600	1.12	1.12	1.12	1.09	1.09	1.09	1.09
148.600	1.15	1.15	1.16	1.12	1.11	1.11	1.11
208.000	1.17	1.18	1.18	1.12	1.13	1.12	1.14
247.600	1.21	1.21	1.21	1.14	1.15	1.15	1.15
346.600	1.26	1.27	1.29	1.18	1.19	1.20	1.20
406.000	1.31	1.33	1.33	1.22	1.23	1.24	1.23
445.600	1.32	1.32	1.34	1.22	1.23	1.25	1.26
544.600	1.36	1.37	1.38	1.25	1.25	1.28	1.28
604.000	1.37	1.39	1.39	1.26	1.26	1.31	1.28
703.000	1.38	1.41	1.41	1.26	1.26	1.29	1.29
762.400	1.36	1.39	1.39	1.28	1.27	1.29	1.29
821.800	1.36	1.39	1.39	1.28	1.26	1.30	1.28
881.200	1.30	1.37	1.37	1.25	1.23	1.27	1.26
940.600	1.31	1.37	1.35	1.23	1.23	1.26	1.26
1000.000	1.28	1.33	1.32	1.22	1.22	1.24	1.26

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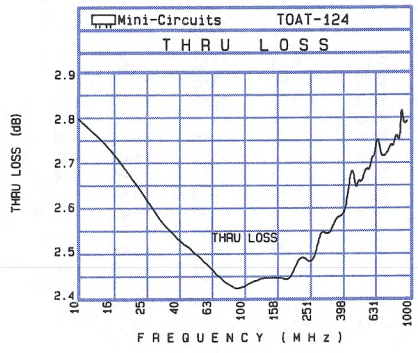
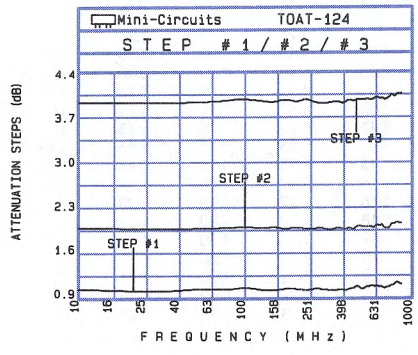
TOAT-124, ZFAT-124

10 - 1000 MHz



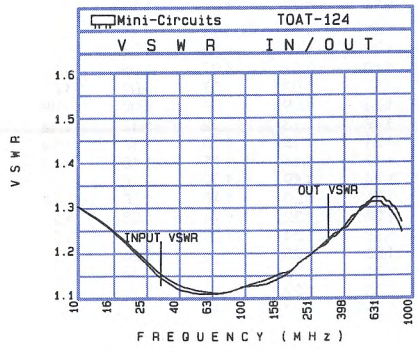
STEP ATTENUATION* AT TTL CONTROL STATE

FREQ. (MHz)	000 thru loss (dB)	001 1 (dB)	010 2 (dB)	011 3 (dB)	100 4 (dB)	101 5 (dB)	110 6 (dB)	111 7 (dB)
10.000	2.80	1.01	1.99	3.01	4.02	5.03	6.03	7.03
49.600	2.52	1.02	2.02	3.05	4.05	5.06	6.05	7.09
148.600	2.46	.99	2.01	3.02	4.03	5.03	6.02	7.07
208.000	2.48	1.01	1.99	3.00	4.05	5.07	6.02	7.05
247.600	2.55	1.01	2.01	3.03	4.05	5.06	6.02	7.02
346.600	2.57	1.04	2.04	3.03	4.04	5.07	6.08	7.06
406.000	2.62	1.02	2.02	3.03	4.05	5.06	6.04	7.05
445.600	2.67	1.04	2.05	3.09	4.06	5.11	6.06	7.09
544.600	2.72	1.08	2.04	3.11	4.08	5.14	6.06	7.13
604.000	2.71	1.06	2.07	3.11	4.09	5.14	6.11	7.15
703.000	2.81	1.08	2.07	3.11	4.10	5.17	6.09	7.16
762.400	2.78	1.09	2.07	3.17	4.07	5.20	6.10	7.21
821.800	2.80	1.12	2.10	3.20	4.14	5.25	6.17	7.27
881.200	2.81	1.12	2.10	3.19	4.14	5.23	6.22	7.30
940.600	2.82	1.12	2.14	3.20	4.17	5.31	6.22	7.35
1000.000	2.81	1.14	2.14	3.28	4.19	5.37	6.28	7.42



INPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.25	1.26	1.22	1.27	1.23	1.24	1.20
49.600	1.10	1.10	1.09	1.10	1.09	1.09	1.08
148.600	1.14	1.12	1.12	1.13	1.12	1.11	1.11
208.000	1.17	1.15	1.15	1.16	1.16	1.14	1.14
247.600	1.19	1.17	1.17	1.17	1.18	1.16	1.16
346.600	1.24	1.21	1.22	1.22	1.23	1.20	1.22
406.000	1.27	1.24	1.25	1.24	1.26	1.22	1.24
445.600	1.29	1.25	1.27	1.26	1.27	1.24	1.26
544.600	1.32	1.28	1.30	1.29	1.31	1.27	1.30
604.000	1.33	1.29	1.31	1.31	1.33	1.29	1.32
703.000	1.32	1.28	1.32	1.31	1.33	1.29	1.34
762.400	1.31	1.28	1.32	1.31	1.34	1.29	1.34
821.800	1.30	1.26	1.31	1.30	1.33	1.29	1.35
881.200	1.28	1.25	1.31	1.29	1.33	1.29	1.35
940.600	1.26	1.23	1.30	1.27	1.32	1.27	1.34
1000.000	1.24	1.21	1.29	1.25	1.31	1.26	1.34



OUTPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.30	1.27	1.25	1.16	1.16	1.15	1.15
49.600	1.12	1.10	1.10	1.07	1.07	1.07	1.06
148.600	1.16	1.13	1.14	1.09	1.10	1.09	1.09
208.000	1.19	1.16	1.16	1.11	1.11	1.09	1.10
247.600	1.20	1.18	1.18	1.13	1.13	1.11	1.12
346.600	1.27	1.23	1.23	1.16	1.17	1.16	1.15
406.000	1.32	1.25	1.26	1.18	1.19	1.17	1.19
445.600	1.32	1.27	1.28	1.19	1.20	1.18	1.18
544.600	1.36	1.30	1.30	1.21	1.22	1.21	1.21
604.000	1.37	1.31	1.31	1.21	1.22	1.21	1.23
703.000	1.36	1.32	1.33	1.22	1.23	1.24	1.23
762.400	1.34	1.30	1.32	1.23	1.24	1.25	1.25
821.800	1.35	1.30	1.31	1.22	1.24	1.25	1.24
881.200	1.32	1.29	1.28	1.22	1.22	1.23	1.25
940.600	1.30	1.27	1.29	1.23	1.23	1.25	1.25
1000.000	1.27	1.26	1.27	1.23	1.23	1.27	1.24

* Step attenuation above thru loss (TTL logic 000)

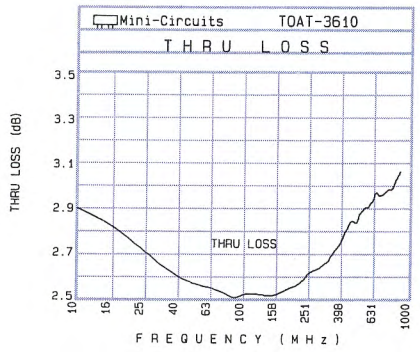
pin diode

Step Attenuators

with TTL Control Inputs

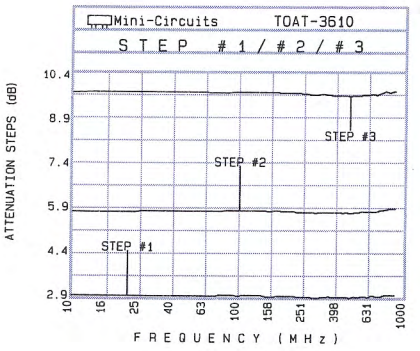
TOAT-3610, ZFAT-3610

10 - 1000 MHz



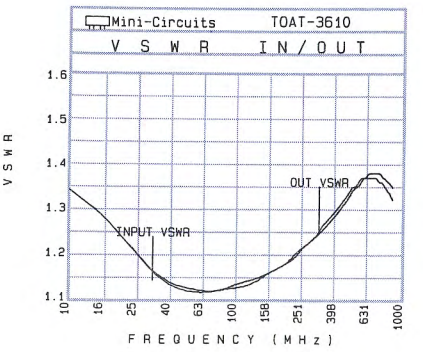
STEP ATTENUATION* AT TTL CONTROL STATE

FREQ. (MHz)	000 thru loss (dB)	001 3 (dB)	010 6 (dB)	011 9 (dB)	100 10 (dB)	101 13 (dB)	110 16 (dB)	111 19 (dB)
10.000	2.60	3.03	6.03	9.12	9.91	13.02	16.00	19.02
49.600	2.33	3.08	6.10	9.15	9.95	13.03	15.97	19.03
148.600	2.30	3.06	6.09	9.12	9.97	12.98	16.03	19.03
208.000	2.35	3.02	6.06	9.06	9.94	12.97	16.03	19.01
247.600	2.39	2.97	6.04	9.04	9.94	12.99	15.93	19.04
346.600	2.46	3.00	6.07	9.05	9.95	12.95	16.02	19.00
406.000	2.52	3.01	6.07	9.04	9.93	12.94	15.99	18.96
445.600	2.55	3.02	6.06	9.00	9.95	12.95	15.98	18.82
544.600	2.62	3.06	6.04	9.01	9.95	12.98	16.02	18.98
604.000	2.65	3.04	6.04	8.94	9.93	13.00	15.96	18.94
703.000	2.74	2.97	6.00	8.94	9.99	12.94	15.91	18.89
762.400	2.70	3.03	6.01	8.97	10.01	12.96	16.00	18.91
821.800	2.74	3.08	6.06	9.05	10.07	13.08	16.07	18.97
881.200	2.80	3.05	6.07	9.01	10.02	13.11	15.98	19.00
940.600	2.84	3.07	6.03	9.04	10.09	13.15	16.13	19.01
1000.000	2.83	3.15	6.14	9.07	10.18	13.25	16.08	19.24



INPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.19	1.22	1.14	1.28	1.17	1.21	1.14
49.600	1.07	1.08	1.05	1.11	1.07	1.08	1.05
148.600	1.09	1.09	1.06	1.13	1.08	1.08	1.05
208.000	1.11	1.11	1.07	1.15	1.09	1.10	1.07
247.600	1.12	1.12	1.08	1.17	1.10	1.11	1.08
346.600	1.16	1.15	1.11	1.20	1.13	1.13	1.10
406.000	1.17	1.16	1.12	1.23	1.15	1.15	1.12
445.600	1.18	1.18	1.13	1.24	1.16	1.16	1.13
544.600	1.20	1.20	1.15	1.27	1.18	1.19	1.15
604.000	1.20	1.21	1.16	1.29	1.19	1.20	1.17
703.000	1.19	1.21	1.18	1.30	1.20	1.22	1.19
762.400	1.19	1.21	1.19	1.30	1.20	1.22	1.20
821.800	1.17	1.22	1.20	1.31	1.20	1.23	1.21
881.200	1.16	1.21	1.20	1.30	1.20	1.24	1.22
940.600	1.14	1.21	1.21	1.29	1.19	1.24	1.23
1000.000	1.13	1.21	1.22	1.28	1.19	1.25	1.24



OUTPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.31	1.24	1.22	1.12	1.11	1.11	1.10
49.600	1.11	1.09	1.08	1.05	1.05	1.04	1.05
148.600	1.15	1.11	1.10	1.07	1.07	1.06	1.06
208.000	1.17	1.11	1.11	1.07	1.07	1.07	1.06
247.600	1.19	1.13	1.13	1.09	1.09	1.09	1.08
346.600	1.24	1.17	1.17	1.13	1.12	1.12	1.12
406.000	1.27	1.21	1.21	1.15	1.15	1.14	1.14
445.600	1.29	1.21	1.19	1.14	1.15	1.15	1.14
544.600	1.32	1.25	1.24	1.19	1.19	1.18	1.19
604.000	1.34	1.26	1.26	1.20	1.19	1.20	1.20
703.000	1.36	1.28	1.28	1.22	1.24	1.23	1.23
762.400	1.37	1.29	1.31	1.24	1.25	1.26	1.27
821.800	1.36	1.31	1.33	1.25	1.26	1.26	1.28
881.200	1.35	1.30	1.31	1.26	1.26	1.26	1.27
940.600	1.34	1.32	1.35	1.29	1.30	1.30	1.30
1000.000	1.32	1.33	1.35	1.29	1.30	1.30	1.33

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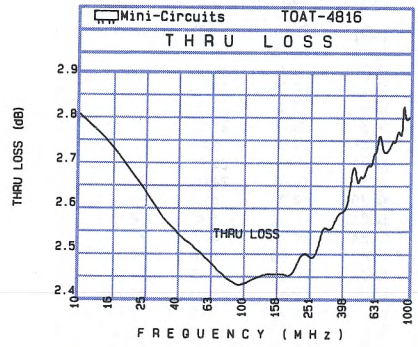
Mini-Circuits

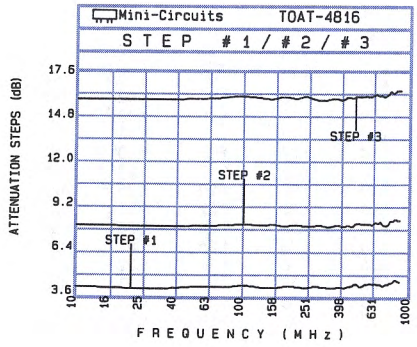
TOAT-4816, ZFAT-4816

10 - 1000 MHz



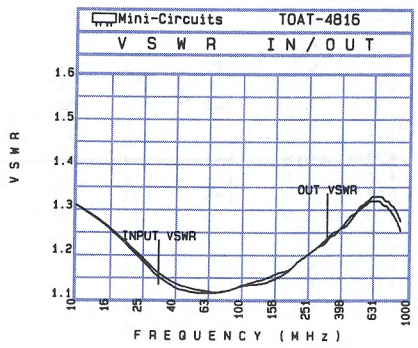
STEP ATTENUATION* AT TTL CONTROL STATE

FREQ. (MHz)	000 thru loss (dB)	001 4 (dB)	010 8 (dB)	011 12 (dB)	100 16 (dB)	101 20 (dB)	110 24 (dB)	111 28 (dB)
10.000	2.58	4.08	7.97	12.05	16.09	20.15	23.88	28.02
49.600	2.19	4.07	8.01	12.07	16.20	20.22	24.12	28.16
148.600	2.20	4.05	8.05	12.12	16.14	20.12	24.07	28.26
208.000	2.23	4.08	8.02	12.13	16.19	20.34	24.10	28.37
247.600	2.28	4.06	8.05	12.08	16.14	20.20	24.19	28.31
346.600	2.36	4.05	7.99	12.06	16.17	20.14	23.99	28.29
406.000	2.41	4.02	8.00	12.08	16.14	20.21	23.98	27.93
445.600	2.45	4.07	8.00	11.99	16.09	20.16	24.21	28.32
544.600	2.48	4.02	7.99	11.97	16.16	20.26	24.46	28.32
604.000	2.55	4.03	8.03	12.01	16.13	20.17	24.10	28.34
703.000	2.55	4.01	8.02	12.00	16.17	20.15	24.22	27.91
762.400	2.58	4.02	8.08	12.12	16.20	20.30	24.12	28.39
821.800	2.56	4.06	8.14	12.09	16.24	20.26	24.15	27.99
881.200	2.61	4.07	8.15	12.11	16.28	20.25	24.17	28.06
940.600	2.64	4.09	8.13	12.16	16.24	20.36	24.33	28.22
1000.000	2.65	4.06	8.12	12.13	16.16	20.34	24.16	28.02



INPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.24	1.27	1.17	1.38	1.21	1.25	1.17
49.600	1.07	1.08	1.05	1.12	1.06	1.08	1.05
148.600	1.08	1.09	1.05	1.13	1.06	1.08	1.05
208.000	1.09	1.10	1.06	1.15	1.08	1.10	1.06
247.600	1.10	1.11	1.07	1.16	1.08	1.11	1.07
346.600	1.13	1.15	1.09	1.21	1.11	1.14	1.09
406.000	1.14	1.17	1.11	1.24	1.13	1.16	1.10
445.600	1.15	1.18	1.11	1.26	1.14	1.17	1.11
544.600	1.16	1.21	1.13	1.30	1.16	1.20	1.14
604.000	1.16	1.22	1.15	1.32	1.16	1.22	1.15
703.000	1.16	1.24	1.16	1.34	1.18	1.24	1.17
762.400	1.16	1.25	1.17	1.36	1.19	1.26	1.18
821.800	1.15	1.25	1.18	1.36	1.19	1.26	1.19
881.200	1.14	1.26	1.19	1.37	1.19	1.28	1.20
940.600	1.13	1.26	1.20	1.37	1.19	1.28	1.21
1000.000	1.12	1.26	1.21	1.37	1.19	1.30	1.23



OUTPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.42	1.29	1.29	1.11	1.11	1.10	1.11
49.600	1.14	1.09	1.10	1.05	1.05	1.05	1.06
148.600	1.11	1.07	1.06	1.05	1.04	1.04	1.04
208.000	1.12	1.06	1.05	1.02	1.02	1.02	1.01
247.600	1.15	1.08	1.07	1.05	1.04	1.04	1.04
346.600	1.22	1.12	1.12	1.09	1.07	1.07	1.08
406.000	1.29	1.19	1.18	1.12	1.13	1.11	1.12
445.600	1.29	1.19	1.18	1.13	1.13	1.13	1.12
544.600	1.35	1.26	1.26	1.19	1.20	1.19	1.20
604.000	1.31	1.24	1.23	1.19	1.19	1.18	1.20
703.000	1.31	1.25	1.26	1.21	1.23	1.23	1.21
762.400	1.28	1.25	1.26	1.23	1.23	1.23	1.24
821.800	1.26	1.22	1.23	1.20	1.19	1.20	1.19
881.200	1.26	1.22	1.23	1.20	1.21	1.21	1.21
940.600	1.29	1.23	1.25	1.19	1.19	1.21	1.22
1000.000	1.28	1.28	1.30	1.26	1.25	1.27	1.26

* Step attenuation above thru loss (TTL logic 000)

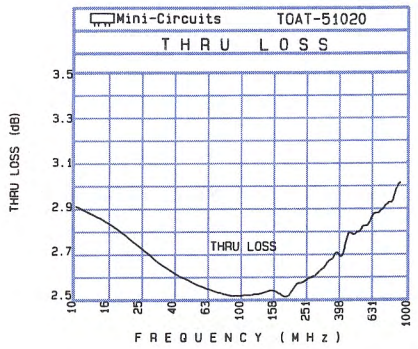
pin diode

Step Attenuators

with TTL Control Inputs

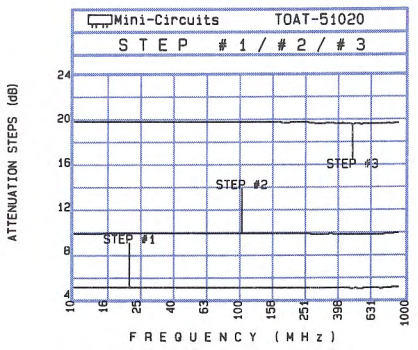
TOAT-51020, ZFAT-51020

10 - 1000 MHz



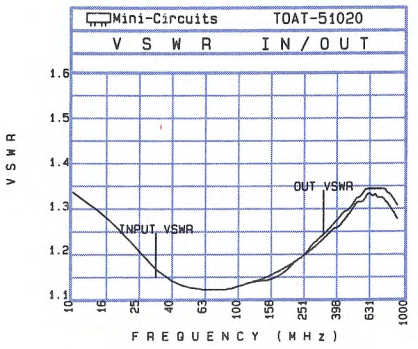
STEP ATTENUATION* AT TTL CONTROL STATE

FREQ. (MHz)	000 thru loss (dB)	001 5 (dB)	010 10 (dB)	011 15 (dB)	100 20 (dB)	101 25 (dB)	110 30 (dB)	111 35 (dB)
10.000	2.68	4.96	9.93	14.90	20.10	24.96	29.77	34.53
49.600	2.53	4.98	9.95	14.90	20.05	24.95	29.92	34.69
148.600	2.43	4.98	9.94	14.93	20.04	25.05	29.90	34.88
208.000	2.47	4.96	9.93	14.89	20.00	24.91	29.92	34.86
247.600	2.50	4.94	9.94	14.88	19.95	24.83	29.91	34.76
346.600	2.60	4.96	9.96	14.87	19.96	24.96	29.92	34.42
406.000	2.67	4.96	9.94	14.82	19.97	24.91	29.80	34.60
445.600	2.70	4.94	9.92	14.80	19.96	24.96	29.84	34.47
544.600	2.79	4.95	9.91	14.81	19.88	24.85	29.76	34.43
604.000	2.84	4.97	9.94	14.84	19.88	24.90	29.83	34.54
703.000	2.90	4.94	9.94	14.82	19.88	24.90	29.72	34.86
762.400	2.92	4.96	9.96	14.81	19.83	24.85	29.80	35.22
821.800	2.96	5.01	9.98	14.88	19.87	24.92	29.99	35.21
881.200	2.99	5.03	10.01	14.96	19.94	24.92	30.10	35.13
940.600	3.03	5.04	10.07	14.98	19.93	24.98	30.03	35.08
1000.000	3.06	5.09	10.16	15.08	20.00	25.28	29.95	35.55



INPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.11	1.15	1.09	1.20	1.10	1.14	1.09
49.600	1.08	1.10	1.06	1.13	1.07	1.10	1.06
148.600	1.08	1.10	1.06	1.12	1.07	1.10	1.06
208.000	1.10	1.12	1.08	1.15	1.09	1.12	1.08
247.600	1.12	1.14	1.09	1.17	1.10	1.13	1.09
346.600	1.15	1.18	1.12	1.21	1.13	1.18	1.12
406.000	1.17	1.21	1.14	1.24	1.16	1.20	1.14
445.600	1.18	1.22	1.16	1.26	1.17	1.22	1.16
544.600	1.21	1.26	1.19	1.30	1.20	1.25	1.19
604.000	1.22	1.28	1.21	1.32	1.22	1.27	1.21
703.000	1.22	1.30	1.23	1.35	1.24	1.30	1.23
762.400	1.22	1.31	1.25	1.36	1.25	1.31	1.25
821.800	1.22	1.32	1.26	1.36	1.26	1.32	1.27
881.200	1.22	1.32	1.27	1.37	1.27	1.33	1.28
940.600	1.22	1.32	1.28	1.36	1.27	1.33	1.29
1000.000	1.21	1.32	1.29	1.36	1.28	1.33	1.30



OUTPUT VSWR

FREQ. (MHz)	001	010	011	100	101	110	111
10.000	1.21	1.15	1.15	1.07	1.08	1.08	1.08
49.600	1.14	1.11	1.10	1.05	1.05	1.05	1.05
148.600	1.15	1.10	1.10	1.05	1.05	1.05	1.05
208.000	1.17	1.13	1.12	1.06	1.06	1.06	1.06
247.600	1.19	1.14	1.14	1.07	1.07	1.06	1.07
346.600	1.26	1.19	1.19	1.10	1.10	1.10	1.09
406.000	1.30	1.22	1.22	1.12	1.11	1.12	1.11
445.600	1.32	1.24	1.24	1.13	1.13	1.13	1.12
544.600	1.37	1.28	1.28	1.15	1.15	1.15	1.15
604.000	1.39	1.30	1.30	1.16	1.16	1.16	1.17
703.000	1.42	1.35	1.34	1.20	1.20	1.20	1.20
762.400	1.43	1.37	1.37	1.22	1.22	1.22	1.22
821.800	1.43	1.37	1.38	1.23	1.23	1.23	1.23
881.200	1.42	1.38	1.39	1.24	1.25	1.25	1.25
940.600	1.41	1.39	1.41	1.26	1.27	1.27	1.27
1000.000	1.40	1.40	1.42	1.27	1.27	1.28	1.28

* Step attenuation above thru loss (TTL logic 000)

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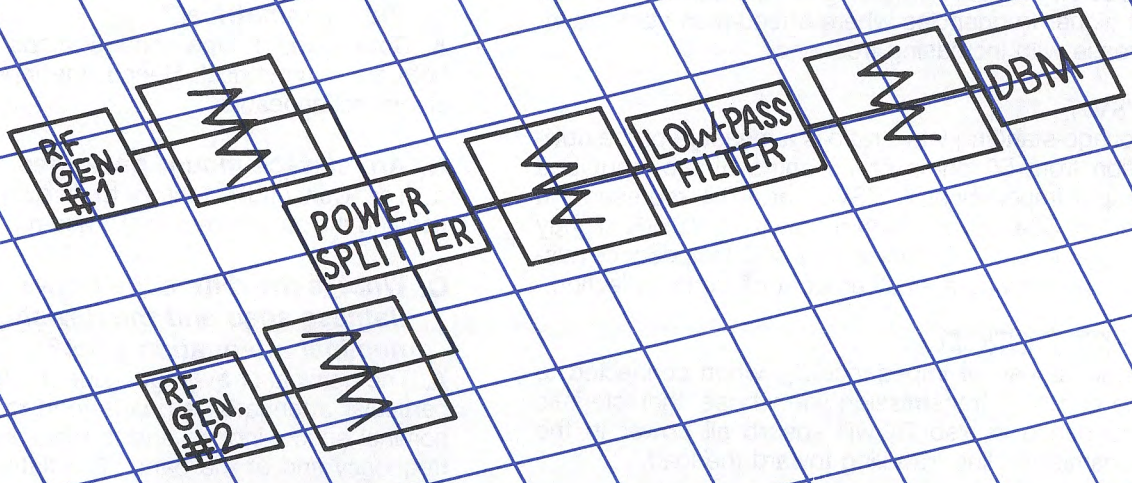
FIXED ATTENUATORS AND TERMINATIONS



contents of this section

technical

introduction, definition of terms, questions 6-2
specifications check list
a guide form for requirements 6-3

product specifications

fixed attenuators, terminations 6-4, 6-5

computer data and curves

CAPD information . . . . . .6-6, thru 6-10

Fixed Attenuators/Terminations

Fixed attenuators are found in a wide variety of electronic equipment for extending the dynamic range of measuring equipment, for preventing signal overload in transmitters and receivers, and for impedance matching to reduce the effects of improper input/output terminations of oscillators, amplifiers and test setups.
The important parameters associated with fixed attenuators include the amount of attenuation, the flatness over a specified frequency, range, VSWR, average and peak power-handling capability, size and height, and performance over a given temperature range. Average power limit decreases linearly as temperature increases and burnout will result (or calibration will be altered) if average power limit is exceeded.
Mini-Circuits' fixed attenuators, packaged in rugged plug-in and connector models, are available in both 50- and 75-ohm models ranging from 1 to 40 dB spanning DC to 1500 MHz.

definition of terms

fixed attenuator
A device used to reduce power levels of a signal by a fixed amount with little or no reflections. The output signal is attenuated relative to the input signal while the input and output impedance is maintained close to 50 ohms (or 75 ohms) over the specified bandwidth. Hence, this device is often used to improve interstage matching in a circuit.

flatness
The total variation in attenuation over the specified frequency range. Flatness generally becomes worse at higher frequencies where attenuation starts to increase with increasing frequency.

vswr
Voltage-standing-wave ratio is a measure of the deviation from 50 ohms or 75 ohms of the input and output impedance. A VSWR of 1.0:1 represents a perfect 50-ohm or 75-ohm match. A VSWR slightly greater than 1.0:1 represents a slight impedance mismatch, implying a small amount of signal reflection.

termination
An ideal load of impedance Z_0, when connected to the end of a transmission line whose characteristic impedance is also Z_0 will absorb all power in the transmission line travelling toward the load.

maximum rf power
The amount of power that can be applied to an attenuator or load which does not result in excessive heating of the attenuator or load.

return loss
The minium return loss the termination exhibits when used for terminating a transmission line it is designed to match. For an attenuator, return loss is measured at one port when the other port is terminated in 50 or 75 ohms for which it is designed.

most often asked questions

Q. *Many of MCL's fixed attenuators are specified up to 1500 MHz. How will they perform at higher frequencies?*
A. With the exception of the 75-ohm models, most fixed attenuators perform reasonably well above 2000 MHz. Please refer to data pages for actual performance characteristics.

Q. *What internal design configuration is used in the fixed attenuators and are they symmetrical?*
A. Both π and T type configurations are used and both are symmetrical. Hence, the input and output are interchangeable.

Q. *Are surface-mount packages available?*
A. Yes. Consult the factory to discuss your application and the parameters of surface-mount packages.

Q. *What is the difference between the flatness spec and the deviation on the nominal attenuation spec?*
A. The nominal or average value of attenuation of a particular attenuator is guaranteed to be within the nominal spec window, and is measured at the low frequency end of the band. The flatness spec only refers to variation of attenuation across the specified bandwidth.

Q. *Can Mini-Circuits' provide terminations at different impedances upon request?*
A. The impedance of Mini-Circuits' terminations are either 50- or 75-ohms. Other impedances are not available.

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Fixed Attenuators

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency range _____ MHz
Attenuation _____ dB, tol. ± _____ dB
Attenuation flatness ± _____ dB
Over frequency _____ MHz
Max. iinput power _____ W
VSWR or return loss (dB) ☐ 50 ohms ☐ 75 ohms
Input _____ Output _____
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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rugged, one-piece design

Fixed Attenuators

1 to 40 dB

DC to 1500 MHz

case style selection

outline drawings see Table of Contents



MAT AT

	MODEL NO.	FREQUENCY RANGE, MHz	ATTENUATION dB Nom.	FLATNESS, MAX. L	M	U	VSWR max. L	M	U	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
MAT case A11	MAT-1	DC-1500	1±0.2	0.3	0.4	0.5	1.3	1.5	1.7	4.45	●	●
	MAT-2	DC-1500	2±0.2	0.3	0.4	0.8	1.3	1.5	1.7	4.45	●	●
	MAT-3	DC-1500	3±0.2	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-4	DC-1500	4±0.2	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-5	DC-1500	5±0.3	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-6	DC-1500	6±0.3	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-7	DC-1500	7±0.3	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-8	DC-1500	8±0.3	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-9	DC-1500	9±0.4	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-10	DC-1500	10±0.4	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-12	DC-1500	12±0.4	0.3	0.6	1.0	1.3	1.5	1.7	4.45	●	●
	MAT-15	DC-1500	15±0.4	0.4	0.7	1.1	1.3	1.5	1.7	4.45	●	●
	MAT-20	DC-1500	20±0.5	0.4	0.8	1.3	1.3	1.6	1.8	4.45	●	●
	MAT-25	DC-1500	25±0.5	0.4	0.8	1.3	1.3	1.6	1.8	4.45	●	●
	MAT-30	DC-1000	30±0.5	0.5	1.0	—	1.3	1.6	—	4.45	●	●
	MAT-40	DC-500	40±0.6	1.0	—	—	1.5	—	—	4.45	●	●
AT case A04	AT-1	DC-1500	1±0.2	0.3	0.4	0.5	1.3	1.5	1.7	3.65	●	●
	AT-2	DC-1500	2±0.2	0.3	0.4	0.8	1.3	1.5	1.7	3.65	●	●
	AT-3	DC-1500	3±0.2	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	■ AT-3-75	DC-500	3±0.2	0.9	—	—	2.0	—	—	3.65	●	●
	AT-4	DC-1500	4±0.2	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-5	DC-1500	5±0.3	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-6	DC-1500	6±0.3	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	■ AT-6-75	DC-500	6±0.3	1.0	—	—	2.0	—	—	3.65	●	●
	AT-7	DC-1500	7±0.3	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-8	DC-1500	8±0.3	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-9	DC-1500	9±0.4	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-10	DC-1500	10±0.4	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	■ AT-10-75	DC-500	10±0.4	1.0	—	—	2.0	—	—	3.65	●	●
	AT-12	DC-1500	12±0.4	0.3	0.6	1.0	1.3	1.5	1.7	3.65	●	●
	AT-15	DC-1500	15±0.4	0.4	0.7	1.1	1.3	1.5	1.7	3.65	●	●
	■ AT-15-75	DC-500	15±0.4	0.8	1.2	—	1.5	2.0		3.65	●	●
	AT-20	DC-1500	20±0.5	0.4	0.8	1.3	1.3	1.6	1.8	3.65	●	●
	■ AT-20-75	DC-500	20±0.5	1.1	—	—	2.0	—	—	3.65	●	●
	AT-30	DC-1000	30±0.5	0.5	1.0	—	1.3	1.6	—	3.65	●	●
	AT-40	DC-500	40±0.6	1.0	—	—	1.5	—	—	3.65	●	●

L = DC-500 MHz M = DC-1000 MHz U = DC-1500 MHz

designers kits available

KIT NO.	MODEL TYPE	No. of Units in Kit	DESCRIPTION	PRICE $ per kit
K1-AT	AT	16	4 of each 3, 6, 10, 20 dB	49.95
K2-AT	AT	15	1 of each 1 to 40 dB	
K1-MAT	MAT	16	2 of each 3, 6, 9, 10, 12, 15, 20, 40 dB	49.95
K2-MAT	MAT	16	1 of each 1 to 40 dB	

pin connections

see case style outline drawings

SERIES	In	Out	Ground
MAT	1	8	2,3,4,5,6,7
AT	1	8	2,3,4,5,6,7

NOTES:

■ Denotes 75 ohm models, connectors available in 75 ohm BNC only

1. For quality control procedures, environmental specifications, and Hi-Rel description see Table of Contents.
2. Absolute maximum ratings see section 1. In addition, maximum RF power 1 watt for AT, CAT, NAT, TAT; 1/2 watt for MAT, SAT; 1/4 watt for Terminati
3. Models are available with male/female coax connectors. For other configurations and inter-series versions consult factory.
4. Prices and specifications subject to change without notice.

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50 ohms and 75 ohms

Mini-Circuits



NAT



TAT
(consult factory)



CAT



SAT

	MODEL NO.	FREQUENCY RANGE, MHz	ATTENUATION dB Nom.	Flatness, max. L	M	U	VSWR max. L	M	U	PRICE Qty. (1-9) NAT	CAT	SAT	DISTRIBUTOR FACTORY	LOCAL
	_AT-1	DC-1500	1±0.2	0.3	0.4	0.5	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-2	DC-1500	2±0.2	0.3	0.4	0.8	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-3	DC-1500	3±0.2	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
*NAT ■	CAT-3-75	DC-500	3±0.2	0.9	—	—	2.0	—	—	—	16.95	—	•	•
case FF57	_AT-4	DC-1500	4±0.2	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-5	DC-1500	5±0.3	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-6	DC-1500	6±0.3	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	■ CAT-6-75	DC-500	6±0.3	1.0	—	—	2.0	—	—	—	16.95	—	•	•
	_AT-7	DC-1500	7±0.3	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
*CAT	_AT-8	DC-1500	8±0.3	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
case FF55	_AT-9	DC-1500	9±0.4	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-10	DC-1500	10±0.4	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	■ CAT-10-75	DC-500	10±0.4	1.0	—	—	2.0	—	—	—	16.95	—		
	_AT-12	DC-1500	12±0.4	0.3	0.6	1.0	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	_AT-15	DC-1500	15±0.4	0.4	0.7	1.1	1.3	1.5	1.7	23.95	16.95	20.95	•	•
	■ CAT-15-75	DC-1000	15±0.4	0.8	1.2	—	1.5	2.0	—	—	16.95	—	•	•
*SAT	_AT-20	DC-1500	20±0.5	0.4	0.8	1.3	1.3	1.6	1.8	23.95	16.95	20.95	•	•
case FF56 ■	CAT-20-75	DC-500	20±0.5	1.1	—	—	2.0	—	—	—	16.95	—	•	•
	_AT-30	DC-1000	30±0.5	0.5	1.0	—	1.3	1.6	—	23.95	16.95	20.95	•	•
	_AT-40	DC-500	40±0.6	1.0	—	—	1.5	—	—	23.95	16.95	20.95	•	•

*Add prefix letter N, C or S to _AT where applicable

L = DC-500 MHz M = DC-1000 MHz U = DC-1500 MHz

NSN GUIDE

MCL NO.	NSN
AT-6	5985-01-275-0339
BTRM-50	6625-01-325-7972
BTRM-75	5985-01-328-7420
CAT-15	5985-01-299-9257
CAT-20	5985-01-265-0338
CAT-30	5985-01-290-0943
CAT-5	5985-01-299-9258
CAT-6	5985-01-300-0481
MAT-1	5985-01-265-8138
MAT-10	5985-01-294-4719
MAT-15	5985-01-294-4720
MAT-2	5985-01-336-3058
MAT-20	5985-01-294-4721
MAT-3	5985-01-274-6609
MAT-4	5985-01-326-6977
MAT-5	5985-01-336-3720
MAT-6	5985-01-295-0261
MAT-7	5985-01-326-6978
MAT-9	5985-01-332-4595
NAT-3	5985-01-298-0747
NAT-10	5985-01-291-5548
NAT-30	5985-01-298-0746
SAT-6	5985-01-237-5343
SAT-10	5985-01-250-4812
SAT-30	5985-01-190-6838

Terminations

DC to 2000 MHz
50 ohms

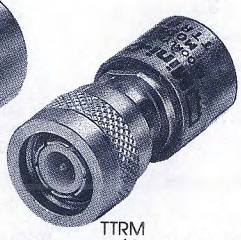
case style selection

outline drawings see Table of Contents

For Notes see opposite page



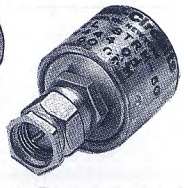
NTRM



TTRM
(Consult Factory)



BTRM



STRM

	MODEL NO.	IMPEDANCE OHMS	FREQUENCY RANGE MHz	RETURN LOSS, dB, MIN. DC-500	DC-1000	DC-2000	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
case LL85	BTRM-50	50	DC-2000	35	30	21	8.25	•	•
■	BTRM-75	75	DC-1000	30	20	—	9.95	•	•
case LL86	STRM-50	50	DC-2000	40	35	26	9.45	•	•
case LL87	NTRM-50	50	DC-2000	35	30	21	9.45	•	•

In Stock...Immediate Delivery

CAPD now available! computer-automated performance data see model index

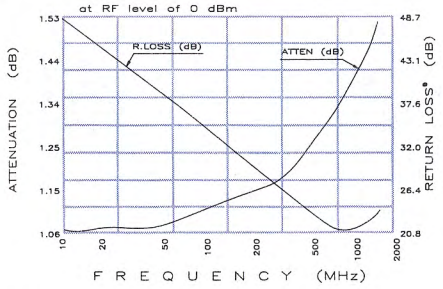
rugged, one-piece design

Fixed Attenuators

Attenuation and Return Loss

AT-1, MAT-1, SAT-1, CAT-1, NAT-1, TAT-1

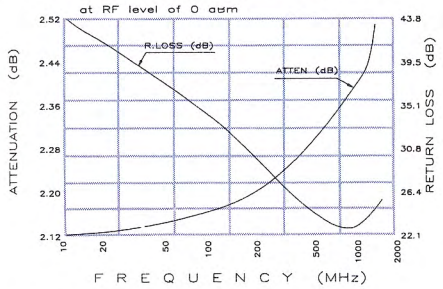
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	1.06	0.01	49.18	0.31
20.000	1.06	0.01	45.40	1.00
50.000	1.07	0.01	38.70	0.60
100.000	1.10	0.01	33.88	0.33
165.000	1.12	0.01	30.26	0.39
200.000	1.13	0.01	28.73	0.35
240.000	1.14	0.02	27.39	0.37
275.000	1.15	0.02	26.52	0.39
735.000	1.30	0.02	20.47	0.47
1500.000	1.50	0.03	22.91	1.17

AT-2, MAT-2, SAT-2, CAT-2, NAT-2, TAT-2

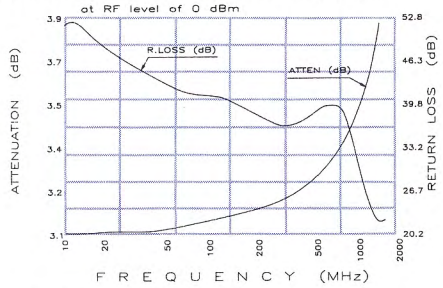
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	2.10	0.02	46.31	2.39
20.000	2.10	0.02	43.00	1.71
50.000	2.12	0.02	38.25	1.00
100.000	2.14	0.01	34.85	0.67
165.000	2.16	0.02	31.65	0.58
200.000	2.17	0.02	30.24	0.54
240.000	2.18	0.02	29.05	0.53
275.000	2.19	0.03	28.25	0.50
735.000	2.32	0.03	22.59	0.41
1500.000	2.51	0.04	26.17	1.39

AT-3, MAT-3, SAT-3, CAT-3, NAT-3, TAT-3

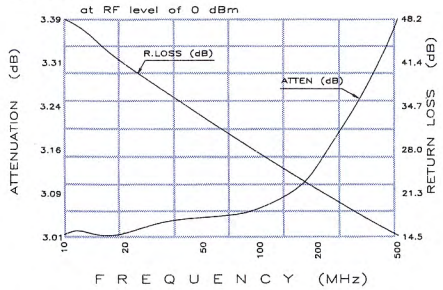
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	3.07	0.00	53.83	0.75
20.000	3.07	0.01	48.68	0.74
50.000	3.08	0.01	42.96	0.36
100.000	3.11	0.00	42.11	0.69
165.000	3.13	0.01	40.05	0.68
200.000	3.14	0.01	38.87	0.60
240.000	3.14	0.01	38.61	0.66
275.000	3.16	0.01	38.45	0.77
735.000	3.36	0.02	36.92	2.64
1500.000	3.82	0.04	20.70	1.03

AT-3-75, CAT-3-75

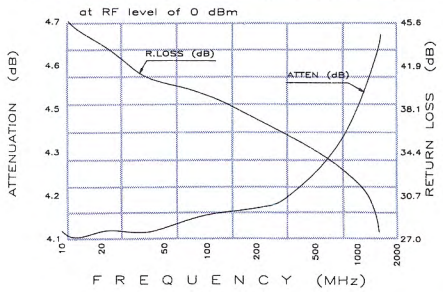
DC to 500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	3.01	0.01	47.80	0.93
20.000	3.01	0.00	40.47	0.70
50.000	3.03	0.01	32.73	0.20
100.000	3.07	0.00	26.43	0.23
110.000	3.07	0.01	25.77	0.29
122.500	3.07	0.01	25.11	0.30
135.000	3.07	0.01	24.49	0.28
147.500	3.08	0.01	23.50	0.24
250.000	3.14	0.01	19.49	0.23
500.000	3.41	0.02	14.30	0.24

AT-4, MAT-4, SAT-4, CAT-4, NAT-4, TAT-4

DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	4.09	0.01	46.24	1.38
20.000	4.09	0.01	43.70	1.12
50.000	4.10	0.01	40.47	0.89
100.000	4.15	0.01	39.80	0.60
165.000	4.15	0.01	38.15	0.59
200.000	4.16	0.01	37.18	0.54
240.000	4.17	0.00	36.69	0.62
275.000	4.18	0.01	36.37	0.58
735.000	4.34	0.01	32.91	1.26
1500.000	4.69	0.03	28.07	1.36

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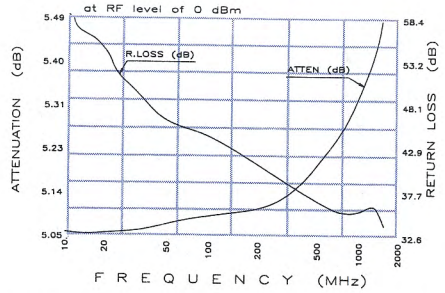
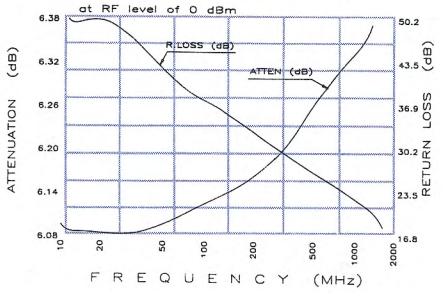
AT-5, MAT-5, SAT-5, CAT-5, NAT-5, TAT-5



DC to 1500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	5.06	0.01	54.99	5.19
20.000	5.06	0.02	50.17	4.32
50.000	5.08	0.01	43.31	2.22
100.000	5.10	0.02	43.07	1.98
165.000	5.11	0.02	41.02	1.58
200.000	5.11	0.02	39.82	1.32
240.000	5.12	0.02	39.10	1.27
275.000	5.13	0.02	38.75	1.17
735.000	5.27	0.03	33.74	1.27
1500.000	5.52	0.02	30.49	2.16

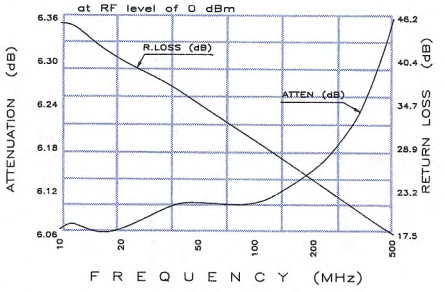
AT-6, MAT-6, SAT-6, CAT-6, NAT-6, TAT-6



DC to 1500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	6.08	0.01	52.93	5.85
20.000	6.08	0.01	49.00	1.14
50.000	6.11	0.01	40.58	0.59
100.000	6.13	0.00	36.63	0.77
165.000	6.14	0.01	32.87	0.67
200.000	6.16	0.01	31.37	0.77
240.000	6.18	0.01	29.95	0.82
275.000	6.19	0.01	28.88	0.89
735.000	6.31	0.05	21.81	0.87
1500.000	6.42	0.05	16.52	0.42

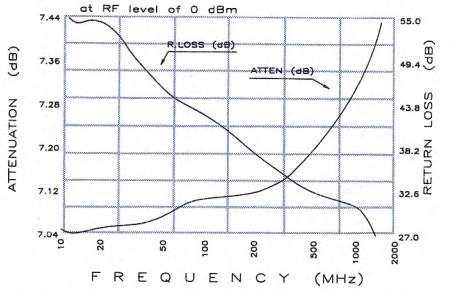
AT-6-75, CAT-6-75



DC to 500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	6.10	0.03	46.04	1.63
20.000	6.08	0.03	40.48	0.78
50.000	6.11	0.04	35.15	0.35
100.000	6.12	0.03	29.59	0.55
110.000	6.13	0.03	28.95	0.49
122.500	6.13	0.03	28.21	0.43
135.000	6.14	0.03	27.52	0.38
147.500	6.13	0.03	26.54	0.34
250.000	6.18	0.04	22.74	0.45
500.000	6.37	0.04	17.49	0.41

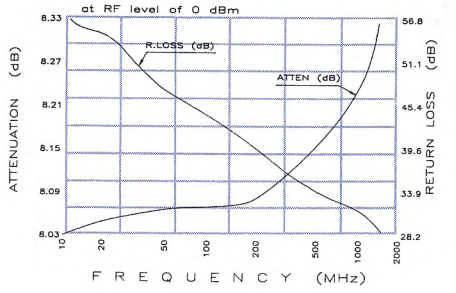
AT-7, MAT-7, SAT-7, CAT-7, NAT-7, TAT-7



DC to 1500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	7.05	0.02	55.12	0.91
20.000	7.06	0.01	54.55	2.86
50.000	7.08	0.01	45.44	1.28
100.000	7.10	0.01	43.27	1.01
165.000	7.11	0.00	40.40	1.11
200.000	7.12	0.01	39.02	1.08
240.000	7.12	0.01	37.66	1.20
275.000	7.13	0.01	36.86	1.27
735.000	7.25	0.01	31.07	1.52
1500.000	7.43	0.02	30.03	3.29

AT-8, MAT-8, SAT-8, CAT-8, NAT-8, TAT-8



DC to 1500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	8.04	0.01	55.70	0.77
20.000	8.04	0.01	53.29	0.76
50.000	8.06	0.01	45.09	0.83
100.000	8.08	0.02	42.05	1.30
165.000	8.09	0.02	38.77	1.40
200.000	8.08	0.01	37.28	1.40
240.000	8.09	0.01	35.63	1.44
275.000	8.10	0.01	34.53	1.49
735.000	8.19	0.01	27.63	1.59
1500.000	8.34	0.01	24.82	2.11

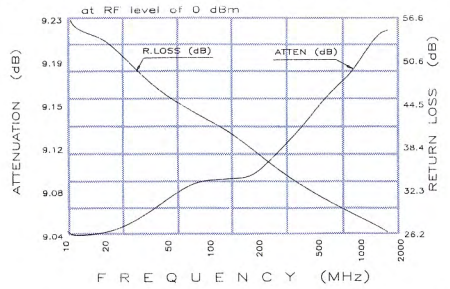
rugged, one-piece design

Fixed Attenuators

Attenuation and Return Loss

AT-9, MAT-9, SAT-9, CAT-9, NAT-9, TAT-9

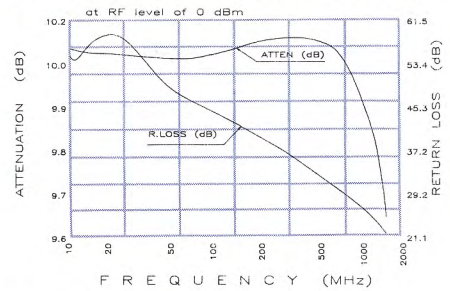
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	9.04	0.01	55.62	1.25
20.000	9.05	0.01	53.80	2.29
50.000	9.06	0.01	44.68	0.74
100.000	9.09	0.00	42.77	0.62
165.000	9.11	0.01	39.79	0.58
200.000	9.11	0.01	38.42	0.66
240.000	9.11	0.02	36.92	0.68
275.000	9.12	0.01	35.94	0.73
735.000	9.20	0.02	29.36	0.72
1500.000	9.24	0.01	27.08	1.22

AT-10, MAT-10, SAT-10, CAT-10, NAT-10, TAT-10

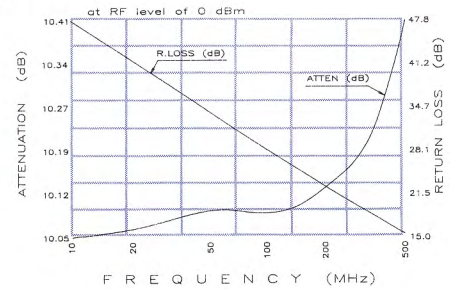
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	10.05	0.03	52.69	5.94
20.000	10.04	0.03	57.77	7.34
50.000	10.07	0.03	47.69	0.93
100.000	10.09	0.03	45.37	1.35
165.000	10.10	0.03	42.34	1.12
200.000	10.10	0.02	40.70	0.99
240.000	10.10	0.03	39.21	1.21
275.000	10.11	0.03	38.08	1.12
735.000	10.04	0.03	29.08	0.36
1500.000	9.63	0.02	20.75	0.88

AT-10-75, CAT-10-75

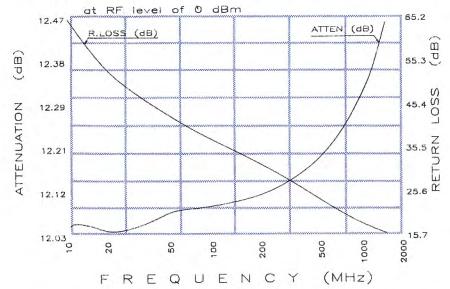
DC to 500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	10.04	0.01	47.74	0.57
20.000	10.04	0.02	44.70	0.33
50.000	10.07	0.01	34.12	0.12
100.000	10.09	0.01	28.14	0.21
110.000	10.09	0.01	27.30	0.17
122.500	10.10	0.01	26.42	0.22
135.000	10.09	0.02	25.72	0.24
147.500	10.08	0.02	24.81	0.21
250.000	10.15	0.02	20.72	0.20
500.000	10.39	0.03	15.11	0.20

AT-12, MAT-12, SAT-12, CAT-12, NAT-12, TAT-12

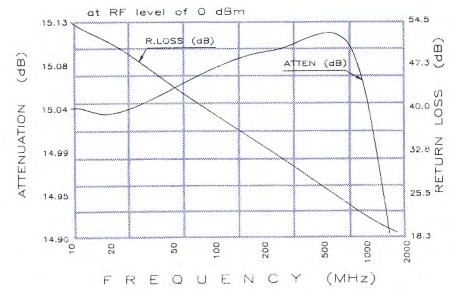
DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	12.05	0.01	60.85	3.50
20.000	12.04	0.01	55.45	2.93
50.000	12.06	0.01	44.68	1.40
100.000	12.09	0.01	42.83	3.14
165.000	12.10	0.01	38.48	3.21
200.000	12.11	0.01	36.69	3.17
240.000	12.10	0.01	35.42	3.29
275.000	12.12	0.01	34.52	3.48
735.000	12.19	0.03	25.54	3.28
1500.000	12.29	0.11	19.34	3.06

AT-15, MAT-15, SAT-15, CAT-15, NAT-15, TAT-15

DC to 1500 MHz



FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	15.04	0.01	51.49	4.85
20.000	15.04	0.01	49.53	2.75
50.000	15.06	0.01	43.06	1.06
100.000	15.09	0.02	38.62	0.80
165.000	15.09	0.02	34.91	0.79
200.000	15.09	0.02	33.39	0.80
240.000	15.09	0.02	31.73	0.78
275.000	15.11	0.02	30.52	0.74
735.000	15.11	0.04	22.45	0.61
1500.000	14.92	0.05	18.05	0.29

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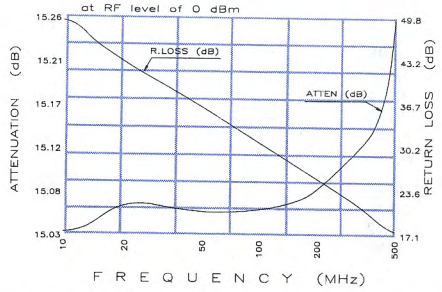
Mini-Circuits

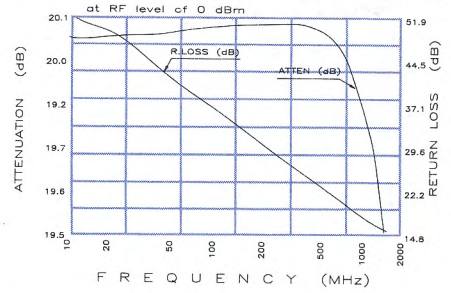
AT-15-75, CAT-15-75



DC to 1000 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	15.05	0.02	49.61	0.96
20.000	15.06	0.03	43.64	0.91
50.000	15.05	0.02	36.83	0.51
100.000	15.07	0.02	30.96	0.42
110.000	15.06	0.03	30.08	0.45
122.500	15.08	0.02	29.19	0.40
135.000	15.08	0.03	28.59	0.49
147.500	15.07	0.03	27.66	0.41
250.000	15.08	0.03	23.64	0.45
500.000	15.22	0.04	17.64	0.42

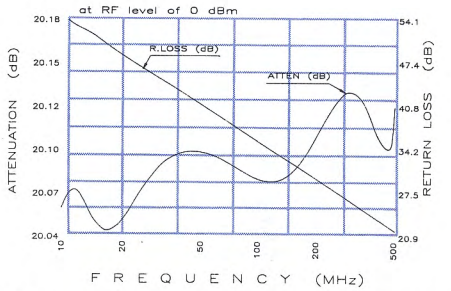
AT-20, MAT-20, SAT-20, CAT-20, NAT-20, TAT-20



DC to 1500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	20.05	0.01	51.60	0.39
20.000	20.07	0.01	50.18	0.70
50.000	20.08	0.01	41.40	0.40
100.000	20.10	0.01	36.37	0.52
165.000	20.10	0.01	32.48	0.52
200.000	20.12	0.02	30.93	0.54
240.000	20.10	0.02	29.29	0.52
275.000	20.10	0.01	28.07	0.51
735.000	20.04	0.04	19.91	0.45
1500.000	19.49	0.06	14.73	0.31

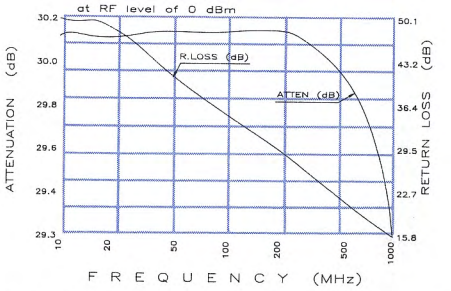
AT-20-75, CAT-20-75



DC to 500 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	20.05	0.02	53.02	1.07
20.000	20.02	0.04	47.46	1.17
50.000	20.07	0.05	40.39	0.96
100.000	20.10	0.02	34.04	0.67
110.000	20.09	0.05	33.05	0.62
122.500	20.11	0.04	32.12	0.64
135.000	20.11	0.05	31.44	0.66
147.500	20.11	0.03	30.41	0.72
250.000	20.12	0.04	26.30	0.65
500.000	20.12	0.04	19.99	0.63

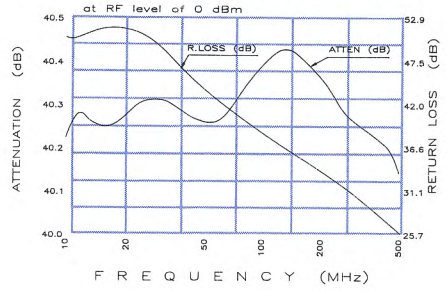
AT-30, MAT-30, SAT-30, CAT-30, NAT-30, TAT-30



DC to 1000 MHz

FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	30.11	0.03	50.49	0.53
20.000	30.10	0.04	49.22	0.99
50.000	30.12	0.04	39.97	0.71
100.000	30.12	0.05	34.46	0.80
135.000	30.13	0.06	31.95	0.82
160.000	30.16	0.03	30.64	0.85
200.000	30.11	0.04	28.79	0.84
215.000	30.07	0.04	28.14	0.85
500.000	29.98	0.04	21.05	0.84
1000.000	29.30	0.06	15.14	0.73

AT-40, MAT-40, SAT-40, CAT-40, NAT-40, TAT-40



DC to 500 MHz

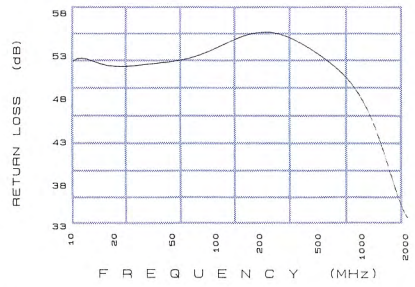
FREQUENCY (MHz)	ATTENUATION $\bar{x}$ (dB)	ATTENUATION σ (dB)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.000	40.29	0.08	50.94	1.47
20.000	40.29	0.06	54.52	1.60
50.000	40.30	0.11	44.68	0.98
100.000	40.35	0.07	40.27	1.30
110.000	40.29	0.12	39.41	1.17
125.000	40.34	0.13	38.45	1.31
135.000	40.34	0.09	37.90	1.33
150.000	40.40	0.08	37.12	1.36
250.000	40.22	0.08	32.62	1.21
500.000	40.06	0.12	27.37	1.23

Terminations

50 ohms and 75 ohms

BTRM-50

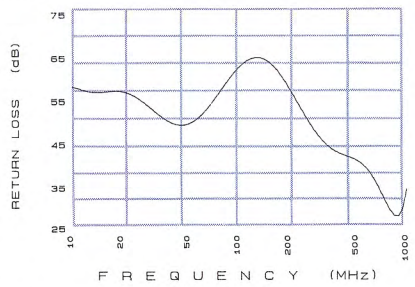
DC to 2000 MHz



FREQUENCY (MHz)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.00	51.94	4.30
20.00	52.19	5.03
50.00	53.25	6.41
100.00	52.85	4.54
165.00	51.64	4.49
200.00	50.86	5.09
270.00	49.06	4.77
500.00	46.12	7.36
1000.00	40.01	7.42
2000.00	29.03	4.82

BTRM-75

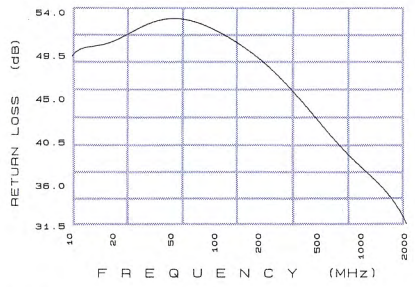
DC to 1000 MHz



FREQUENCY (MHz)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.00	48.53	5.67
20.00	49.89	4.47
50.00	49.33	1.12
100.00	50.66	6.80
135.00	52.98	12.08
160.00	54.94	5.23
200.00	48.52	3.34
215.00	46.65	3.71
500.00	37.95	2.61
1000.00	27.31	1.52

NTRM-50

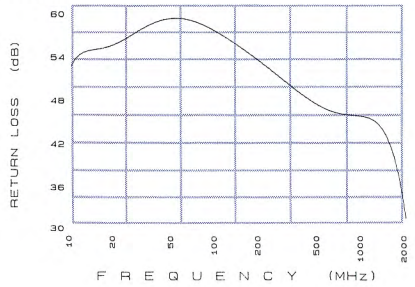
DC to 2000 MHz



FREQUENCY (MHz)	RETURN LOSS x (dB)	RETURN LOSS σ (dB)
10.00	46.13	2.12
20.00	46.99	2.43
50.00	49.09	2.73
100.00	48.19	2.33
165.00	47.65	1.78
200.00	47.75	1.47
270.00	47.18	2.04
500.00	44.96	3.45
1000.00	39.14	1.88
2000.00	29.80	2.77

STRM-50

DC to 2000 MHz



FREQUENCY (MHz)	RETURN LOSS $\bar{x}$ (dB)	RETURN LOSS σ (dB)
10.00	58.28	9.09
20.00	57.99	8.59
50.00	54.10	3.94
100.00	55.75	5.36
165.00	50.96	4.96
200.00	50.26	4.53
270.00	50.86	6.95
500.00	46.69	7.74
1000.00	42.87	5.47
2000.00	35.85	3.22

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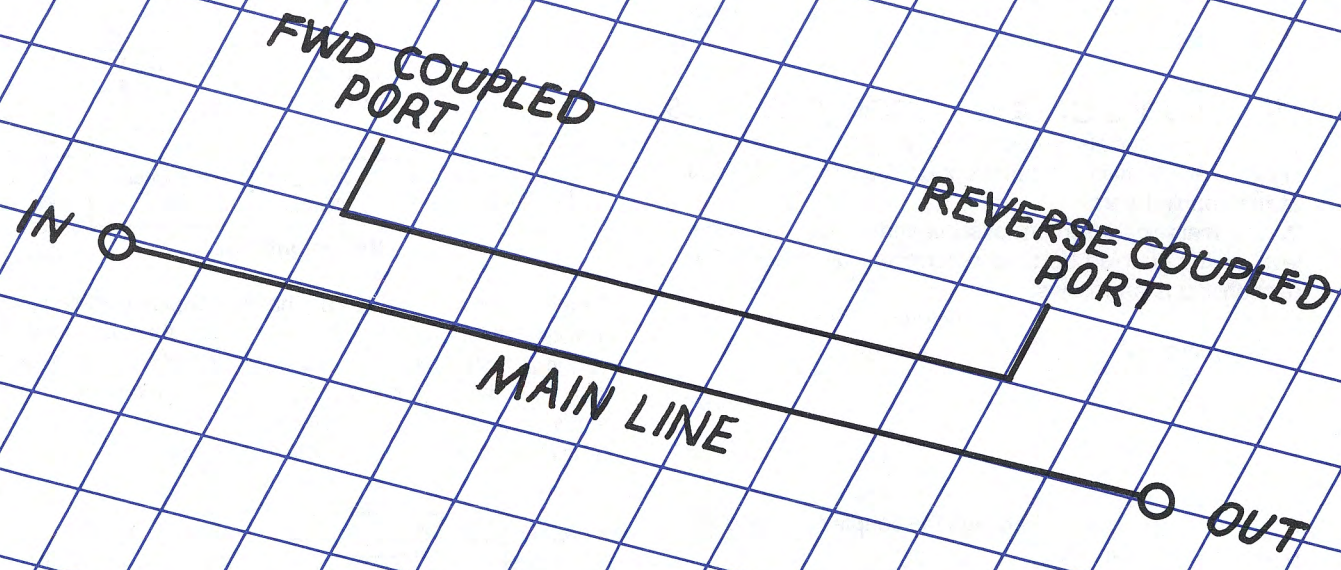
DIRECTIONAL COUPLERS



contents of this section

technical

introduction 7-2
definition of terms 7-3
most often asked questions 7-3, 7-4
specifications check list
a guide form for requirements 7-5

product specifications

6 to 30 dB coupling models. 7-6, 7-7

computer data and curves

CAPD information . . . . . 7-8 thru 7-22

Directional Couplers

The directional couplers offered by Mini-Circuits are designed for both commercial and military applications. All models are available in plug-in, flat-pack, surface mount, and connectorized SMA, BNC, Type N, TNC (option) packages. All units are designed and built to meet the environmental requirements of MIL-C-15370 and are manufactured to ensure statistical control of important parameters such as insertion loss and input/output return loss. Especially designed for high power applications, the H series of directional couplers can operate with up to 25 watts of RF input.

Mini-Circuits directional couplers are reactive devices featuring very low insertion loss. Most models have 3 ports, and are manufactured with an internal 50-ohm termination. In these cases, power coupled from any power incident to the output port (the reflected power) is absorbed and not available to the user. However, all 4-port (bi-directional) models have both the incident and reflected coupled power available. Examples are the ZFDC-20-1H and the BD-suffix models.

The basic function of a directional coupler is to operate on an input so that two output signals are available. However, when the input is applied to the opposite port of an internally terminated coupler, only one output signal is produced.

directional coupler characteristics.

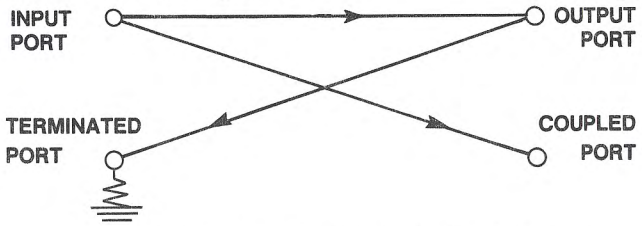
1. The output signals are unequal in amplitude. The larger signal is at the main-line output port. The smaller signal is at the coupled port.

2. The main line insertion loss depends upon the signal level at the coupled port, as determined by design. The relationship is as follows:

Coupling, dB	Theoretical Minimum Main Line Insertion Loss, dB
6	1.2
10	.46
15	.14
20	.04
30	.004

3. There is high isolation between the coupled port and the output of the main line.

A schematic representation of the coupler is as follows; the arrows show signal flow:



Key characteristics of a directional coupler include coupling coefficient, coupling flatness, main-line loss and directivity, defined on the next page. Mini-Circuits' full line of directional couplers, spanning 5 kHz to 2 GHz, provide excellent performance. They feature

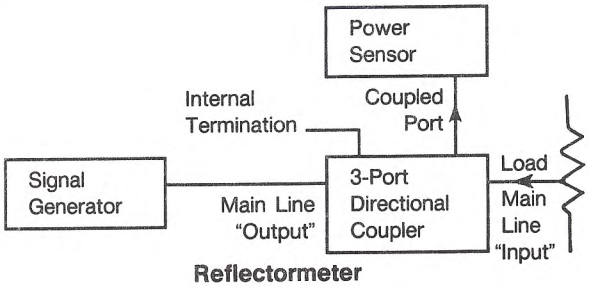
1. **flat coupling over a broad bandwidth**
2. **low main-line loss,** as low as 0.1 dB
3. **directivity** as high as 55 dB and
4. **a wide range of coupling values,** from 6 dB to 30 dB.

directional coupler applications

The high performance characteristics of these units enable the following signal processing functions to be accomplished:

measure incident and reflected power to determine VSWR,
signal sampling,
signal injection,
signal generator/oscillator leveling,
and power flow monitoring.

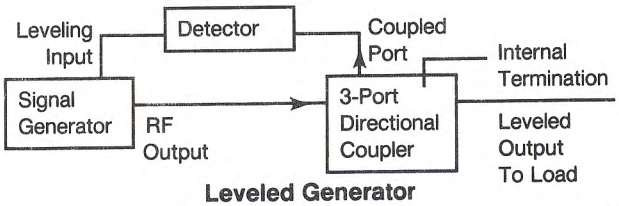
The following diagram shows how a high-directivity coupler is connected to sample reflected power from a load, which is connected to the setup after a fully-reflecting termination has been used to obtain a 0 dB return-loss reference.



Reflectormeter

The coupler is connected so that its coupled port samples power reflected from the load. It can thus be used to monitor fault conditions causing high VSWR, or to align the load device for low VSWR. A coupler used in this manner is called a reflectometer.

A leveling application is illustrated below.



Leveled Generator

The coupler is connected between a signal generator and a load, such that the coupled port samples power coming from the generator. It can thus monitor generator output independent of load conditions. The coupled-port signal can be used to level the generator output. Since generator output-power variation caused by load mismatch is suppressed by this feedback technique, the generator-coupler combination will have a source VSWR which is much better than that of the generator if it were not leveled.

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modern definition of terms

coupling coefficient
The ratio in dB of the incident power fed into the main port to the coupled port power when all ports are terminated by reflectionless terminations.

coupling tolerance
The allowable unit-to-unit variation in nominal coupling.

coupling flatness
The maximum peak-to-peak variation in coupling coefficient that may be expected over a specified frequency range.

coupling Loss
The reduction in power available to the main-line output due solely to power transferred to the coupled line. It is equal to the theoretical minimum main-line insertion loss.

main-line loss
The change in load power, due to the insertion of the coupler in a transmission system, with reflectionless terminations connected to the ports of the coupler. The main-line loss includes the effect of power transferred to the coupled line.

directivity
The difference in dB of the power output at a coupled port, when power is transmitted in the desired direction, to the power output at the same coupled port when the same amount of power is transmitted in the opposite direction. In the case of a bi- directional coupler, an alternative definition is the difference in dB of the power output of the two coupled ports, when power is transmitted in a constant direction on the main line. Reflectionless terminations are assumed to be connected to all ports.

average power
The CW average power handling capability with one-way transmission through the main line of the coupler under matched load conditions

vswr
The standing-wave ratio at any port of a coupler is specified for the case of reflectionless terminations at all other ports. As with any device, VSWR is a measure of the quality of match relative to a given characteristic impedance.

bandwidth
The range of frequencies over which performance falls within specific limits.

bi-directional coupler
Another name for a 4-port coupler; that is, a single coupler having no internal termination. It is intended to allow forward and reflected signals to be sampled simultaneously.

dual directional coupler
The combination of two 3-port couplers having their main lines cascaded, and their internally terminated ports facing each other at the interface between the couplers. This provides bi- directional coupler action, but with independent use of the coupled ports: A mismatched load applied to either of them will not affect the other.

most often asked questions about directional couplers

Q. *What is the difference between a 3-port and a 4-port coupler?*

A. A directional coupler is basically a 4-port network. The main-line and auxiliary line each have 2 ports: A 3-port coupler has one end of this auxiliary line, the "isolated port," internally terminated. When all 4 ports are made available to the user, the device is called a "bi- directional coupler."

Q. *What advantage does a 3-port coupler have over a 4-port?*

A. Directivity of a coupler is strongly affected by the impedance match provided by the termination at the isolated port. Furnishing that termination internally ensures high performance.

most often asked questions cont.

Q. *Can a 4-port coupler be used to sample forward and reflected power simultaneously, by placing measuring instruments at both ports of the coupled line?*

A. Yes, but with care to provide good impedance match at all 4 ports of such a "bi-directional coupler." A coupler's directivity can be no better than the return loss of the terminations at the far-end main-line and coupled line ports; poor directivity causes inaccurate power monitoring by leaking forward and reflected signals into one another's paths. An alternative approach which overcomes this limitation is to use two 3-port couplers back-to-back; this combination is called a "dual directional coupler."

Q. *Is a coupled port an input or an output?*

A. It can be used as either. The coupling factor determines the attenuation between main-line and coupled line signals in both cases.

Q. *How is directivity measured when the 4th port is internally terminated?*

A. Measure the loss from the main-line input to the coupled port with the main-line output terminated. Then reverse the main-line connections. The difference in dB readings is the directivity.

Q. *How good does the directivity of a coupler have to be, as a reflectometer, to measure the return loss of an unknown impedance?*

A. A mathematical determination requires knowledge of phase relationships in a given case, but as a guide, less than 1dB error will result when the directivity is 20dB greater than the unknown's return loss.

Q. *How is power rating determined for pulsed-RF operation?*

A. The first limitation to peak pulse power which a coupler can handle is determined by dividing the average power rating by the duty factor of the pulse train. This applies when the duration of each pulse is much shorter than the thermal time constant of the internal terminating resistor. If the pulse duration is greater than about a millisecond, the peak-power should be reduced.

A further limitation may be necessary to avoid saturation of the transformer core used in the coupler to avoid compression and distortion of the signal. For specific applications, consult the factory.

Q. *What performance degradation occurs if a 50-ohm directional coupler is used in a 75-ohm system?*

A. The most pronounced effect is a reduction in directivity because the internal 50-ohm termination would give a VSWR of 1.5:1. The directivity would be limited to the corresponding return loss, 14 dB.

Q. *What effect does DC current through the main-line have upon performance?*

A. Most Mini-Circuits' couplers have their ports at DC ground. Therefore DC current would not pass through from in to out. However, for those models designed to pass DC current, when the current is large relative to RF current, signal compression and distortion due to core saturation may occur.

Q. *Does the input power rating apply equally to the main-line and coupled port?*

A. Not for a 3-port coupler. The coupled port rating is less, because power applied to the coupled port is almost entirely dissipated in the internal termination.

Q. *If the external load on the output port is mismatched, where does the reflected power go?*

A. Most goes back to the input port. A portion of it, corresponding to the coupling factor, is dissipated in the internal termination.

Q. *How do similar coupler designs in different case styles or with different connectors compare in performance?*

A. Performance is similar, except at high frequencies, where the rule generally is "the smaller, the better."

Q. *How important is grounding of pins?*

A. All ground pins should be connected to ground with short path length to obtain full directivity and VSWR performance.

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Directional Couplers

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency range _____ MHz
Coupling avg. _____ db, Tol. ± _____ dB
Coupling flatness max. ± _____ dB
Mainline insertion loss max. _____ dB
Directivity min. _____ dB
Max. input power _____ watt
VSWR or return loss (dB)
☐ 50 ohms ☐ 75 ohms ☐ Other
Input _____ Output _____ Coupled _____
Operating temperature: _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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very broadband

Directional Couplers

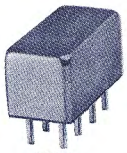
6 to 30 dB

5 KHz to 2000 MHz

case style selection

outline drawings see Table of Contents

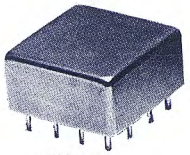

TDC


PDC


TODC


SCDC


LRDC


P4DC
PDC-20A-5

	MODEL NO.	FREQ. MHz f_L–f_U	COUPLING dB Nom.	Flatness	MAINLINE LOSS* dB L Typ.	L Max.	M Typ.	M Max.	U Typ.	U Max.	DIRECTIVITY dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	VSWR (:1) Typ.	POWER INPUT, W L Max.	MU Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
TDC	TDC-6-1	10-400	6.3±0.4	±0.4	2.0	2.4	2.0	2.4	2.0	2.5	36	30	30	25	20	15	1.5	1	2	23.95	●	●
case B02	TDC-10-1	1-400	10.0±0.5	±0.5	1.2	1.5	1.0	1.3	1.2	1.5	35	25	30	20	20	15	1.5	1	2	17.95	●	●
	TDC-10-2	5-1000	11±0.5	±0.6	1.4	1.8	1.5	1.8	1.6	2.0	50	35	25	20	20	15	1.5	0.5	0.5	25.95	●	●
PDC	PDC-10-1	0.5-500	11.5±0.5	±0.6	0.85	1.3	0.65	1.0	0.85	1.3	32	25	32	25	22	15	1.2	1.5	3	13.45	●	●
◇◇	PDC-10-1BD	1-400	11.5±0.5	±0.5	0.6	0.9	0.8	1.1	0.9	1.3	55	35	35	20	22	15	1.2	2.0	4	11.45	●	●
case A01 :	PDC-10-2	250-1000	10.5±0.5	±0.6	1.4	1.6	—	—	1.6	2.0	30	23	30	20	25	15	1.5	—	5	34.45	●	●
	PDC-10-5	1-2000	10.5±0.5	±1.0	1.2	1.9	1.3	1.9	2.0	2.5	38	25	30	18	22	18	1.3	0.5	0.5	40.95	●	●
	PDC-10-6	0.005-20	11±0.5	±0.5	0.4	1.2	0.4	0.8	0.4	1.0	40	30	40	30	35	25	1.3	1.5	3	23.95	●	●
.	PDC10-21	1-1000	11±0.5	±0.5	1.2	1.7	1.2	1.7	1.6	2	40	30	25	20	25	20	1.3	1	2	32.95	●	●
	PDC-10-22	5-750	11±0.5	±0.5	1.1	1.6	1.2	1.7	1.6	1.9	35	30	25	20	25	20	1.25	1	2	23.95	●	●
	PDC-10-54	10-1500	10.5±0.5	±0.7	1.2	1.8	1.3	1.9	1.6	2.3	35	25	28	23	28	23	1.3	0.5	0.5	35.95	●	●
	PDC-15-6	0.01-35	15±0.5	±0.5	0.3	0.6	0.2	0.4	0.3	0.6	38	30	35	25	28	20	1.15	2	4	23.95	●	●
	PDC-15-21	1-500	14.7±0.5	±0.6	0.7	1.1	0.7	1.1	0.8	1.2	35	30	35	30	30	23	1.4	1	2	23.95	●	●
††	PDC-20-1	25-400	21±0.75	±0.5	0.2	0.25	0.3	0.35	0.35	0.5	25	20	35	25	25	20	1.25	3	5	23.95	●	●
◇◇	PDC-20-1BD	0.5-200	19.2±0.5	±0.5	0.3	0.5	0.3	0.5	0.4	0.6	40	30	35	20	18	22	1.1	3	5	16.95	●	●
	PDC-20-1W	10-700	19.2±0.5	±0.5	0.25	0.5	0.4	0.7	0.7	1.1	34	30	27	23	23	20	1.4	1	2	23.95	●	●
	PDC-20-3	0.2-250	19.5±0.5	±0.5	0.35	0.6	0.25	0.5	0.35	0.6	36	30	33	25	25	20	1.2	1.5	4	15.95	●	●
◇◇	PDC-20-3BD	0.2-250	19.5±0.5	±0.5	0.3	0.6	0.25	0.5	0.35	0.6	47	40	40	25	30	20	1.1	1.5	4	17.95	●	●
case III45	PDC-20A-5	0.1-2000	20.0±0.5	±1.0	0.6	1.5	0.6	1.5	1.9	2.9	34	20	25	15	20	10	1.5	0.5	2	44.95	●	●
case A01	■ PDC-10-1-75	1-250	10.5±0.5	±0.75	1.1	1.5	1.1	1.5	1.1	1.5	30	20	30	20	30	20	2.0	2	4	14.95	●	●
	■ PDC-10-6-75	0.2-100	10.0±0.5	±0.2	1.2	1.6	0.9	1.2	0.9	1.3	50	30	40	25	37	25	1.5	1	2	23.95	●	●
	■ PDC-15-6-75	0.02-35	14.5±0.5	±0.5	0.3	0.7	0.3	0.7	0.3	0.7	35	20	35	20	35	20	1.3	1.5	4	25.95	●	●
	■ PDC-20-3-75	1-150	19.5±0.5	±0.75	0.35	0.8	0.35	0.8	0.35	0.8	25	20	25	20	25	20	2.0	2	4	14.95	●	●
	■ PDC-20-6-75	0.05-40	20.4±0.3	±0.25	0.1	0.25	0.1	0.2	0.1	0.3	45	35	35	20	25	18	1.2	1.5	3	23.95	●	●
TODC	TODC-10-1	10-400	11.3±0.5	±0.5	1.2	1.5	1.0	1.3	1.2	1.5	35	25	30	20	25	20	1.5	0.5	1	17.95	●	●
case QQ96																						
o□SCDC	SCDC-11-2	500-1100	11.3±0.5	±0.6	—	—	1.1	1.8••	—	—	—	—	20	14••	—	—	1.4	2	2	11.95	●	●
case YY161	SCDC-25-2	500-1090	25.5±0.75	±0.8	—	—	0.5	1.0••	—	—	—	—	22	10••	—	—	1.4	2	2	13.95	●	●
o□LRDC	LRDC-20-2	300-1100	20.5±1.0	±1.3	—	—	0.25	0.6••	—	—	—	—	22	10••	—	—	1.2	2	2	15.95	●	●
case QQQ130																						
▼P4DC	P4DC-30A-2	5-1000	30.5±0.5	±1	0.7	1.2	0.7	1.2	0.8	1.5	30	15	32	20	20	10	1.15	1	2	34.95	●	●
case C07																						

L=low range (f_L to 10 f_L) M=mid range (10 f_L to f_U/2) U=upper range (f_U/2 to f_U)

pin and coaxial connection

see case style outline drawing

Series	In	Out	Cpl$_{in}$	◇◇ Cpl$_{out}$	Case Ground	Not Used
TODC	5	8	2	—	all others	11
PDC	1	4	3	6	2,5,7,8	6
TDC	1	2	4	—	3	—
ZEDC	1	2	3	—	—	—
ZMDC	3	2	1	—	—	—
ZDC	3	2	1	—	—	—
SCDC	1	2	5	—	4,7,8	3,6
ZFDC (except 20-4, -5)	1	2	3	—	—	—
ZFDC-20-4, -5	3	1	2	—	—	—
PDC-20A-5	9	5	12	—	1,2,3,4,6, 7,8,10,11	—
▼P4DC-30A-2	8	12	—	—	—	—
LRDC-20-2	6	1	4	—	2,5	3

NOTES:

□ NON-HERMETIC
o Available on tape and reel, please consult factory.
: $L = f_L - 2f_L$
* Includes theoretical power loss at coupled port.
■ Denotes 75 ohm models, available only with 75 ohm BNC
∴ bi directional, L = 30 to 100 MHz
◇◇ bi directional
†† Models PDC-20-1, ZDC-20-1, ZMDC-20-1: L=25-50 MHz, M=50-300 MHz, U=300-400 MHz
● Model ZFDC-20-5: above 1000 MHz, coupling flatness ±1.0dB
. Models PDC-10-21, ZFDC-10-21; Upper range coupling ±0.75dB
** Mainline loss and directivity are specified for total frequency range.
▼ 4 coupled ports, 25 dB min. isolation between ports. Cpl #1, pin2; Cpl #2, pin 1; Cpl #3, pin 13; Cpl #4, pin 14. Gnd. pins: 3, 4, 5, 6, 7, 10, 11, 15, 16.

1. For quality control procedures, see Table of Contents.
2. For environmental specifications, see Table of Contents.
3. For connector types and case mounting options, see case style outline drawing.
4. Prices and specifications subject to change without notice.
5. All models are licensed under U.S. Patent 3,426,298.

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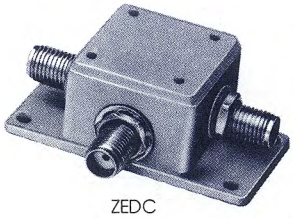
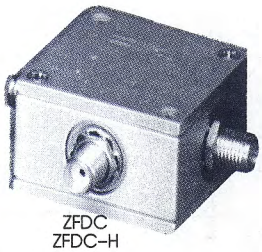
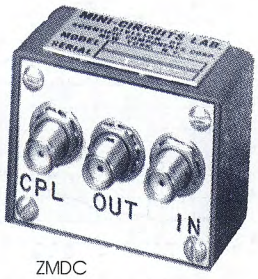
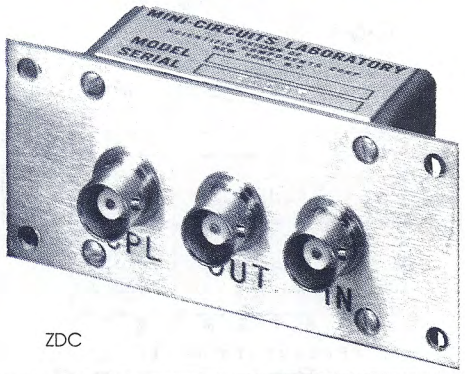

ZEDC


ZFDC
ZFDC-H



ZMDC



ZDC

	MODEL NO.	FREQ. MHz f_L-f_U	COUPLING dB Nom.	COUPLING dB Flatness	MAINLINE LOSS* dB L Typ.	MAINLINE LOSS* dB L Max.	MAINLINE LOSS* dB M Typ.	MAINLINE LOSS* dB M Max.	MAINLINE LOSS* dB U Typ.	MAINLINE LOSS* dB U Max.	DIRECTIVITY dB L Typ.	DIRECTIVITY dB L Min.	DIRECTIVITY dB M Typ.	DIRECTIVITY dB M Min.	DIRECTIVITY dB U Typ.	DIRECTIVITY dB U Min.	VSWR Typ.	POWER INPUT, W L Max.	POWER INPUT, W M,U Max.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
ZEDC	ZEDC-10-2B	1-1000	11±0.5	±0.75	1.3	1.5	1.5	1.8	1.5	1.8	35	30	30	20	18	13	1.3	1.5	3	64.95	●	
case V37	ZEDC-15-2B	1-1000	15±0.5	±0.5	0.5	1.0	0.8	1.2	1.0	1.4	35	30	30	25	25	15	1.15	1.5	3	64.95	●	
ZFDC	ZFDC-10-1	1-500	10.5±0.25	±0.6	1.0	1.3	0.8	1.1	1.0	1.3	32	25	33	25	22	15	1.2	1.5	3	44.95	●	
case K18	ZFDC-10-2	10-1000	10.75±0.5	±0.5	1.5	2.0	1.2	1.6	1.5	2.0	35	28	30	25	27	20	1.5	1.5	3	51.95	●	
	ZFDC-10-5	1-2000	10.8±0.5	±1.0	1.2	1.9	1.2	1.8	1.8	2.5	38	25	30	18	22	18	1.3	0.5	0.5	84.95	●	
	ZFDC-10-6	0.005-20	11±0.5	±0.5	0.4	1.2	0.4	0.8	0.4	1.0	40	30	40	30	35	25	1.3	1.5	3	52.95	●	
	•• ZFDC-10-21	1-1000	11±0.5	±0.5	1.2	1.7	1.2	1.7	1.6	2.0	40	30	25	20	25	20	1.2	1	2	54.95	●	
	■ ZFDC-10-1-75	1-400	10.5±0.5	±0.5	1.0	1.4	1.1	1.5	1.1	1.6	46	30	44	28	34	20	1.3	2	4	45.95	●	
	■ ZFDC-10-21-75	10-750	11±0.5	±0.75	1.5	1.8	1.5	1.9	1.7	2.1	36	30	30	20	26	20	1.4	1	2	54.95	●	
	ZFDC-10-22	1-750	11±0.5	±0.5	1.1	1.6	1.2	1.7	1.4	1.9	35	30	25	20	25	20	1.25	1	2	49.95	●	
	ZFDC-15-5	1-2000	15.5±0.5	±1.0	1.0	1.8	1.2	1.8	1.3	2.3	30	20	25	20	18	11	1.3	0.5	2	71.95	●	
	ZFDC-15-6	0.03-35	15±0.5	±0.5	0.3	0.6	0.2	0.4	0.3	0.6	38	30	35	25	28	20	1.15	2	4	49.95	●	
	■ ZFDC-15-6-75	0.02-35	14.5±0.5	±0.5	0.3	0.7	0.3	0.7	0.3	0.7	35	20	35	20	35	20	1.3	1.5	4	49.95	●	
	ZFDC-20-3	0.2-250	19.5±0.5	±0.25	0.35	0.6	0.25	0.5	0.35	0.6	36	25	33	25	25	20	1.2	1.5	4	44.95	●	
	■ ZFDC-20-3-75	10-250	19.3±0.5	±0.3	0.25	0.4	0.3	0.5	0.4	0.6	29	25	29	25	28	24	1.2	1	2	49.95	●	
	ZFDC-20-4	1-1000	19.5±0.5	±0.5	1.2	1.5	0.6	0.8	1.2	1.5	36	28	27	20	23	18	1.1	.5	2	64.95	●	
	● ZFDC-20-5	0.1-2000	19.5±0.5	±0.5	0.3	1	0.7	1.4	1.5	2.3	30	20	27	20	22	10	1.2	.5	2	84.95	●	
	■ ZFDC-3375	0.2-200	30.5±0.5	±0.6	0.5	0.8	0.6	0.9	0.7	1.0	30	25	25	20	19	15	1.6	.5	2	45.95	●	
ZFDC-H	∴ ZFDC-20-1H	30-400	20.5±0.5	±0.4	0.15	0.4	0.15	0.4	0.3	0.4	30	25	30	25	30	23	1.2	25	25	58.95	●	
case J17																						
ZMDC	ZMDC-10-1	0.5-500	11.5±0.5	±0.6	0.85	1.3	0.65	1.0	0.85	1.3	32	25	32	25	22	15	1.2	1.5	3	49.95	●	
case M21	: ZMDC-10-2	250-1000	10.5±0.5	±0.5	1.1	1.4	—	—	1.6	1.9	40	30	30	20	20	15	1.5	—	5	59.95	●	
	ZMDC-15-6	.01-35	15±0.5	±0.5	0.4	0.6	0.2	0.4	0.4	0.6	38	30	35	25	2☆	20	1.15	2	4	59.95	●	
	†† ZMDC-20-1	25-400	21±0.75	±0.5	0.2	0.25	0.3	0.35	0.35	0.5	25	20	35	25	25	20	1.25	3	5	59.95	●	
	ZMDC-20-3	0.2-250	19.5±0.5	±0.5	0.35	0.5	0.25	0.5	0.35	0.6	36	30	33	25	25	20	1.2	1.5	4	49.95	●	
	ZMDC-30-1	0.1-250	30±0.5	±0.5	0.4	0.6	0.5	0.8	0.55	0.85	23	18	20	15	17	10	1.5	1.0	3	51.95	●	
ZDC	ZDC-10-1	0.5-500	11.5±0.5	±0.6	0.85	1.3	0.65	1.0	0.85	1.3	32	25	32	25	22	15	1.2	1.5	3	44.95	●	
case M22	: ZDC-10-2	250-1000	10.5±0.5	±0.5	1.1	1.4	—	—	1.6	1.9	40	25	—	—	20	15	1.5	—	4	51.95	●	
	ZDC-15-2	0.5-250	15±0.5	±0.5	0.8	1.2	0.7	1.0	0.9	1.2	32	28	32	28	32	28	1.4	1.5	3	51.95	●	
	ZDC-15-6	.01-35	15±0.5	±0.5	0.3	0.6	0.2	0.4	0.3	0.6	38	30	35	25	28	20	1.15	2	4	51.95	●	
	†† ZDC-20-1	25-400	20±0.5	±0.5	0.2	0.25	0.3	0.35	0.35	0.5	25	20	35	25	25	20	1.25	3	5	51.95	●	
	ZDC-20-3	0.2-250	19±0.5	±0.5	0.35	0.6	0.25	0.5	0.35	0.6	36	30	33	25	25	20	1.2	1.5	4	44.95	●	
	■ ZDC-10-1-75	1-250	10.5±0.5	±0.75	1.1	1.5	1.1	1.5	1.1	1.5	30	20	30	20	30	20	2	2	4	44.95	●	
	■ ZDC-15-6-75	.02-35	14.5±0.5	±0.6	0.3	0.6	0.2	0.4	0.4	0.6	35	30	35	25	28	20	1.5	2	4	52.95	●	
	■ ZDC-20-3-75	1-150	19.5±0.5	±0.75	0.35	0.8	0.35	0.8	0.35	0.8	25	20	25	20	25	20	2	2	4	45.95	●	
	■ ZDC-2375	50-100	10.5±0.3	±0.2	—	—	—	—	1.1	1.3	—	—	—	—	35	30	1.3	—	4	52.95	●	
	■ ZDC-20-3-75-1	55-90	18.6±0.5	±0.3	0.4	0.6	0.4	0.6	0.4	0.6	35	30	35	30	35	30	1.2	—	4	52.95	●	

L = low range (f_L to 10 f_L) M = mid range (10f_L to f_U/2) U = upper range (f_U/2 to f_U)

MCL NO.	NSN	MIL-C-15370/18*
PDC-10-1	5985-01-178-4406	002
PDC-10-1-75	5985-01-294-3796	
PDC-10-2	5985-01-178-4406	008
PDC-10-21	5985-01-130-0177	003
PDC-10-22	5985-01-190-7738	
PDC-15-6	5985-01-147-0160	009
PDC-20-3	5985-01-076-8477	001
TDC-10-1	5905-01-226-4528	
ZDC-10-1-BNC	5985-01-125-3467	
ZDC-20-1	5985-01-178-4405	

MCL NO.	NSN	MIL-C-15370/18*
ZDC-20-3-BNC	5985-01-096-5007	
ZDC-20-3B	5985-01-264-9105	
ZEDC-10-2	5985-01-251-2669	
ZEDC-15-2B	5985-01-337-9981	
ZFDC-10-1	5985-01-230-6676	
ZFDC-10-1(SMA)	5985-01-179-5122	
ZFDC-10-1B	5985-01-135-9780	
ZFDC-10-2	5985-01-208-5694	
ZFDC-10-21	5985-01-253-0600	
ZFDC-10-6B	5985-01-314-4176	

MCL NO.	NSN	MIL-C-15370/18*
ZFDC-15-5	5985-01-298-0144	
ZFDC-15-6	5985-01-330-6792	
ZFDC-20-3	5985-01-230-6677	
ZFDC-20-3(BNC)	6985-01-146-0478	
ZFDC-20-3(TNC)	5985-01-226-7882	
ZFDC-20-4	5985-01-266-9992	
ZFDC-20-5(BNC)	5985-01-097-2192	
ZMDC-10-1	4935-01-227-6945	
ZMDC-10-1B	4935-01-227-6945	
ZMDC-20-1	5985-01-193-8515	

*units are not QPL listed

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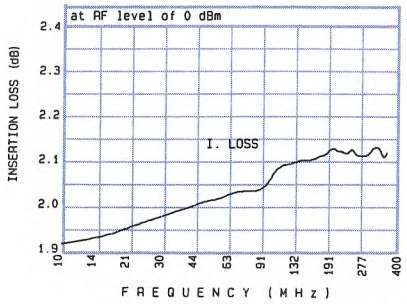
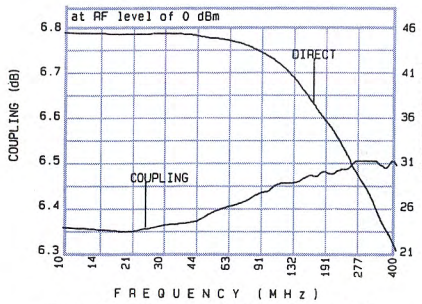
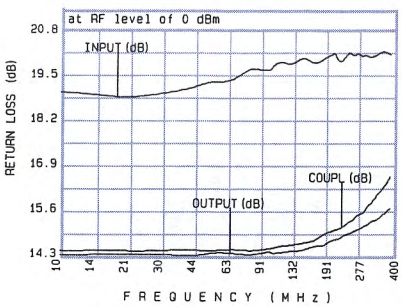
very broadband
Directional Couplers

TDC-6-1

10 to 400 MHz



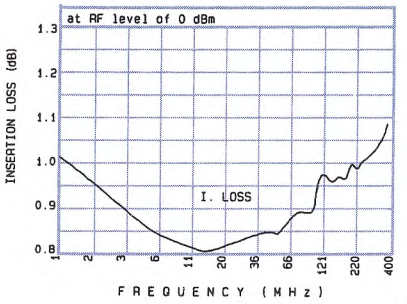


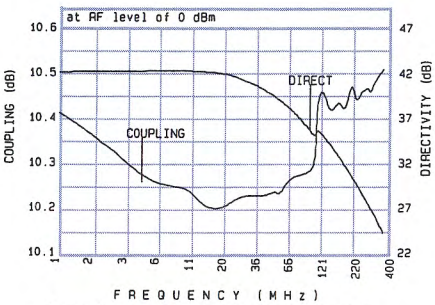


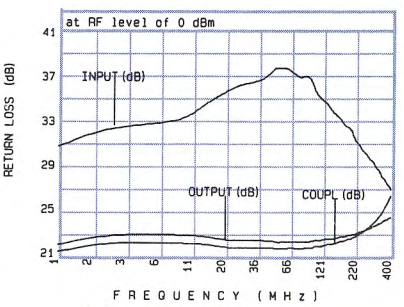
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
10.00	1.92	6.36	45.76	19.09	14.37	14.49
19.75	1.95	6.35	45.59	18.93	14.42	14.53
77.28	2.04	6.42	44.33	19.84	14.39	14.51
99.70	2.08	6.45	42.98	19.88	14.44	14.59
155.28	2.11	6.48	38.20	19.95	14.63	14.79
200.13	2.13	6.48	34.76	20.15	14.85	15.13
233.28	2.14	6.49	32.09	20.33	15.02	15.37
311.28	2.14	6.51	26.84	20.21	15.39	16.11
389.28	2.14	6.51	22.28	20.33	15.87	16.92
400.00	2.13	6.50	21.59	20.33	16.01	17.00

TDC-10-1

1 to 400 MHz



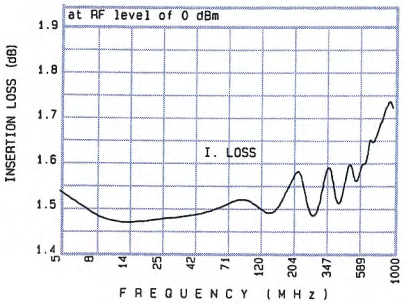


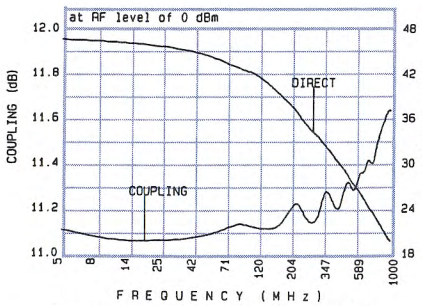


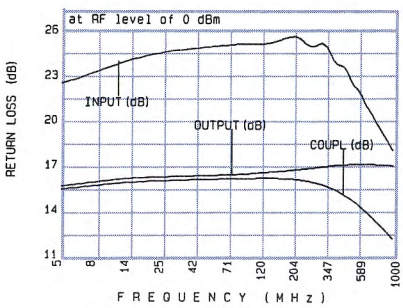
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
1.00	1.02	10.42	42.50	31.09	22.15	21.49
2.00	0.94	10.35	42.57	32.84	23.07	22.37
5.00	0.84	10.25	42.61	33.16	23.14	22.36
10.00	0.82	10.26	42.65	33.63	23.03	22.30
20.00	0.82	10.21	42.34	36.08	22.58	21.92
50.00	0.85	10.25	39.59	38.32	22.54	21.92
100.00	0.90	10.30	35.13	36.59	22.51	21.93
200.00	1.00	10.46	30.37	32.59	23.10	22.74
387.53	1.11	10.52	22.60	27.56	24.68	26.36
400.00	1.12	10.53	22.17	27.26	24.68	26.63

TDC-10-2

5 to 1000 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
5.00	1.54	11.12	46.98	22.70	15.85	15.65
10.00	1.46	11.07	46.73	23.89	16.30	16.03
20.00	1.48	11.07	46.28	24.86	16.48	16.22
50.00	1.49	11.09	44.93	25.17	16.57	16.32
100.00	1.52	11.13	42.76	25.29	16.72	16.38
200.00	1.59	11.25	37.70	25.93	16.98	16.31
500.00	1.56	11.29	27.82	22.47	17.33	14.79
557.11	1.61	11.38	26.63	21.79	17.30	14.37
972.94	1.72	11.67	18.90	17.81	17.20	12.01
1000.00	1.76	11.75	18.62	17.57	17.20	11.89

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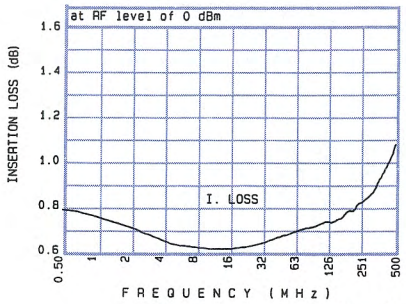
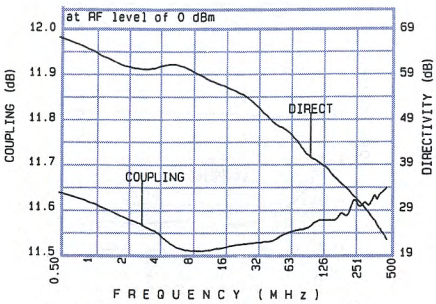
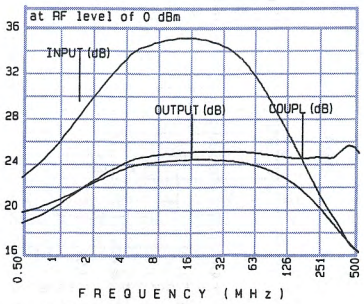
Mini-Circuits

PDC-10-1, ZFDC-10-1, ZDC-10-1, ZMDC-10-1

0.5 to 500 MHz







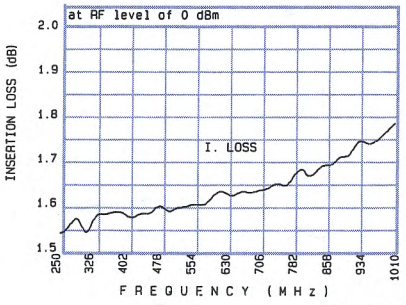
Freq. (MHz)	I. Loss (dB) In-Out
0.50	0.80
1.75	0.72
5.49	0.64
84.17	0.72
180.32	0.80
250.25	0.85
291.46	0.88
388.86	0.98
486.26	1.11
500.00	1.13

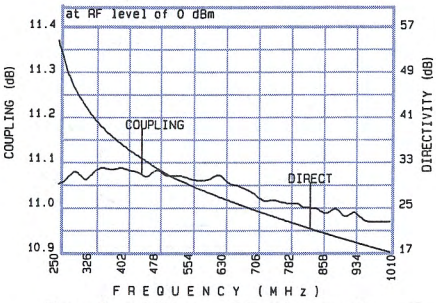
Coupling (dB) In-CPL	Directivity (dB)
11.64	67.65
11.58	59.85
11.51	62.42
11.56	41.10
11.59	34.41
11.61	30.61
11.61	28.87
11.65	24.21
11.68	20.17
11.70	19.54

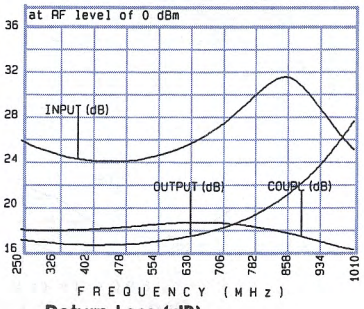
Return Loss (dB) In	Out	CPL
22.87	19.76	18.76
30.24	22.43	22.75
34.63	24.16	24.78
29.64	23.57	25.00
23.43	21.33	24.75
20.71	19.77	24.77
19.66	19.00	24.80
17.56	17.51	25.80
16.49	16.42	25.43
16.35	16.29	25.22

PDC-10-2, ZMDC-10-2, ZDC-10-2

250 to 1000 MHz







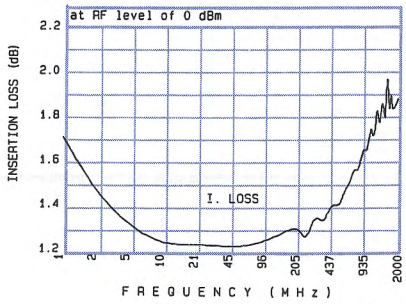
Freq. (MHz)	I. Loss (dB) In-Out
250.00	1.54
371.62	1.59
493.24	1.59
500.00	1.59
513.51	1.60
635.13	1.62
756.75	1.64
858.10	1.69
979.72	1.77
1000.00	1.79

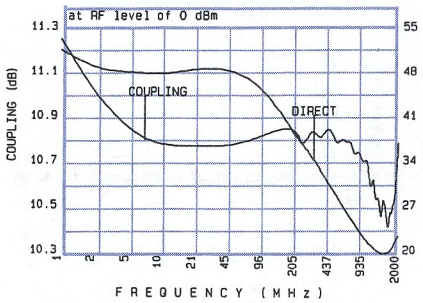
Coupling (dB) In-CPL	Directivity (dB)
11.05	54.80
11.08	37.67
11.07	31.15
11.07	30.80
11.07	30.26
11.05	26.24
11.01	22.89
10.98	20.37
10.97	17.60
10.97	17.12

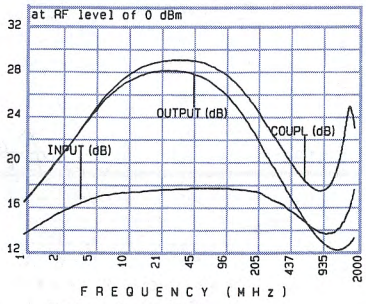
Return Loss (dB) In	Out	CPL
26.03	17.11	18.01
24.40	16.72	18.06
24.21	16.77	18.34
24.23	16.78	18.35
24.28	16.81	18.38
25.84	17.54	18.73
29.35	19.03	18.50
31.80	21.42	17.77
26.08	26.67	16.50
25.26	27.86	16.35

PDC-10-5, ZFDC-10-5

1 to 2000 MHz







Freq. (MHz)	I. Loss (dB) In-Out
1.00	1.72
2.00	1.44
5.00	1.29
10.00	1.23
20.00	1.24
50.00	1.22
100.00	1.26
200.00	1.34
1000.00	1.79
2000.00	1.95

Coupling (dB) In-CPL	Directivity (dB)
11.26	51.91
10.99	48.59
10.82	48.39
10.78	47.89
10.78	49.11
10.78	48.83
10.84	44.88
10.88	38.04
10.73	21.92
10.79	22.74

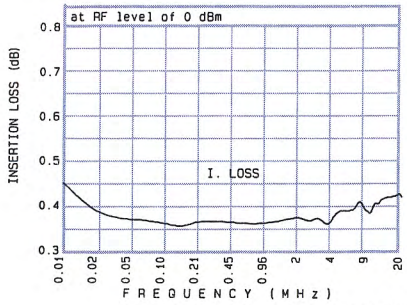
Return Loss (dB) In	Out	CPL
13.62	16.54	16.42
15.74	20.60	20.51
17.27	25.50	25.75
17.43	27.76	28.35
17.70	28.51	29.38
17.86	28.03	29.30
17.82	25.88	27.79
17.53	21.96	24.56
13.85	12.50	18.15
20.63	14.32	18.05

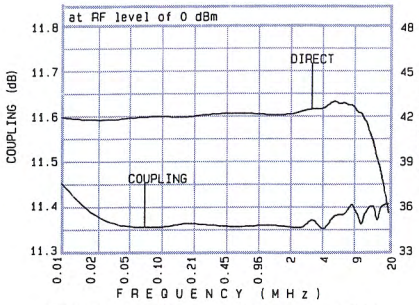
very broadband

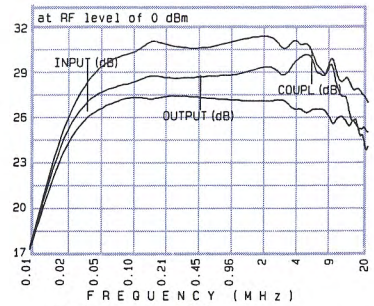
Directional Couplers

PDC-10-6, ZFDC-10-6

0.005 to 20 MHz







Freq. (MHz)	I. Loss (dB) In-Out
0.005	0.46
0.020	0.38
0.050	0.38
0.100	0.37
0.200	0.38
0.500	0.37
9.930	0.39
10.540	0.41
19.250	0.44
20.000	0.43

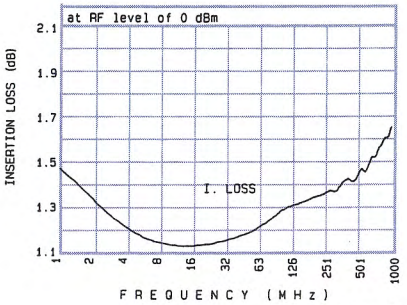
Coupling (dB) In-CPL	Directivity (dB)
11.46	42.21
11.37	41.97
11.36	42.22
11.36	42.32
11.37	42.36
11.36	42.58
11.39	42.12
11.40	41.92
11.40	34.07
11.40	33.28

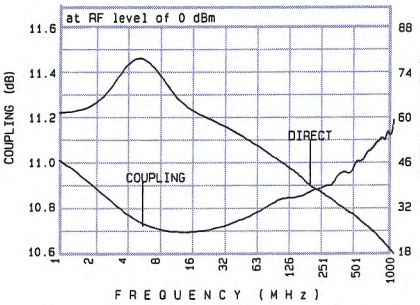
Return Loss (dB)

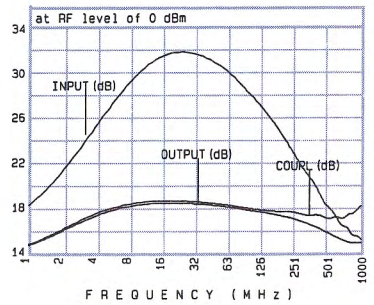
In	Out	CPL
17.45	17.48	17.63
25.66	26.73	27.36
27.20	28.32	30.42
27.80	28.59	30.46
27.84	28.82	30.99
27.58	29.12	30.88
26.27	29.24	28.38
26.30	28.82	28.06
25.36	27.52	24.05
25.30	27.33	24.31

PDC-10-21, ZFDC-10-21

1 to 1000 MHz







Freq. (MHz)	I. Loss (dB) In-Out
1.00	1.49
2.25	1.30
9.74	1.14
167.08	1.36
361.89	1.45
500.50	1.47
584.17	1.55
777.72	1.63
972.53	1.72
1000.00	1.75

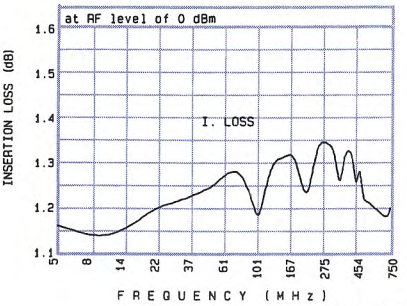
Coupling (dB) In-CPL	Directivity (dB)
11.03	62.75
10.87	64.39
10.70	66.04
10.88	40.75
10.98	33.06
11.02	29.44
11.07	27.42
11.13	23.07
11.17	19.15
11.21	18.72

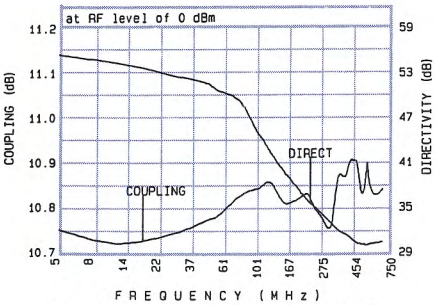
Return Loss (dB)

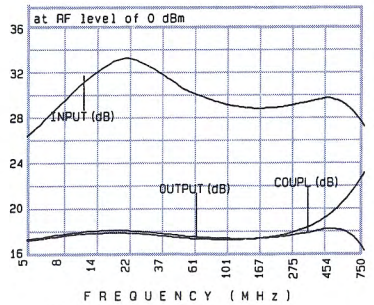
In	Out	CPL
18.51	14.90	14.98
22.67	16.76	16.95
31.25	18.72	18.93
25.31	17.63	17.99
20.15	16.56	17.67
18.08	15.85	17.37
16.97	15.51	17.40
15.77	15.13	17.78
15.32	15.25	18.59
15.44	15.35	18.78

PDC-10-22, ZFDC-10-22

5 to 750 MHz







Freq. (MHz)	I. Loss (dB) In-Out
5.00	1.17
10.00	1.13
20.00	1.21
50.00	1.26
100.00	1.20
200.00	1.24
366.22	1.34
500.00	1.22
727.43	1.28
750.00	1.27

Coupling (dB) In-CPL	Directivity (dB)
10.76	56.00
10.72	55.00
10.74	54.00
10.79	52.00
10.85	45.27
10.84	36.71
10.87	31.90
10.90	30.51
10.96	30.19
10.94	29.66

Return Loss (dB)

In	Out	CPL
26.72	17.45	17.54
31.54	18.12	18.32
34.28	18.19	18.42
30.97	17.69	17.87
29.52	17.58	17.66
29.28	17.84	17.74
29.98	19.03	18.34
29.97	20.33	18.48
27.90	23.20	16.88
27.62	23.46	16.58

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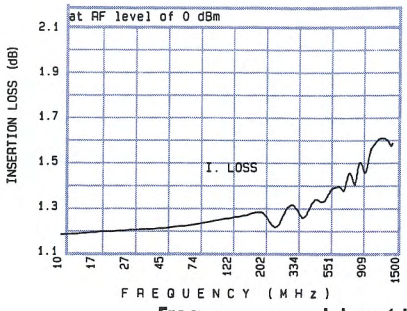
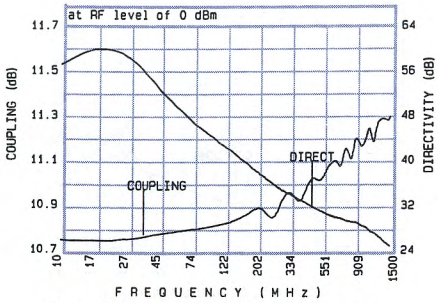
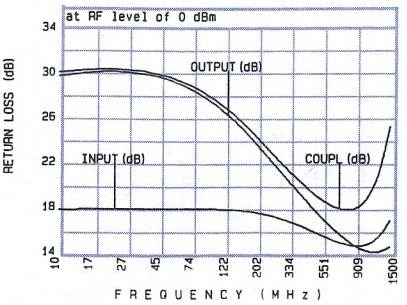
PDC-10-54

10 to 1500 MHz







Freq. (MHz)	I. Loss (dB) In-Out
10.00	1.19
20.00	1.21
50.00	1.22
100.00	1.26
200.00	1.31
500.00	1.34
750.00	1.42
1000.00	1.58
1460.00	1.60
1500.00	1.56

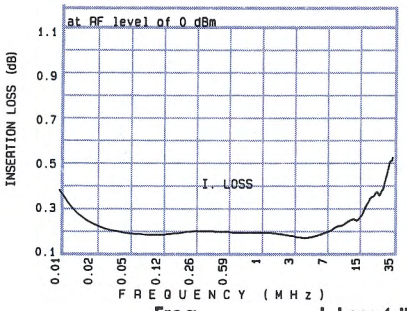
Coupling (dB) In-CPL	Directivity (dB)
10.76	57.69
10.75	63.30
10.80	49.75
10.82	43.92
10.93	37.99
11.03	31.49
11.13	29.86
11.28	28.13
11.34	24.78
11.30	24.58

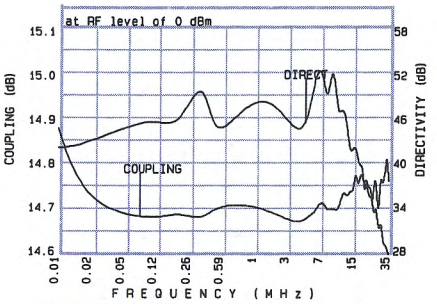
Return Loss (dB)

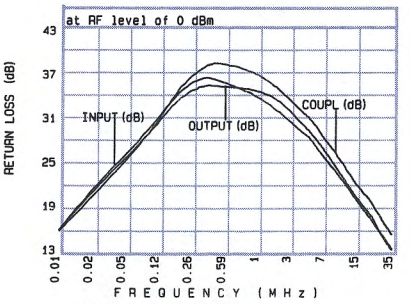
In	Out	CPL
18.12	30.01	30.38
18.18	30.68	30.84
18.21	29.84	30.10
18.17	27.52	27.95
17.77	23.54	24.25
15.86	17.46	19.07
14.99	15.27	18.14
15.12	14.41	19.41
18.36	15.24	27.48
18.83	15.42	27.35

PDC-15-6, ZFDC-15-6, ZMDC-15-6, ZDC-15-6

0.01 to 35 MHz







Freq. (MHz)	I. Loss (dB) In-Out
0.01	0.40
0.02	0.22
0.11	0.19
5.00	0.19
7.80	0.22
16.55	0.29
17.51	0.32
26.25	0.40
34.04	0.53
35.00	0.55

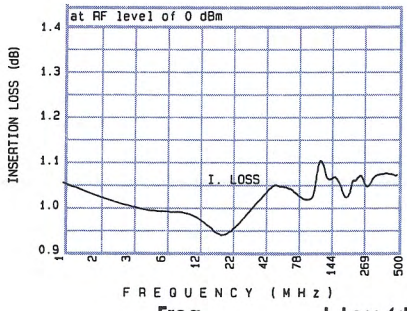
Coupling (dB) In-CPL	Directivity (dB)
14.89	42.70
14.71	43.09
14.68	47.43
14.69	47.31
14.70	47.82
14.75	40.87
14.79	40.28
14.73	33.38
14.80	28.46
14.77	28.18

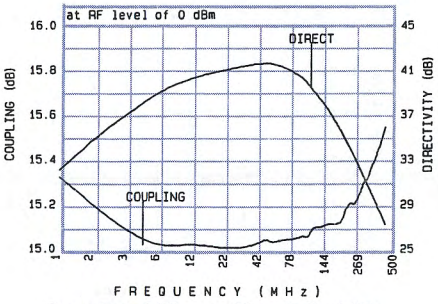
Return Loss (dB)

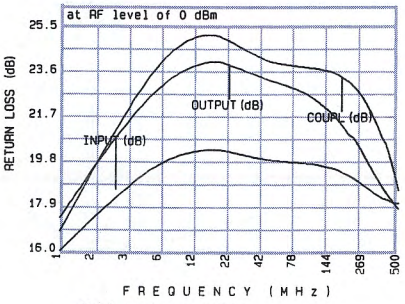
In	Out	CPL
16.22	16.21	16.11
21.21	20.87	20.13
30.96	30.40	30.27
28.81	29.56	31.39
25.23	26.10	27.86
19.67	19.99	21.95
19.17	19.66	21.42
16.05	16.18	18.31
13.80	13.98	15.90
13.68	13.81	15.76

PDC-15-21

1 to 500 MHz







Freq. (MHz)	I. Loss (dB) In-Out
1.00	1.06
2.00	1.02
5.00	0.99
10.00	1.00
20.00	0.94
50.00	1.05
100.00	1.04
200.00	1.07
250.50	1.05
500.00	1.10

Coupling (dB) In-CPL	Directivity (dB)
15.34	32.42
15.17	36.04
15.02	38.99
15.04	40.49
15.02	41.24
15.04	41.93
15.06	40.11
15.20	35.05
15.25	32.88
15.74	25.54

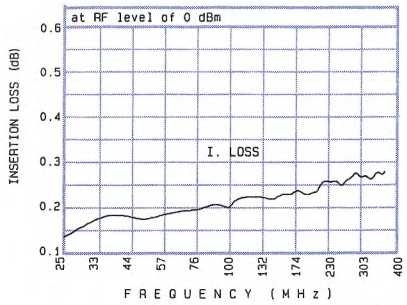
Return Loss (dB)

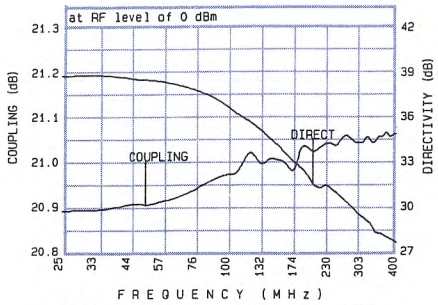
In	Out	CPL
16.05	17.46	16.90
17.98	20.35	20.48
19.71	22.88	23.85
20.29	23.93	25.18
20.35	24.08	25.14
19.93	23.29	24.09
19.78	22.64	23.85
19.30	21.06	23.28
18.98	20.43	22.73
18.12	17.89	18.66

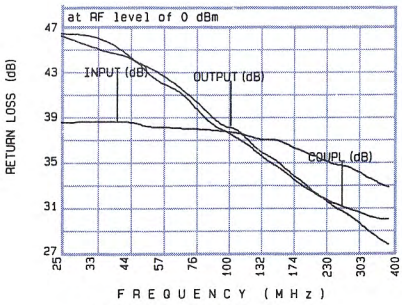
very broadband
Directional Couplers

PDC-20-1, ZMDC-20-1, ZDC-20-1

25 to 400 MHz



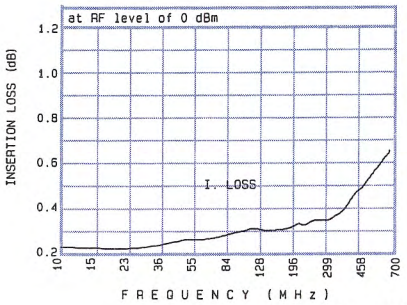


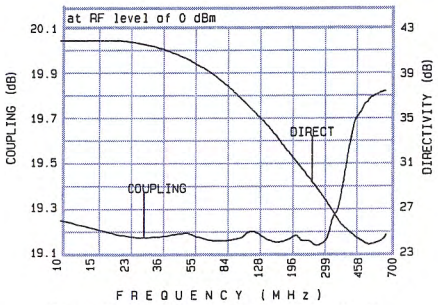


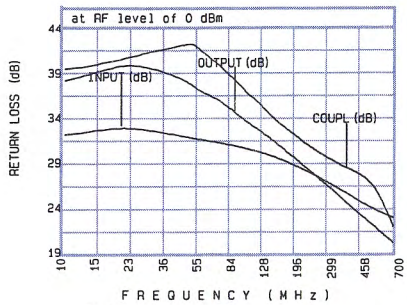
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
25.00	0.14	20.90	39.03	38.82	46.83	46.62
50.00	0.18	20.91	38.76	38.41	43.91	43.34
100.00	0.22	20.98	36.87	37.98	38.48	37.78
118.75	0.23	21.05	35.93	37.56	36.95	36.63
200.00	0.24	21.03	31.74	35.84	32.57	32.64
212.51	0.27	21.04	31.42	35.51	32.18	32.20
254.17	0.27	21.06	30.87	34.98	30.91	31.28
316.68	0.27	21.07	29.28	33.88	29.06	30.42
389.60	0.31	21.07	28.01	32.78	27.58	30.10
400.00	0.32	21.07	27.86	32.68	27.39	30.03

PDC-20-1W

10 to 700 MHz



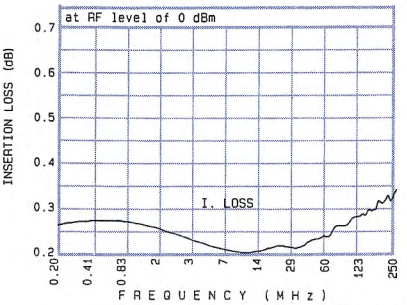


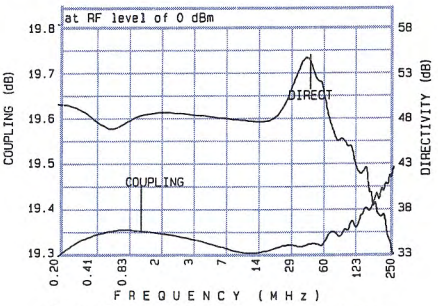


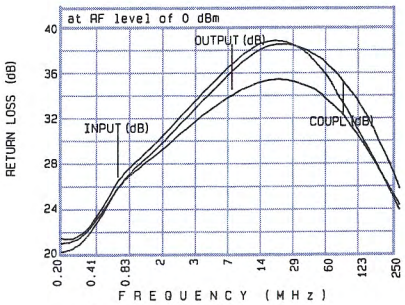
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
10.00	0.24	19.26	42.27	32.56	38.59	39.87
20.00	0.23	19.19	42.35	33.59	40.69	41.00
50.00	0.28	19.21	40.65	32.19	38.16	42.91
100.00	0.31	19.18	36.99	30.96	33.93	37.04
200.00	0.35	19.20	31.34	28.72	29.15	31.77
334.71	0.39	19.29	26.31	26.26	25.25	29.01
355.00	0.41	19.40	25.76	25.95	24.79	28.80
500.00	0.57	19.81	24.06	24.22	22.25	26.42
679.71	0.75	19.83	26.55	23.17	19.88	20.13
700.00	0.77	19.82	27.18	23.07	19.62	19.39

PDC-20-3, ZFDC-20-3, ZDC-20-3, ZMDC-20-3

0.2 to 250 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
0.20	0.27	19.30	50.00	21.66	21.23	20.44
0.30	0.28	19.34	49.89	21.42	21.34	20.83
0.92	0.28	19.36	49.51	28.84	28.04	28.38
49.93	0.24	19.33	51.88	36.50	34.32	37.55
101.43	0.29	19.39	45.73	31.41	30.95	34.11
125.15	0.30	19.40	42.05	29.83	29.57	32.57
162.29	0.30	19.42	38.02	27.88	27.75	30.24
216.29	0.33	19.46	35.65	25.38	25.70	27.77
243.13	0.34	19.49	33.18	24.43	24.88	26.47
250.00	0.35	19.50	33.42	24.21	24.67	26.09

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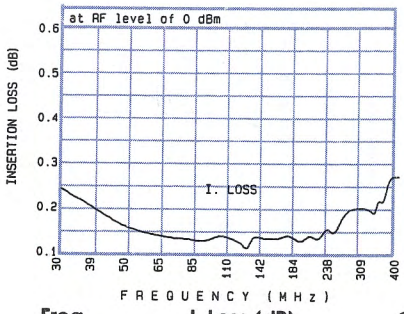
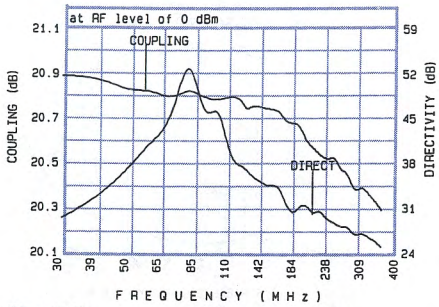
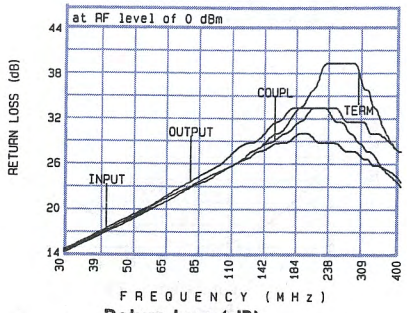
ZFDC-20-1H

30 to 400 MHz





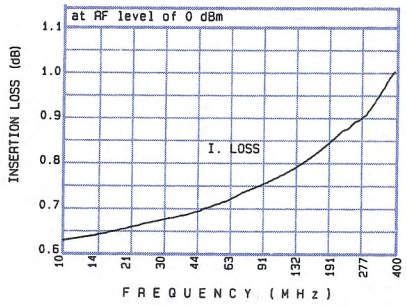


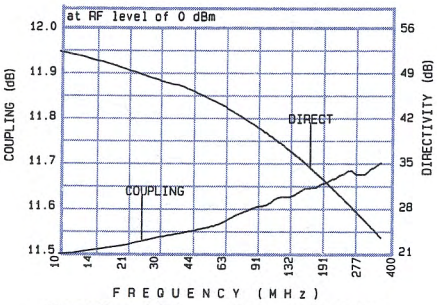
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Coupling (dB) Out-Term	Directivity (dB) Out-CPL	Directivity (dB) In-Term
30.00	0.25	20.91	21.06	29.98	30.09
50.00	0.16	20.84	20.94	37.79	38.11
60.00	0.15	20.85	20.91	42.22	42.34
100.00	0.15	20.80	20.89	49.13	40.37
160.00	0.14	20.76	20.77	35.50	33.21
200.00	0.15	20.61	20.67	32.23	30.16
280.00	0.21	20.44	20.54	28.30	27.87
300.00	0.19	20.40	20.47	27.58	26.41
391.00	0.28	20.21	20.32	24.19	24.06
400.00	0.28	20.15	20.25	24.06	24.50

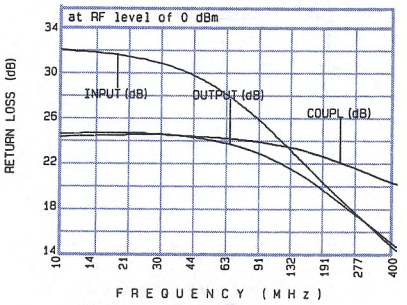
Return Loss (dB) In	Out	CPL	Term
15.04	15.04	14.88	14.72
19.40	19.73	19.40	19.08
21.23	21.23	20.83	20.83
25.66	26.44	25.66	25.66
29.42	32.26	30.71	30.71
30.71	34.15	34.15	36.61
28.30	30.71	32.26	40.09
27.32	29.42	32.26	36.61
24.94	24.29	28.30	28.30
24.29	23.69	28.30	28.30

TODC-10-1

10 to 400 MHz





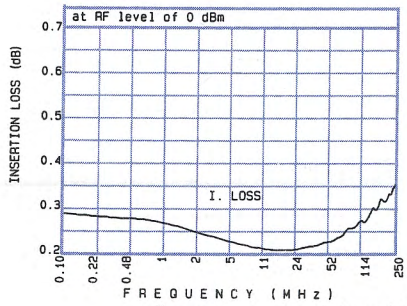


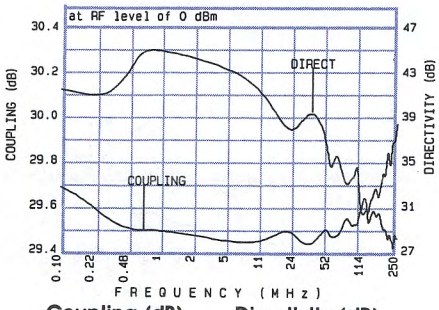
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)
10.00	0.63	11.50	52.78
20.00	0.66	11.52	50.12
50.00	0.71	11.56	45.69
100.00	0.77	11.61	39.88
130.00	0.80	11.63	37.04
200.00	0.87	11.67	31.63
230.00	0.89	11.68	29.69
320.00	0.99	11.71	24.82
390.00	1.03	11.70	21.73
400.00	1.04	11.70	21.32

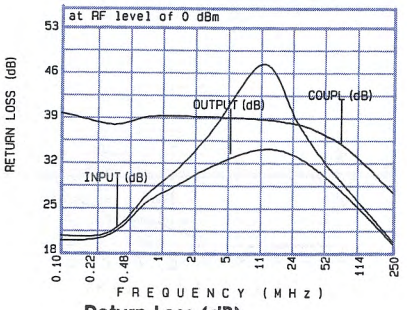
Return Loss (dB) In	Out	CPL
32.35	24.87	24.61
31.88	24.97	24.78
29.41	24.34	24.55
25.13	22.64	23.95
23.08	21.55	23.57
19.67	19.21	22.51
18.62	18.34	22.10
16.10	16.23	21.03
14.62	14.91	20.44
14.44	14.76	20.40

ZMDC-30-1

0.1 to 250 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)
0.10	0.29	29.70	41.70
0.30	0.28	29.53	40.54
0.92	0.27	29.51	45.28
49.93	0.23	29.53	37.06
101.43	0.27	29.52	35.82
125.15	0.31	29.62	31.94
162.29	0.32	29.64	30.86
216.29	0.36	29.78	28.15
243.13	0.39	29.94	28.36
250.00	0.40	29.98	28.40

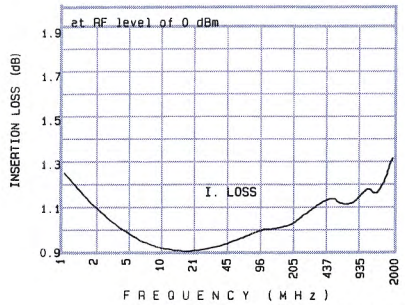
Return Loss (dB) In	Out	CPL
20.80	20.07	40.08
20.41	20.23	37.53
29.21	27.62	39.72
31.75	29.83	36.47
26.21	25.27	33.07
24.55	23.83	31.69
22.50	21.90	29.80
20.26	19.82	27.86
19.32	18.96	27.14
19.10	18.72	26.90

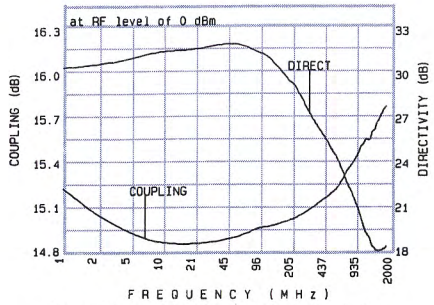
very broadband

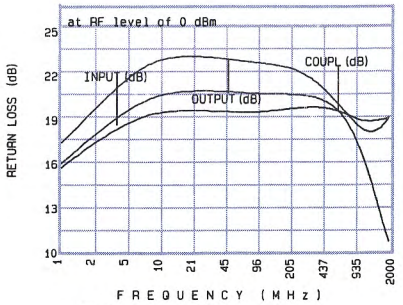
Directional Couplers

ZFDC-15-5

1 to 2000 MHz



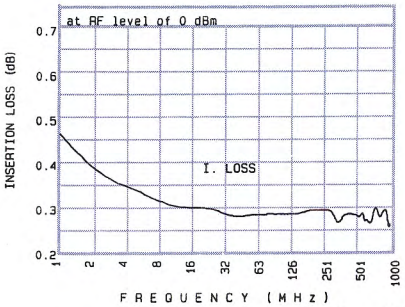


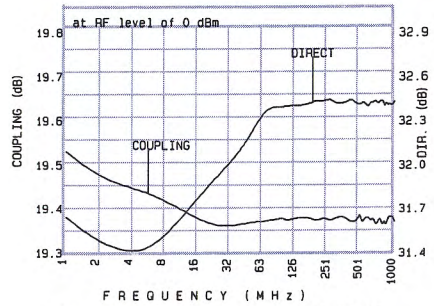


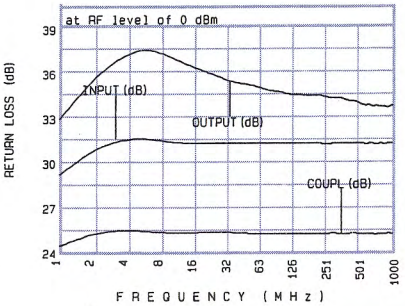
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
1.00	1.28	15.26	30.81	16.05	17.71	16.35
1.98	1.09	15.06	30.99	17.95	20.28	18.50
9.97	0.93	14.88	31.98	19.94	23.59	21.17
200.66	1.07	15.05	29.96	20.12	22.78	21.05
758.84	1.15	15.41	22.67	19.57	19.42	18.68
1009.10	1.21	15.56	20.52	19.28	18.65	16.68
1243.70	1.19	15.58	19.09	19.27	18.53	14.73
1592.20	1.28	15.74	18.30	19.35	19.01	12.18
1889.20	1.37	15.84	19.26	19.63	19.81	10.59
2000.00	1.38	15.88	20.19	19.72	20.25	10.14

ZFDC-20-4

1 to 1000 MHz



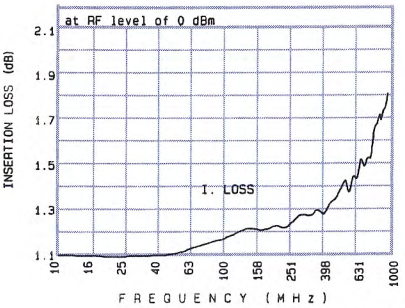


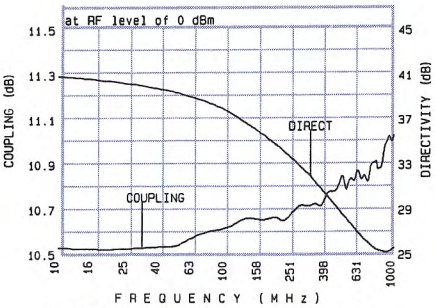


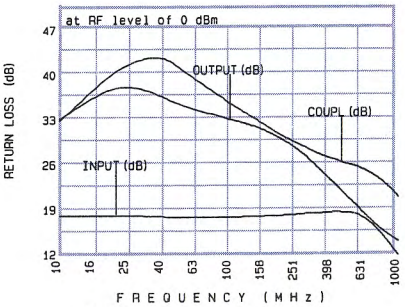
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
1.00	0.48	19.54	31.67	29.54	33.27	24.80
2.00	0.38	19.47	31.46	31.70	36.63	25.89
5.00	0.35	19.45	31.41	32.14	38.42	25.82
10.00	0.31	19.41	31.65	31.62	37.18	25.62
20.00	0.32	19.37	31.91	31.73	36.40	25.77
50.00	0.30	19.38	32.26	31.69	35.62	25.63
100.00	0.30	19.38	32.43	31.67	34.96	25.64
500.00	0.28	19.38	32.44	31.65	34.28	25.66
966.81	0.29	19.39	32.44	31.70	34.17	25.69
1000.00	0.31	19.38	32.46	31.69	34.12	25.63

ZFDC-10-2

10 to 1000 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
10.00	1.12	10.55	41.31	18.67	33.83	33.53
20.00	1.11	10.54	40.86	18.79	40.11	42.53
50.00	1.12	10.55	39.90	18.39	35.97	41.56
100.00	1.19	10.63	38.28	18.40	33.63	36.05
200.00	1.25	10.69	35.14	18.70	30.74	31.33
370.00	1.28	10.72	31.24	19.21	25.13	27.97
500.00	1.46	10.87	28.92	19.13	21.59	26.74
700.00	1.52	10.81	26.56	17.47	17.93	25.28
970.00	1.92	11.01	25.88	13.05	15.04	22.16
1000.00	1.96	11.05	26.03	12.53	14.74	21.65

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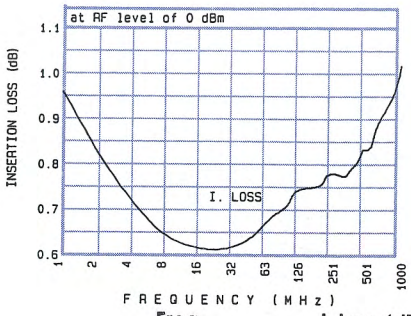
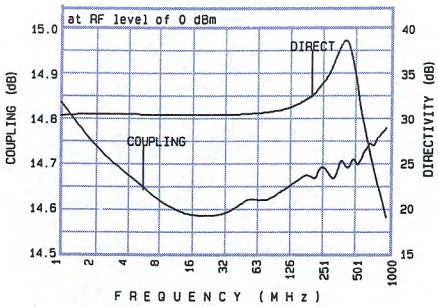
Mini-Circuits

ZEDC-15-2B

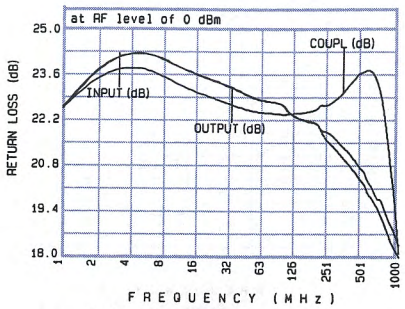
1 to 1000 MHz



Freq. (MHz)	I. Loss (dB) In-Out
1.00	0.97
2.00	0.81
5.00	0.68
10.00	0.63
20.00	0.62
50.00	0.66
100.00	0.75
200.00	0.79
500.00	0.85
1000.00	1.04



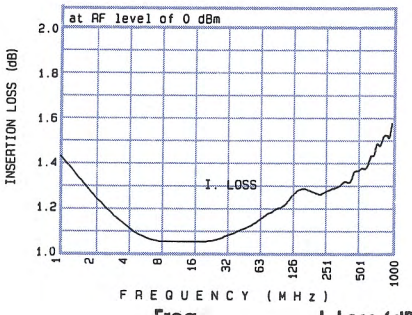
Coupling (dB) In-CPL	Directivity (dB)
14.85	30.94
14.73	31.19
14.66	31.01
14.60	30.97
14.59	30.99
14.64	31.10
14.65	31.59
14.69	33.80
14.72	30.81
14.79	15.83



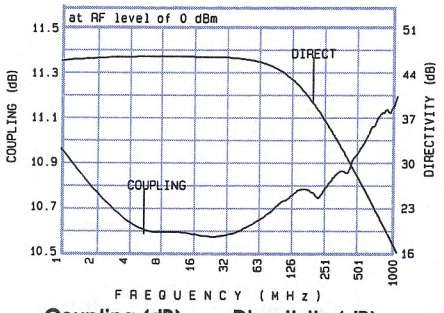
Return Loss (dB) In	Out	CPL
22.72	22.68	22.69
24.23	24.19	23.90
24.54	24.55	24.02
23.94	23.94	23.38
23.58	23.56	23.01
22.98	22.97	22.58
22.58	22.60	22.52
22.04	22.01	22.84
20.30	20.65	23.89
18.09	18.46	18.21

ZEDC-10-2B

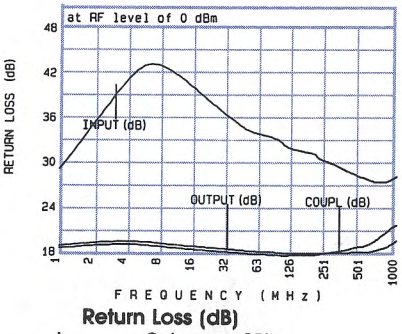
1 to 1000 MHz



Freq. (MHz)	I. Loss (dB) In-Out
1.00	1.45
2.00	1.23
5.00	1.06
10.00	1.07
20.00	1.06
50.00	1.14
100.00	1.23
200.00	1.28
500.00	1.39
1000.00	1.67



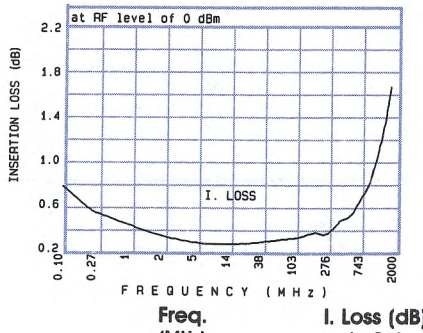
Coupling (dB) In-CPL	Directivity (dB)
10.98	46.64
10.75	47.13
10.59	47.31
10.62	47.30
10.58	47.22
10.64	46.80
10.76	44.74
10.76	38.91
11.00	26.99
11.22	16.77



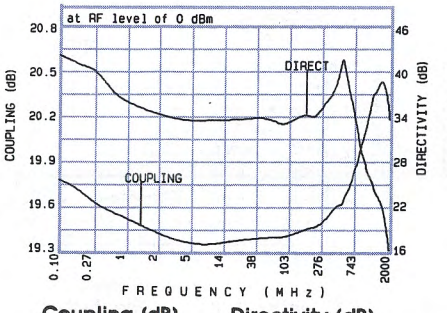
Return Loss (dB) In	Out	CPL
29.59	19.38	19.07
36.69	19.94	19.55
45.10	20.07	19.64
42.74	19.52	19.10
38.88	19.22	18.79
34.53	18.71	18.37
33.47	18.53	18.20
31.74	18.49	18.32
28.71	18.63	19.35
28.81	20.20	22.33

PDC-20A-5

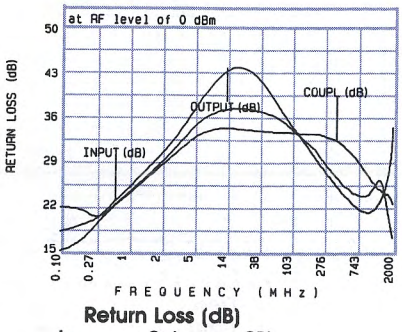
0.1 to 2000 MHz



Freq. (MHz)	I. Loss (dB) In-Out
0.10	0.80
0.20	0.60
0.50	0.49
1.00	0.41
2.00	0.34
5.00	0.29
10.00	0.28
20.00	0.29
1000.00	0.95
2000.00	2.12



Coupling (dB) In-CPL	Directivity (dB)
19.80	42.90
19.71	41.29
19.57	37.18
19.50	35.94
19.42	34.63
19.36	33.94
19.36	34.20
19.39	34.18
20.15	28.28
20.22	16.58



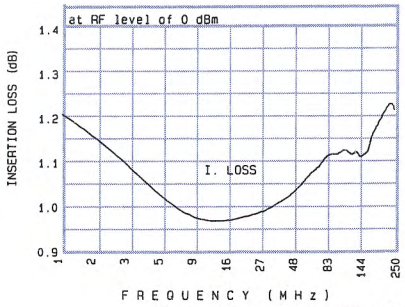
Return Loss (dB) In	Out	CPL
22.32	18.40	15.30
22.12	19.73	17.14
23.02	23.62	22.88
26.29	27.31	26.01
29.91	31.22	29.52
35.77	38.05	33.98
38.00	43.40	35.28
38.45	46.13	34.97
24.62	21.67	27.44
17.72	35.28	23.10

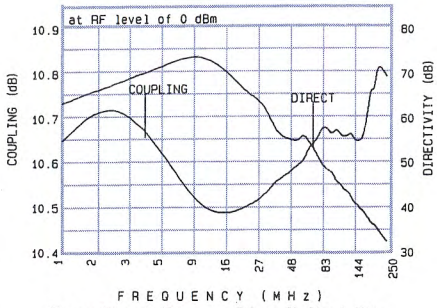
very broadband

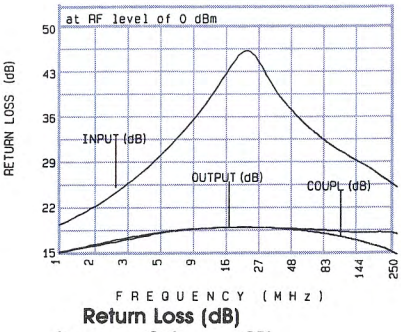
Directional Couplers

PDC-10-1-75, ZDC-10-1-75

1 to 250 MHz



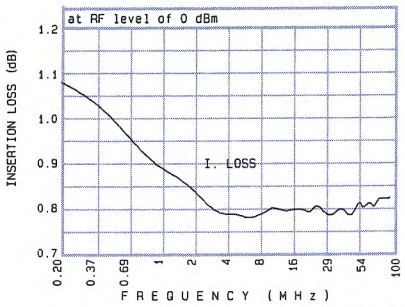


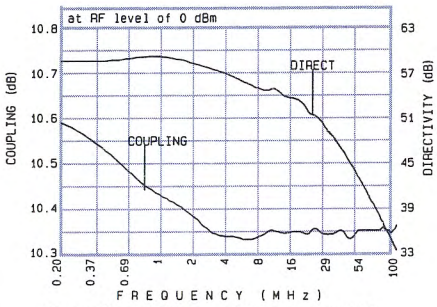


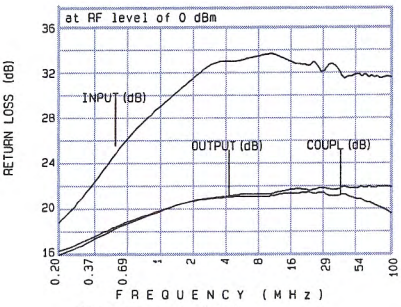
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
1.00	1.22	10.66	64.46	19.98	15.74	15.69
2.00	1.14	10.77	68.62	23.91	17.52	17.17
5.00	1.02	10.63	72.79	31.09	19.14	18.96
10.00	0.97	10.48	76.67	38.21	19.58	19.60
20.00	0.99	10.51	66.34	49.72	19.67	19.75
50.00	1.06	10.61	55.63	36.71	19.46	19.26
100.00	1.14	10.67	46.20	31.50	19.08	18.28
125.00	1.14	10.66	41.93	30.23	18.94	17.79
200.00	1.26	10.80	34.67	27.42	18.97	16.52
250.00	1.18	10.76	30.79	25.90	18.73	15.50

PDC-10-6-75

0.2 to 100 MHz



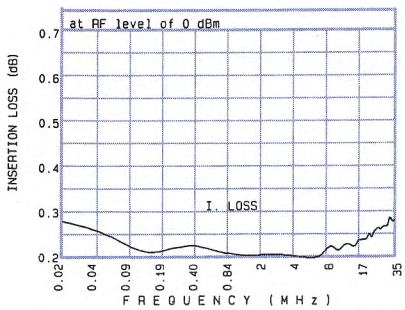


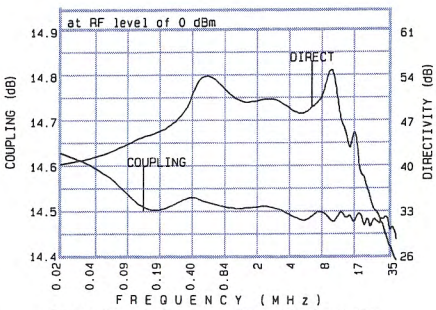


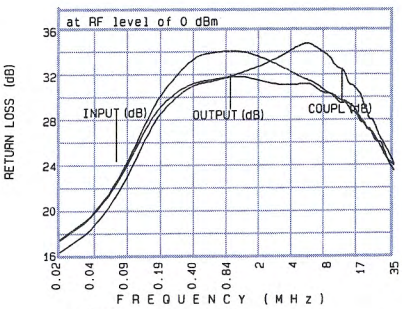
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
0.20	1.09	10.60	59.21	19.03	16.12	16.44
0.50	1.01	10.52	59.15	25.12	18.50	18.70
1.99	0.87	10.41	59.22	31.41	20.99	20.95
12.67	0.80	10.35	54.18	33.63	21.86	21.66
31.19	0.80	10.35	49.12	33.22	21.99	21.39
49.70	0.82	10.36	43.60	32.31	22.15	21.08
52.89	0.81	10.36	42.89	31.97	22.22	21.12
75.60	0.83	10.36	37.98	31.95	22.27	20.40
96.94	0.84	10.36	34.35	32.13	22.09	19.55
100.00	0.85	10.37	33.88	32.26	22.13	19.41

PDC-15-6-75, ZFDC-15-6-75, ZDC-15-6-75

0.02 to 35 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
0.02	0.29	14.64	41.06	17.84	17.76	16.69
0.11	0.21	14.51	45.49	27.28	27.01	26.01
0.19	0.23	14.51	46.04	31.77	30.62	30.08
5.00	0.21	14.49	49.49	32.03	31.88	35.38
8.76	0.22	14.48	56.79	30.52	30.72	33.26
17.51	0.27	14.47	39.43	27.49	27.88	29.50
18.47	0.25	14.50	37.32	27.92	27.54	28.43
27.22	0.30	14.50	30.61	25.08	25.19	25.91
34.04	0.32	14.47	26.41	24.15	23.56	23.91
35.00	0.32	14.45	26.24	23.72	23.38	23.52

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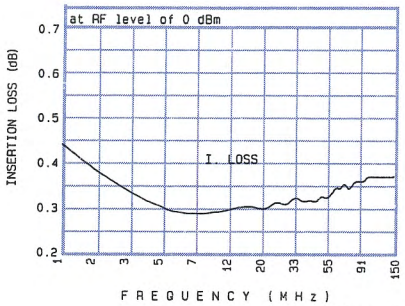
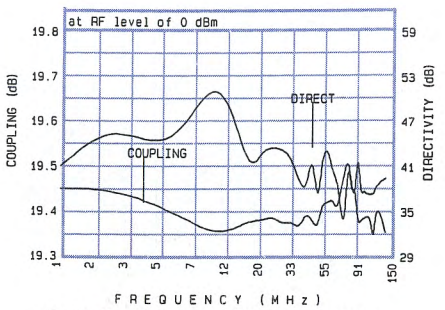
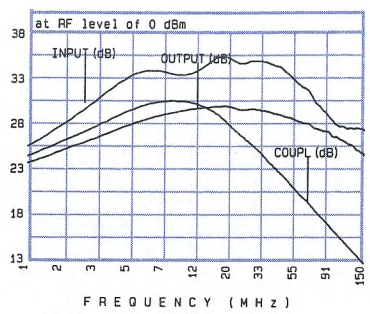
Mini-Circuits

PDC-20-3-75, ZDC-20-3-75

1 to 150 MHz







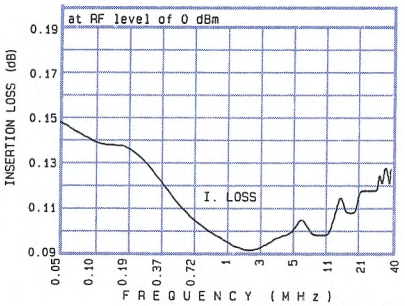
Freq. (MHz)	I. Loss (dB) In-Out
1.00	0.45
1.93	0.36
9.94	0.30
20.00	0.30
46.82	0.34
73.64	0.36
85.00	0.37
119.45	0.38
146.09	0.39
150.00	0.39

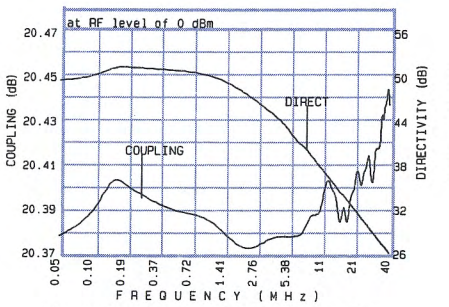
Coupling (dB) In-CPL	Directivity (dB)
19.46	41.58
19.46	47.84
19.35	56.88
19.39	43.82
19.37	35.25
19.53	43.57
19.56	33.76
19.51	31.82
19.52	30.86
19.54	29.43

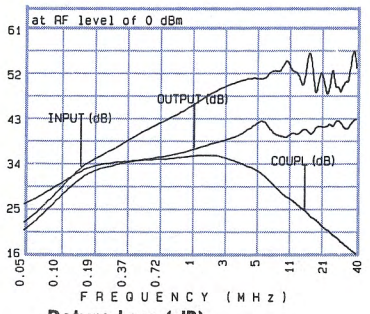
Return Loss (dB) In	Out	CPL
25.97	24.04	24.88
29.62	26.37	27.44
32.94	30.18	31.33
35.94	30.58	28.32
34.29	29.28	22.54
30.78	28.04	18.80
29.93	27.73	17.77
28.10	26.21	14.96
28.08	25.47	13.35
27.90	25.09	13.11

PDC-20-6-75

0.05 to 40 MHz







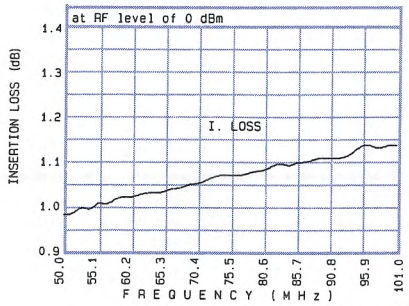
Freq. (MHz)	I. Loss (dB) In-Out
0.05	0.15
0.10	0.14
0.20	0.14
0.50	0.11
1.00	0.10
12.64	0.12
19.87	0.12
26.43	0.12
38.77	0.13
40.00	0.12

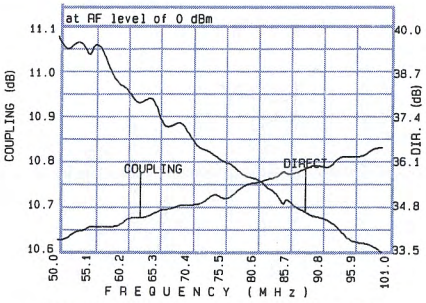
Coupling (dB) In-CPL	Directivity (dB)
20.38	50.11
20.39	50.77
20.40	51.93
20.39	51.56
20.39	51.07
20.40	36.48
20.40	32.72
20.42	30.27
20.45	27.05
20.44	26.75

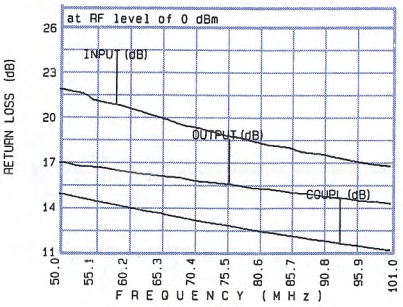
Return Loss (dB) In	Out	CPL
23.07	21.50	26.75
30.25	28.78	31.25
36.45	34.32	35.14
42.08	36.01	35.76
45.08	36.92	36.15
48.65	42.37	25.92
49.54	42.49	21.88
49.04	43.45	19.45
51.37	43.29	16.37
49.82	44.94	16.03

ZDC-2375

50 to 100 MHz







Freq. (MHz)	I. Loss (dB) In-Out
50.00	0.99
55.38	1.02
62.13	1.04
68.88	1.06
75.63	1.08
82.38	1.11
87.88	1.12
94.63	1.15
98.63	1.15
100.00	1.15

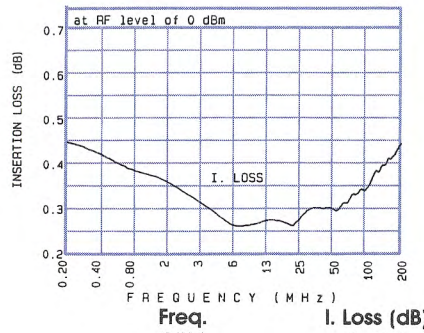
Coupling (dB) In-CPL	Directivity (dB)
10.63	39.89
10.66	39.71
10.68	37.84
10.71	37.45
10.72	36.18
10.77	35.42
10.79	34.78
10.82	33.96
10.84	33.75
10.84	33.55

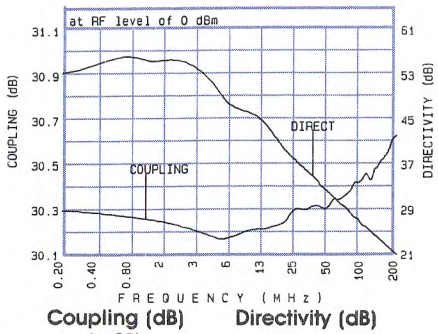
Return Loss (dB) In	Out	CPL
22.24	17.31	15.20
21.48	16.98	14.72
20.75	16.54	14.13
19.77	16.24	13.57
19.10	15.90	13.09
18.49	15.53	12.62
17.99	15.24	12.21
17.46	14.84	11.81
17.20	14.72	11.55
17.13	14.62	11.48

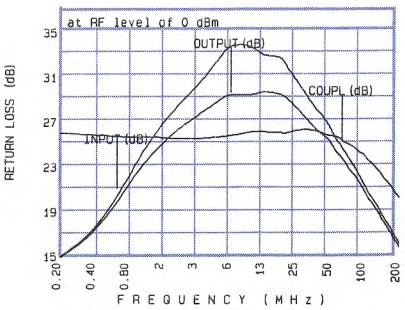
very broadband

Directional Couplers

ZFDC-3375 — 75 ohms — 0.2 to 200 MHz

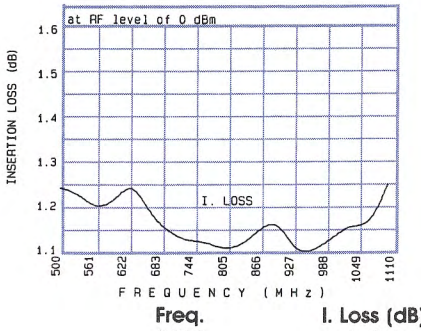


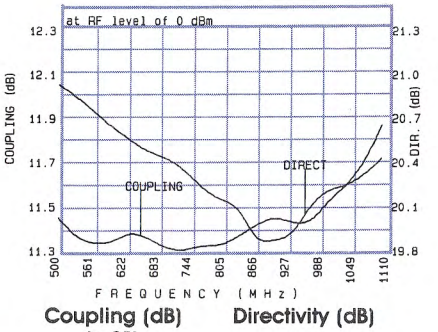


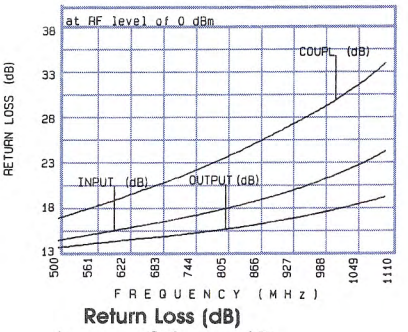


Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
0.20	0.46	30.32	54.26	15.40	15.32	26.38
0.70	0.39	30.29	58.24	21.96	21.46	26.02
2.20	0.34	30.25	57.71	29.51	27.30	25.81
20.18	0.27	30.26	40.30	32.35	29.59	26.40
60.64	0.32	30.36	31.26	25.43	24.39	25.99
97.10	0.37	30.45	27.21	21.96	21.46	24.64
109.09	0.40	30.49	26.73	21.07	20.54	23.95
151.55	0.43	30.56	24.19	18.69	18.36	22.27
194.01	0.47	30.67	22.14	16.90	16.57	20.93
200.00	0.47	30.65	21.85	16.65	16.31	20.69

SCDC-11-2 — 50 ohms — 500 to 1100 MHz

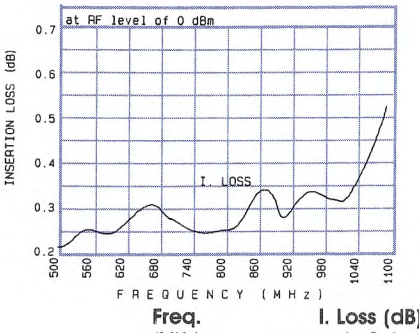


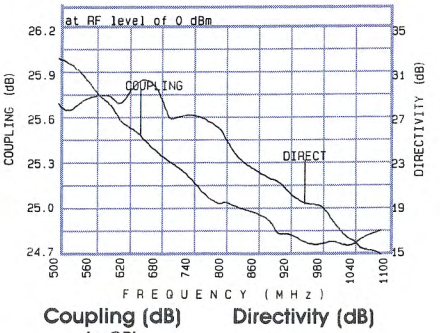


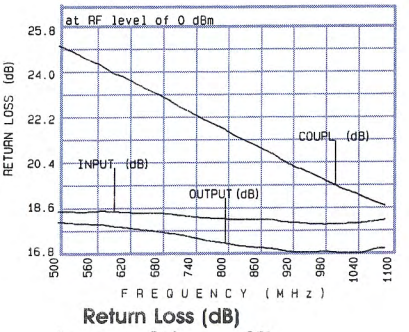


Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
500.000	1.25	11.47	20.96	14.72	13.88	17.20
532.250	1.24	11.38	20.88	15.08	14.12	17.87
633.000	1.27	11.41	20.58	16.22	14.85	19.99
733.750	1.13	11.32	20.38	17.40	15.48	22.25
834.500	1.12	11.39	20.14	18.82	16.30	24.98
932.000	1.10	11.45	19.92	20.52	17.31	28.03
1000.250	1.14	11.55	20.25	22.04	18.19	30.29
1032.750	1.17	11.61	20.27	22.82	18.69	31.74
1065.250	1.16	11.71	20.34	23.74	19.18	33.03
1100.000	1.26	11.89	20.46	24.94	19.77	34.94

SCDC-25-2 — 50 ohms — 500 to 1090 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
500.000	0.22	26.04	28.84	18.57	18.16	25.35
547.500	0.27	25.93	29.36	18.54	18.07	24.81
610.500	0.26	25.60	28.13	18.58	17.97	24.16
702.750	0.29	25.34	27.27	18.47	17.70	23.02
799.500	0.26	25.08	26.19	18.29	17.31	21.93
900.750	0.27	24.83	21.97	18.18	17.03	20.73
999.750	0.33	24.81	18.24	18.09	16.93	19.68
1013.250	0.32	24.79	17.52	18.07	16.88	19.50
1076.250	0.48	24.86	15.59	18.21	17.11	18.93
1090.000	0.54	24.88	15.20	18.27	17.10	18.84

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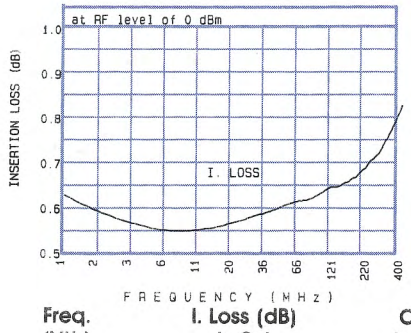
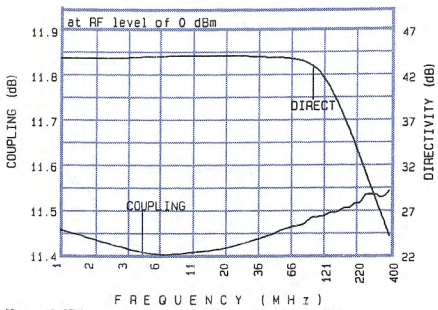
Mini-Circuits

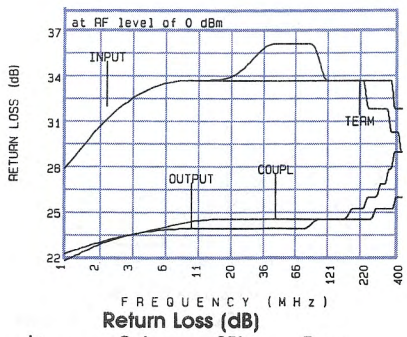
PDC-10-1BD

50 ohms

1 to 400 MHz







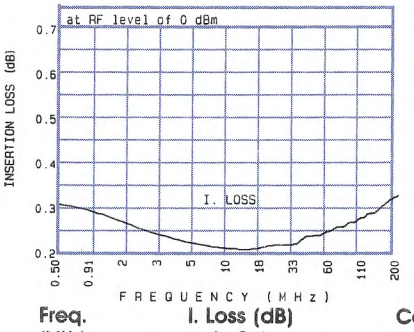
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Coupling (dB) Out-Term	Directivity (dB) Out-CPL	Directivity (dB) In-Term
1.00	0.64	11.47	11.48	44.64	42.04
2.00	0.59	11.44	11.43	44.54	43.04
5.00	0.56	11.41	11.41	44.84	43.05
10.00	0.56	11.42	11.42	44.89	42.69
20.00	0.58	11.43	11.43	44.89	40.54
50.00	0.62	11.47	11.47	44.74	34.72
100.00	0.65	11.50	11.50	43.24	29.06
200.00	0.70	11.53	11.56	34.09	23.05
389.00	0.83	11.56	11.72	22.88	17.08
400.00	0.84	11.56	11.74	22.42	16.81

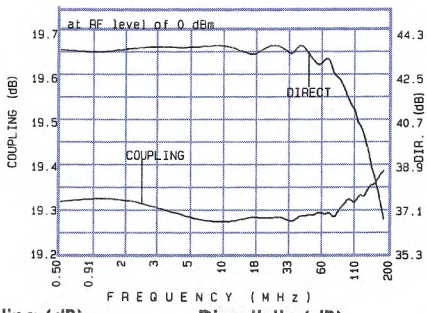
Return Loss (dB) In	Out	CPL	Term
28.30	22.12	22.61	28.30
32.26	23.69	23.69	32.26
34.15	24.29	24.29	34.15
34.15	24.29	24.94	34.15
34.15	24.29	24.94	34.15
36.61	24.29	24.94	34.15
34.15	24.94	24.94	34.15
34.15	25.66	24.94	34.15
29.42	29.42	26.44	32.26
29.42	29.42	26.44	32.26

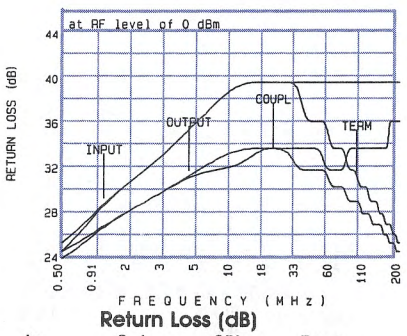
PDC-20-1BD

50 ohms

0.5 to 200 MHz







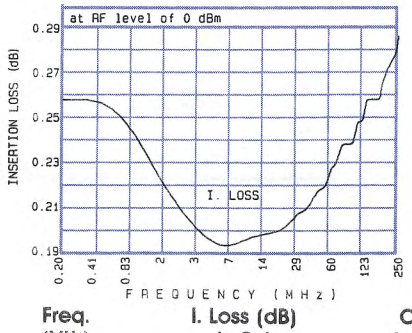
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Coupling (dB) Out-Term	Directivity (dB) Out-CPL	Directivity (dB) In-Term
0.50	0.32	19.33	19.36	43.86	41.25
1.00	0.30	19.34	19.34	43.68	43.14
2.00	0.26	19.33	19.32	44.04	43.67
5.00	0.23	19.29	19.28	43.89	43.43
10.00	0.22	19.28	19.28	44.16	43.69
20.00	0.23	19.29	19.28	44.05	42.57
50.00	0.25	19.30	19.30	43.36	40.26
100.00	0.29	19.33	19.35	41.46	34.99
194.50	0.34	19.42	19.55	35.52	29.13
200.00	0.34	19.44	19.57	35.35	29.00

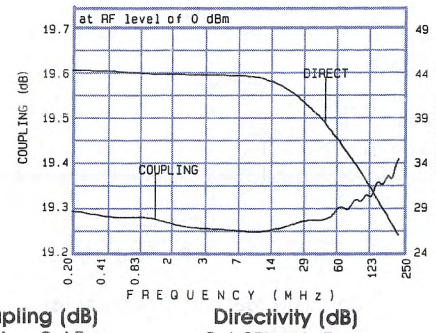
Return Loss (dB) In	Out	CPL	Term
24.94	24.29	24.94	25.66
29.42	27.32	27.32	29.42
32.26	29.42	29.42	32.26
36.61	32.26	32.26	36.61
40.09	32.26	34.15	40.09
40.09	34.15	34.15	40.09
40.09	34.15	32.26	36.61
40.09	34.15	29.42	30.71
40.09	36.61	24.94	25.66
40.09	36.61	24.94	25.66

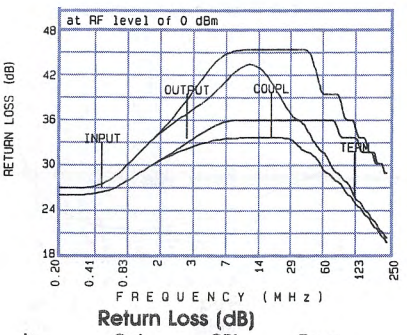
PDC-20-3BD

50 ohms

0.2 to 250 MHz







Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Coupling (dB) Out-Term	Directivity (dB) Out-CPL	Directivity (dB) In-Term
0.20	0.26	19.30	19.32	44.80	51.00
0.50	0.26	19.28	19.30	44.72	49.34
1.00	0.24	19.29	19.29	44.37	46.60
2.00	0.21	19.26	19.25	44.36	46.58
5.00	0.19	19.26	19.24	44.25	46.04
10.00	0.20	19.25	19.24	44.19	44.88
20.00	0.20	19.27	19.26	42.56	42.41
50.00	0.22	19.29	19.28	37.55	37.31
122.00	0.26	19.36	19.36	30.62	30.53
250.00	0.29	19.47	19.61	24.07	24.01

Return Loss (dB) In	Out	CPL	Term
27.32	26.44	26.44	27.32
27.32	26.44	26.44	27.32
32.26	29.42	29.42	32.26
36.61	32.26	32.26	36.61
46.06	36.61	34.15	40.09
46.06	36.61	34.15	46.06
46.06	36.61	34.15	40.09
40.09	36.61	30.71	32.26
34.15	32.26	24.29	24.94
27.32	27.32	18.49	18.78

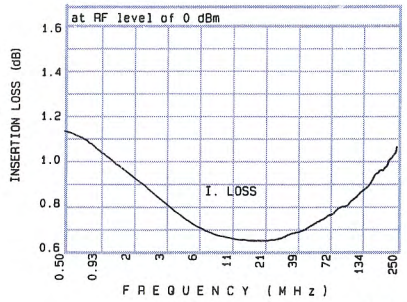
very broadband

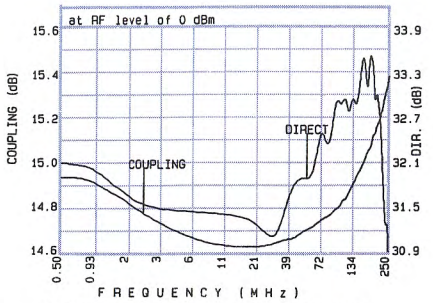
Directional Couplers

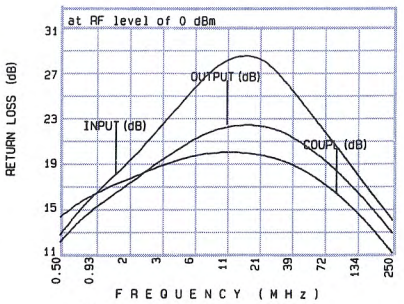
50 ohms

ZDC-15-2

0.5 to 250 MHz







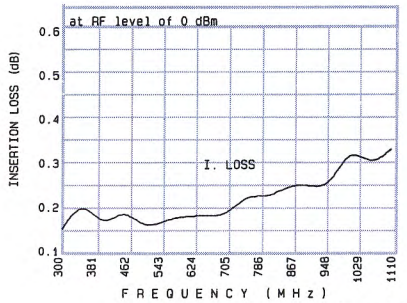
Freq. (MHz)	I. Loss (dB) In-Out
0.50	1.15
1.00	1.05
2.00	0.93
5.00	0.73
10.00	0.66
20.00	0.65
50.00	0.72
100.00	0.81
125.00	0.87
250.00	1.08

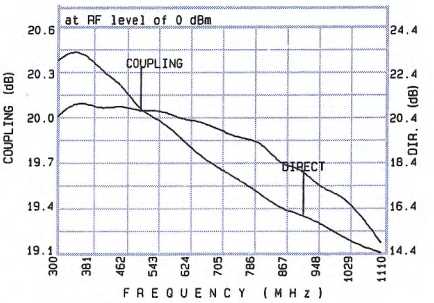
Coupling (dB) In-CPL	Directivity (dB)
14.95	32.15
14.92	32.05
14.81	31.55
14.68	31.49
14.64	31.46
14.63	31.41
14.71	31.96
14.82	32.92
14.91	33.09
15.41	30.95

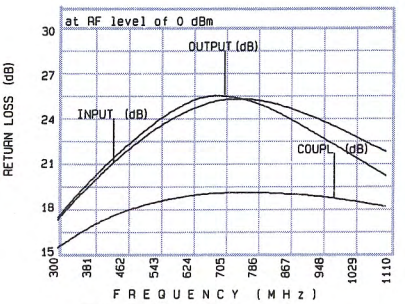
Return Loss (dB) In	Out	CPL
12.86	12.22	14.49
16.79	15.50	16.72
19.94	17.88	18.21
25.12	21.17	19.99
28.97	22.79	20.50
29.44	22.96	20.33
24.47	21.02	18.68
20.17	18.17	16.20
18.71	17.07	15.17
14.30	13.12	11.31

LRDC-20-2

300 to 1100 MHz







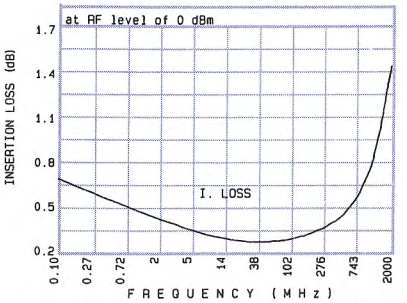
Freq. (MHz)	I. Loss (dB) In-Out
300.000	0.16
448.750	0.21
550.250	0.18
601.000	0.19
698.875	0.19
749.625	0.24
851.125	0.26
999.750	0.35
1050.500	0.30
1100.000	0.34

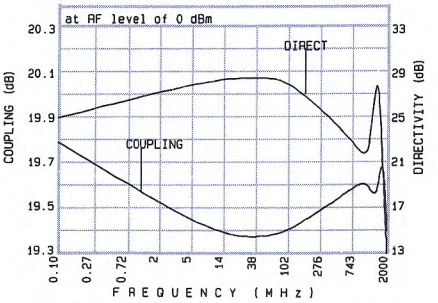
Coupling (dB) In-CPL	Directivity (dB)
20.04	23.22
20.12	22.19
20.09	20.53
20.02	19.71
19.95	18.31
19.89	17.77
19.70	16.47
19.51	15.24
19.37	14.79
19.18	14.49

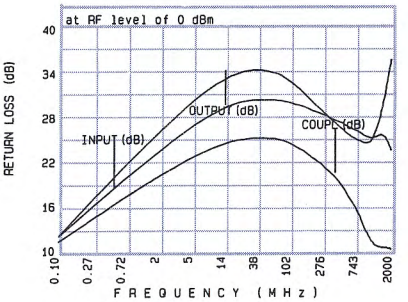
Return Loss (dB) In	Out	CPL
17.43	17.56	15.52
21.71	22.04	17.87
23.93	24.41	18.73
24.72	25.28	19.01
25.69	25.96	19.30
25.71	25.73	19.31
25.24	24.60	19.24
23.57	22.19	18.85
22.79	21.31	18.61
22.13	20.48	18.37

ZFDC-20-5

0.1 to 2000 MHz







Freq. (MHz)	I. Loss (dB) In-Out
0.10	0.72
10.00	0.29
50.00	0.29
100.00	0.30
500.00	0.42
1000.00	0.73
1200.00	0.87
1500.00	1.10
1750.00	1.32
2000.00	1.48

Coupling (dB) In-CPL	Directivity (dB)
19.81	25.36
19.38	28.99
19.38	29.03
19.40	28.78
19.56	24.55
19.64	21.67
19.59	22.52
19.55	31.53
19.80	21.12
19.41	13.08

Return Loss (dB) In	Out	CPL
12.50	12.52	11.77
30.81	34.92	25.86
31.14	35.30	25.90
30.96	34.11	25.64
27.86	26.44	20.15
25.90	24.74	12.73
25.76	25.81	11.26
26.52	29.13	11.01
25.75	33.02	10.96
24.25	36.48	10.81

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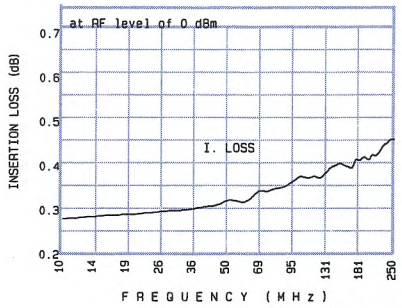
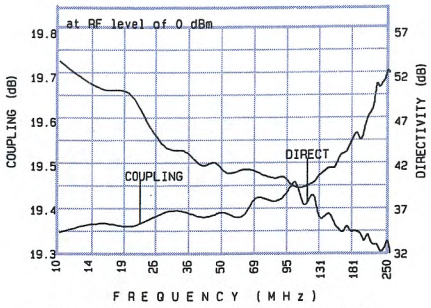
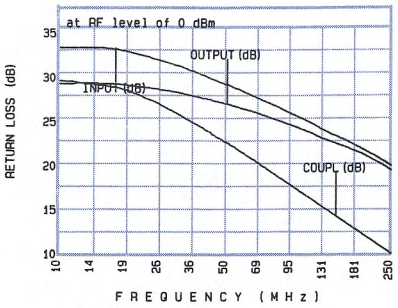
Mini-Circuits

ZFDC-20-3-75

10 to 250 MHz







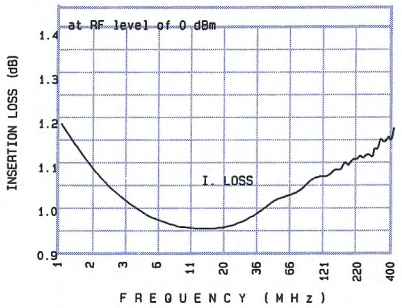
Freq. (MHz)	I. Loss (dB) In-Out
10.00	0.29
20.00	0.30
50.00	0.34
90.00	0.37
100.00	0.39
125.00	0.39
170.00	0.43
200.00	0.44
244.00	0.47
250.00	0.47

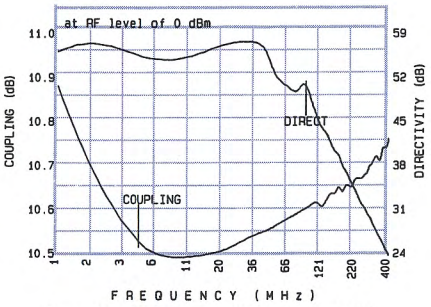
Coupling (dB) In-CPL	Directivity (dB)
19.36	54.40
19.36	52.31
19.41	41.16
19.44	41.57
19.46	41.41
19.49	35.96
19.56	34.87
19.62	35.28
19.73	34.47
19.72	32.56

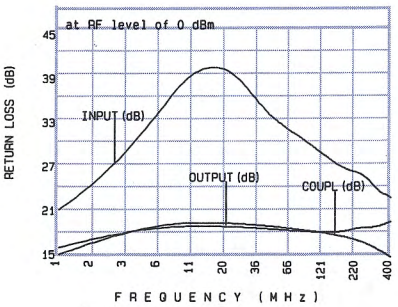
Return Loss (dB) In	Out	CPL
33.81	29.81	30.17
33.26	29.61	28.99
29.77	27.51	23.16
26.71	25.32	18.69
26.15	24.89	17.85
24.78	23.76	16.01
23.12	22.40	13.64
22.09	21.57	12.33
20.73	20.21	10.76
20.58	20.04	10.55

ZFDC-10-1-75

1 to 400 MHz







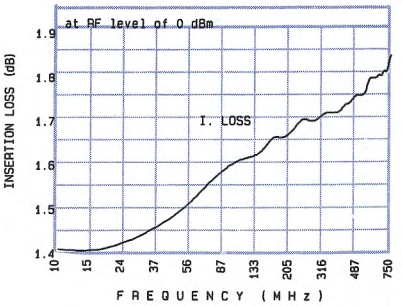
Freq. (MHz)	I. Loss (dB) In-Out
1.00	1.21
2.00	1.08
5.00	0.99
10.00	0.97
20.00	0.97
50.00	1.04
100.00	1.09
200.00	1.13
389.00	1.18
400.00	1.20

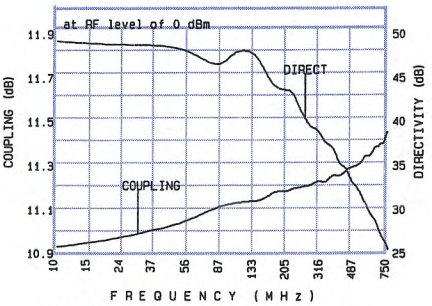
Coupling (dB) In-CPL	Directivity (dB)
10.89	56.79
10.67	58.96
10.50	55.42
10.50	55.25
10.51	58.11
10.57	52.66
10.62	48.80
10.66	36.21
10.75	24.90
10.77	24.30

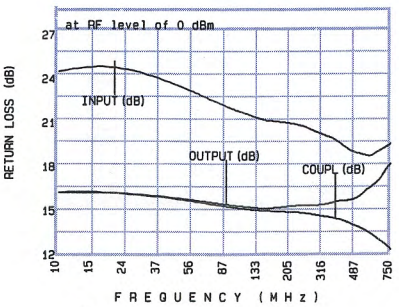
Return Loss (dB) In	Out	CPL
21.67	16.53	15.54
25.46	17.86	17.44
32.76	19.19	19.44
40.71	19.52	20.00
41.89	19.47	19.95
33.97	19.07	19.42
30.31	18.69	18.77
26.98	19.00	17.73
23.51	19.97	15.38
23.32	20.01	15.22

ZFDC-10-21-75

10 to 750 MHz







Freq. (MHz)	I. Loss (dB) In-Out
10.00	1.42
20.00	1.41
50.00	1.50
100.00	1.62
200.00	1.68
375.00	1.73
408.00	1.75
500.00	1.77
732.00	1.86
750.00	1.86

Coupling (dB) In-CPL	Directivity (dB)
10.95	49.73
10.98	49.26
11.05	49.31
11.15	48.54
11.20	44.12
11.28	37.21
11.28	35.48
11.32	33.01
11.47	26.42
11.47	25.92

Return Loss (dB) In	Out	CPL
24.79	16.51	16.55
25.50	16.61	16.60
23.76	16.14	16.07
22.17	15.66	15.52
21.33	15.64	15.24
20.10	15.96	14.77
19.75	16.01	14.64
19.25	16.34	14.19
19.79	18.41	12.79
19.96	18.56	12.65

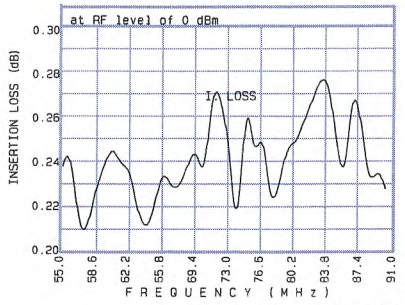
very broadband

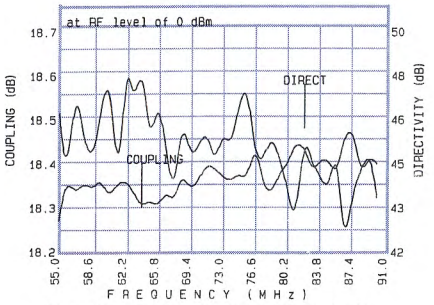
Directional Couplers

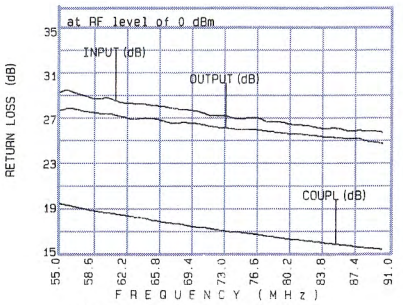
ZDC-20-3-75-1

75 ohms

55 to 90 MHz







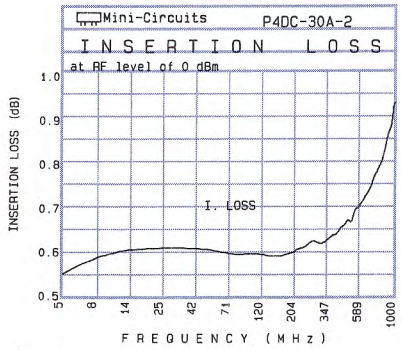
Freq. (MHz)	I. Loss (dB) In-Out	Coupling (dB) In-CPL	Directivity (dB)	Return Loss (dB) In	Out	CPL
55.00	0.24	18.28	46.80	29.85	28.20	19.78
59.40	0.24	18.38	46.83	29.29	27.90	19.03
64.00	0.21	18.31	48.79	28.85	27.60	18.52
68.40	0.24	18.39	46.77	28.36	27.17	17.93
73.00	0.25	18.38	46.18	27.89	26.71	17.37
77.40	0.22	18.36	45.09	27.16	26.40	16.87
82.00	0.27	18.45	46.22	26.91	26.01	16.40
86.40	0.28	18.48	41.62	26.34	25.72	16.02
89.20	0.24	18.43	45.53	26.41	25.42	15.75
90.00	0.23	18.41	43.75	26.29	25.27	15.66

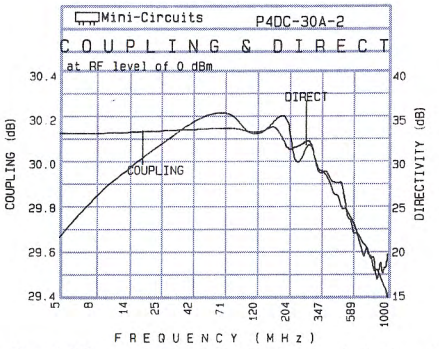
4-COUPLED PORT

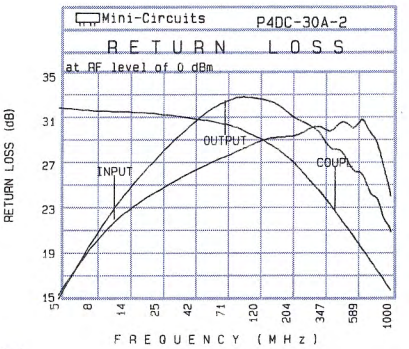
P4DC-30A-2

50 ohms

5 to 1000 MHz







Freq. (MHz)	I. Loss (dB) In-Out x̄	I. Loss (dB) In-Out σ	Coupling (dB) In-Cpl x̄	Coupling (dB) In-Cpl σ	Directivity (dB) x̄	Isolation (dB) Cpl-Cpl x̄	Isolation (dB) Cpl-Cpl σ	Return Loss (dB) In x̄	Return Loss (dB) Out x̄	Return Loss (dB) Cpl x̄
5.000	0.56	0.02	30.13	0.03	22.16	31.60	0.04	15.65	15.24	32.74
10.000	0.60	0.03	30.17	0.03	28.64	31.55	0.03	21.44	22.13	32.53
20.000	0.61	0.03	30.19	0.03	32.72	31.52	0.05	24.43	27.16	32.47
50.000	0.60	0.04	30.17	0.04	36.46	31.50	0.05	27.29	32.44	32.03
100.000	0.59	0.03	30.16	0.04	35.97	31.47	0.06	29.01	33.97	31.27
200.000	0.60	0.02	30.16	0.04	35.13	31.41	0.13	29.62	32.11	29.23
500.000	0.69	0.05	30.03	0.15	29.15	31.10	0.46	28.73	26.88	23.82
555.000	0.72	0.04	30.02	0.16	28.28	31.05	0.52	28.18	25.84	23.00
975.000	1.00	0.19	30.16	0.37	19.73	30.43	1.06	24.48	21.08	18.51
1000.000	1.00	0.17	30.18	0.39	19.09	30.37	1.07	24.04	20.62	18.24

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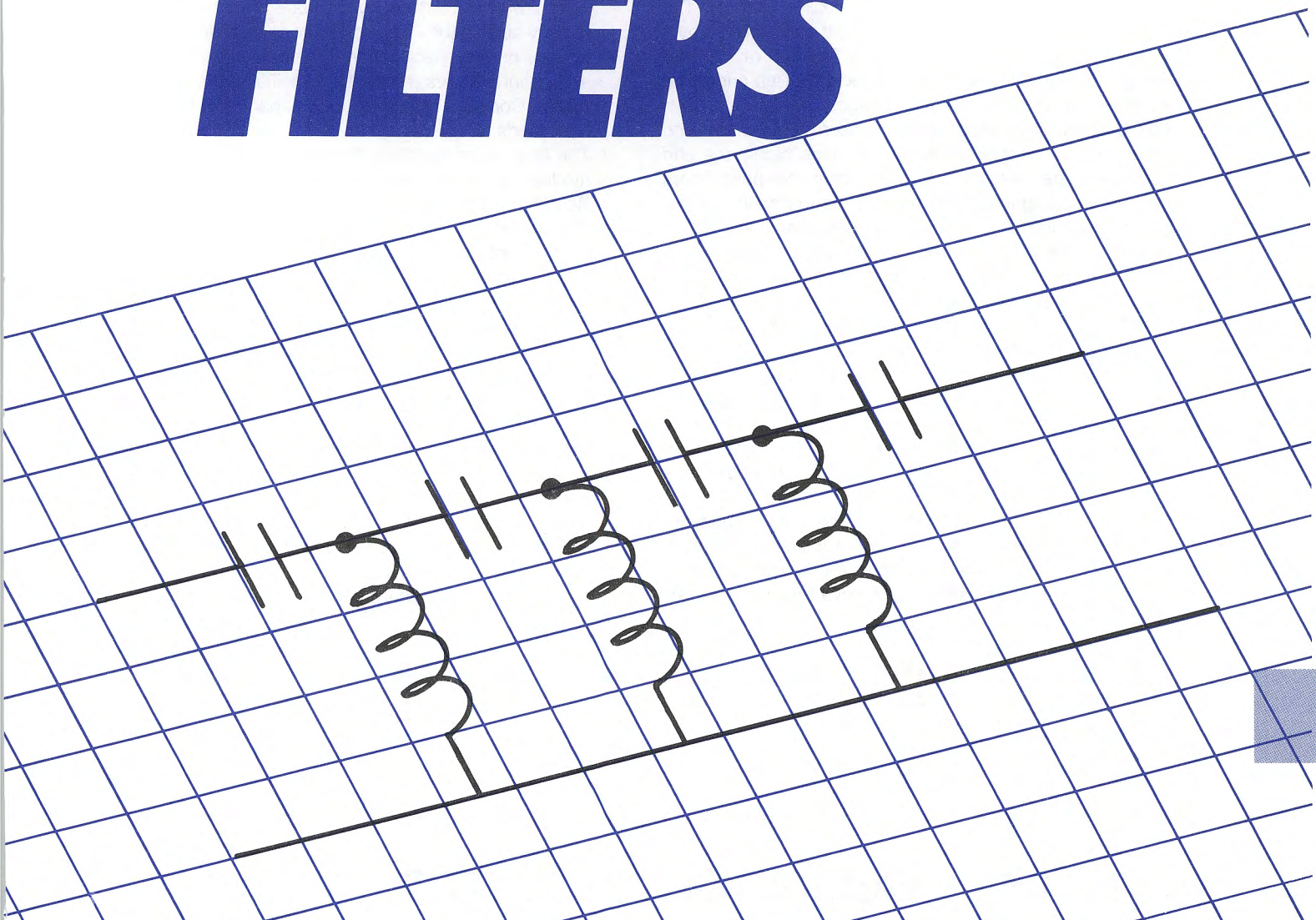
SECTION 8

FILTERS



contents of this section

technical

introduction, definition of terms 8-2, 8-3
most often asked questions 8-4
constant-impedance IF bandpass filters
improve circuit performance 8-5, 8-6
specifications check list
a guide form for requirements 8-7

product specifications

low pass 8-8
high pass 8-9
bandpass 8-10
flat time delay. (low pass) 8-11

computer data and curves

CAPD information . . . . . 8-12 thru 8-33

Filters

In the operation of electronic systems and circuits, the basic function of a filter is to selectively pass, by frequency, desired signals and to suppress undesired signals. The amount of insertion loss and phase shift encountered by a signal passing through the filter is a function of the filter design. Similarly, the amount of rejection of an undesired signal is a function of the filter design.

Mini-Circuits' filters are passive, they contain inductors and capacitors. Three types of filters, low-pass, high-pass, and band-pass are available. Two different low-pass filters have been designed to (1) provide high rejection of undesired signals very close to the pass-band and (2) to provide a linear phase versus frequency characteristic across the pass-band frequency range. A linear phase characteristic is essential when passing a pulse waveform in order to preserve the pulse shape and avoid a distorted waveform. High-pass filters have similarly been designed to provide high rejection of undesired signals very close to the pass-band. Constant impedance band-pass filters have been designed to allow signals to pass within the passband and to be rejected outside of this band. However, these filters provide a matched 50-ohm impedance both within and outside the passband. This is a very important characteristic especially when intermodulation distortion and non-linear devices, such as mixers and oscillators are to be considered. Refer to the article "Constant Impedance IF Bandpass Filters Improve Performance" for more details.

Mini-Circuits' filters are available in a variety of packages and connector styles. Pin plug-in and surface-mount packages are available to accommodate both commercial and military applications. In addition to the catalog models described on the specification sheets, Mini-Circuits designs and manufactures filters to specific customer requirements. Consult our Applications department for your specific needs.

The basic filter designs offered by Mini-Circuits utilizes a modified butterworth or "maximally flat" design, a modified Bessel-Thomson or flat delay design, and an Elliptic function design. All filters are specified by their amplitude response, both in the passband and reject-band, also by their VSWR and phase characteristic where applicable. For convenience, the 20 dB and 40 dB reject-bands are specified. The cut-off frequency, fco, of each filter is also given. This frequency corresponds to the 3 dB insertion loss point of the filter response. This frequency point easily allows the filter response to be normalized to fco.

The CAPD data given in the handbook for each filter has a significant amount of data points to clearly describe the filter performance characteristic. The data curves show the overall filter performance curves. Any resonances that would be available can easily be observed. The data and curves present a very accurate decription of each filter and may be used in conjunction with various software programs designed to analyze system performance.

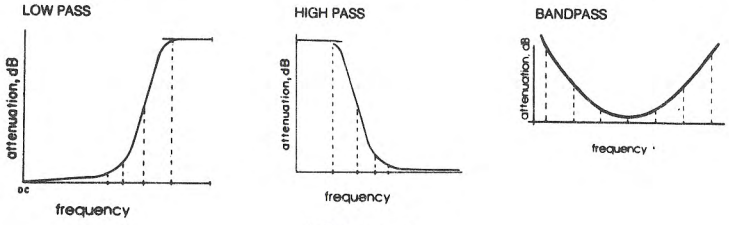


Figure 1

modern definition of terms

insertion loss

is equal to the difference in dB power measured at the filter input and at the filter output. The power measured at the filter input is equal to the measured power when the filter is replaced by a properly matched power meter or network analyzer. The input impedance of the measuring instrument should be equal to the characteristic impedance of the filter or system. Unless otherwise specified, Mini-Circuits' filters are designed for 50 ohm systems. Similarly, the power measured at the filter output is equal to the measured power when the filter is terminated by the same measuring instrument as discussed. The insertion loss will be equal to the sum of three loss factors. One is the loss due to the impedance mismatch at the filter input, the second is due to the mismatch at the filter output, and the third is due to the dissipative loss associated with each reactive element within the filter.

passband

is equal to the frequency range for which the filter insertion loss is less than a specified value. For example, most of the Mini-Circuits' low-pass filter models are specified to have a maximum insertion loss value of 1 dB within the passband.

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modern definition of terms cont.

stopband

is equal to the frequency range for which the filter insertion loss is greater than a specified value. For example, most of the Mini-Circuits' low-pass filter models are characterized by the frequency range where the insertion loss is greater than 20 dB and 40 dB in the stopband. These two values are arbitrary; they could easily have been chosen for some other values. The purpose of selecting 20 dB and 40 dB is two-fold. One is to provide the design engineer with a simple means to calculate the frequency selectivity of the filter. The second is to allow a quick calculation of the suitability of the filter in a particular situation. Since 20 dB or 40 dB represent sufficient loss requirements in many systems, these values were chosen. The data in this handbook provides actual loss values as a function of frequency. For many Mini-Circuit filters the stopband losses can exceed 60 dB.

cut-off frequency, f_{co}

is the frequency at which the filter insertion loss is equal to 3 dB. It is a very convenient point for expressing the passband and stopband boundry points. In addition, it allows a convenient means to normalize the frequency response of a filter. For example, if the frequency of a low-pass filter response were divided by f_{co} then the resulting response would be "normalized" to f_{co}. A typical normalized low-pass response is shown in figure 2. The normalized response allows the design engineer to quickly specify the filter needed to meet his system requirements. For example, considering the low-pass filter, the upper frequency range of the passband is equal to 0.9 times the cut-off frequency. If the passband requirement is DC to 225 MHz then f_{co} equals 250 MHz. Similarly the stopband frequencies can be calculated.

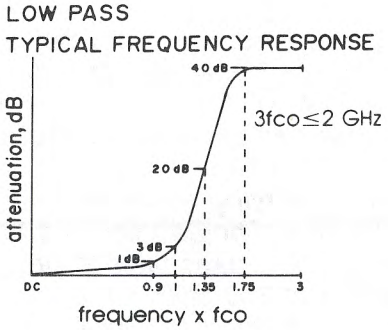

Figure 2

VSWR

is a measure of the impedance looking into one port of the filter while the other filter port is terminated in its characteristic impedance, namely, 50 ohms. Many times, the impedance match is expressed in terms of return loss. The conversion between return loss and VSWR is easily attainable using the chart given in Section 0. Most of the filter models shown in this handbook are designed to present a good impedance match in the passband and a highly reflective impedance [illegible] in the stopband. Typically the VSWR in the center of the passband is better than 1.2 to 1 and the VSWR in the stopband is typically 18 to 1, very highly reflective. One very notable exception to this VSWR characteristic is the constant impedance band-pass filter series. In these models, both filter ports present a good impedance match in the passband and stopband. Return loss data over the entire frequency range is given in the CAPD pages.

center frequency

is the frequency at which band-pass filters are geometrically centered. For example, if f_1 and f_2 represent the 3 dB frequency points of a band-pass filter, then the center frequency f_0 is calculated as follows:

$$f_0 = \sqrt{f_1 \times f_2}$$

When the bandwidth, $f_2 - f_1$, is a small percentage of the value of f_0, then f_0, the geometric mean between f_2 and f_1 will approximately equal the arithmetic mean between f_2 and f_1.

linear phase or flat time delay

filters have the characteristic of enabling the signal at the filter output to have a constant phase difference for each fixed increment of frequency difference of the signal. Thus,

$\Delta\phi = K\Delta f$ where K is a constant.

Mini-Circuits' PBLP filter models utilize a Bessel-Thomson design to achieve the linear phase characteristic or flat time delay. This enables the transmission of various frequency components contained in a pulse waveform to be delayed by the same amount while travelling through the filter thus preserving the pulse wave shape.

group delay

is the amount of time it takes for a signal having a finite time duration, such as a pulse, to pass through the filter. Ideally, all frequencies present in the signal should have the same time delay, so that the signal will not be distorted. In most types of filters this is not the case, and group delay defined as $d\phi/df$ varies with frequency. For linear phase filters the group delay is constant. It is easy to compare the group delay between a linear phase PBLP low-pass filter and the high selectivity PLP low-pass filters given in the specifications. Referring to the data pages it is observed that the linear phase filters have a much lower and flatter value of group delay.

most often asked questions

Q. *Is a filter a reciprocal device? Is it possible to interchange between input and output ports?*

A. Yes. Filter response is unaffected as long as the source and load impedances are the specified value.

Q. *I intend to use an MCL 50-ohm filter in a 75-ohm system. What might be the consequences?*

A. The impedance mismatch will change the response. Pass-band ripple, stop-band rejection, and VSWR will be affected to a degree which depends upon the particular filter design.

Q. *Does MCL offer surface-mount filters?*

A. We offer surface-mount filters in this Handbook and are continually developing new filters to meet customer requirments. If your requirements are not met by the filters listed, please call our Applications Engineers.

Q. *How does temperature influence filter performance?*

A. Our filters are designed to operate from –55° to 100°C and meet our specifications over this full temperature range. There may be slight variations from room termperature performance.

Q. *Can I cascade a low-pass filter with a high-pass filter to achieve band-pass performance?*

A. Yes, if their passbands overlap enough to avoid interaction of their skirt responses, which could increase the combined insertion loss. As a guide, select the two filters so that the resulting bandpass has at least 5 percent bandwidth at 1 dB insertion loss.

Q. *How can I calculate a filter's rejection in the stopband?*

A. Refer to the CAPD page in this handbook which shows data or a graph for a filter in the same series as the filter you need. If the cutoffs are not the same, scale all frequencies in the CAPD by the ratio of the cutoff frequency of your filter to the cutoff frequency of the filters whose data are listed.

Q. *I have a 130 MHz crystal oscillator and I would like to reduce the hamonics at its output. Which 50 ohm filter series would you recommend?*

A. In order to avoid frequency pulling of the oscillator and the generation of internal products, it is recommended that a matched broad band impedance be connected to the oscillator output. Although, Mini-Circuits' constant impedance filters would satisfy this criteria, they would not provide sufficient selectivity to substantially reduce the harmonics of the oscillator fundamental frequency output signal. On the other hand, the low-pass filter series offered would provide excellent selectivity and would substantially reduce the harmonics of the fundamental. The problem, however, is that the filter impedance is highly reflective at the harmonic frequencies. This will cause the harmonic signals to be reflected back into the oscillator. The solution is to insert at least a 6 dB attenuator (12 dB return loss) between the oscillator and filter. The fixed attenuator section of this handbook offers a wide choice for your selection.

Q. *I have a need to increase the selectivity performance of my system. I had chosen a PLP-100 low-pass filter. However, I now need 30 dB of attenuation at 146 MHz rather than the 20 dB specified. How should I proceed?*

A. First determine your pass band requirements, that is, the maximum attenuation allowed within your band width required. Let us assume your maximum allowable passband insertion loss is 2 dB. Then referring to the data pages for low-pass filters, choose the filter model that provides 30 dB attenuation at 146 MHz and has the widest passband for an insertion loss of 2 dB or less. If the passband is too narrow for the filter chosen, then you can use and alternative selection process. Reconfigure your system to use two low-pass filters. The insertion loss in the passband of the combination will be additive. Therefore, two PLP-100 low-pass filters will provide less than 2 dB of attenuation and can provide 40 dB of insertion loss at 146 MHz. If less passband insertion loss is desired, then the second low-pass filter can be chosen such that the attenuation at 146 MHz is at least 10 dB. Please keep in mind that the low-pass filter VSWR outside the passband is highly reflective. Therefore, each of the two filters should be embedded in the system so that each one sees a good match. This ensures that the rejection is additive.

Q. *My system requires a low noise, 10 dB amplifier at 300 MHz with a bandwidth of ± 10 MHz. The amplifier I have available has a frequency response from 200 to 400 MHz. I am very concerned about amplifying an undersired signal at 350 MHz. Should I select a bandpass filter or a low-pass filter to provide rejection at 350 MHz.*

A. If there are no undesired signals between 200 to 290 MHz then a low-pass filter is recommended. The reasons are: (1) The low-pass filter has half as many reactive components as the bandpass filter. Therefore, it would cost much less than a bandpass filter. And (2) for the same rejection at 350 MHz, the low pass filter would inherently have less dissipative loss in the desired passband. This is especially important because of the low noise requirement.

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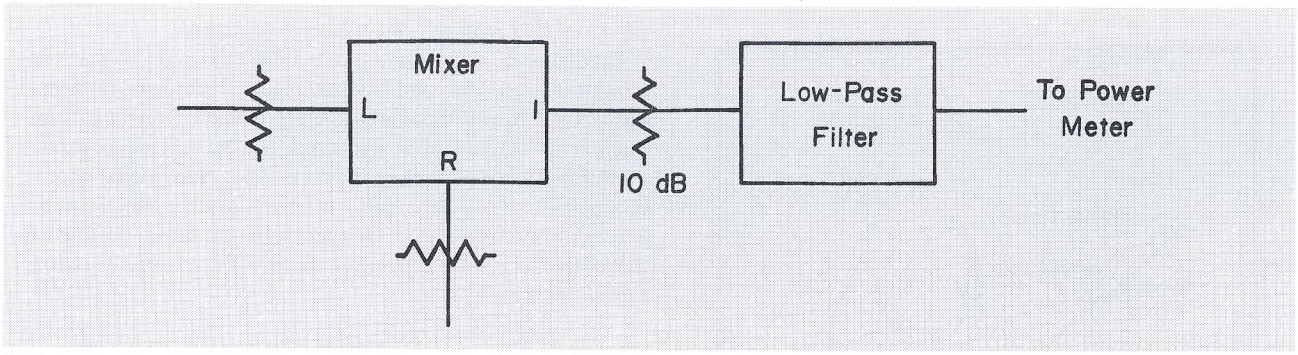
Constant-Impedance IF Bandpass Filters Improve Circuits Performance



1. The mixer conversionloss measurement setup is diagrammed.

The effect of constant-impedance bandpass filters on conversion loss and intermodulation of mixers is described.

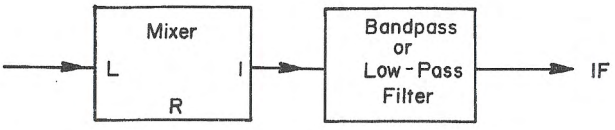
Radhakrishnaiah P. N. Setty
Director of Engineering
Mini-Circuits Laboratory, Brooklyn, New York

Double-balanced mixers are normally very wideband. When used as downconverters, the sum and difference fequencies are of equal amplitude. Filtering is essential to remove the sum frequency.

Conversion loss is usually measured with a 10-dB attenuator at the I-port, followed by a low-pass or bandpass filter to reject the sum frequency (Fig. 1). In this setup, the sum frequency is rejected by the low-pass filter and reflected back into the mixer.

Because of the 10-dB pad, the level of the sum frequency reflected back into the mixer is at least 20-dB below that leaving the I-port. The purpose of the 10-dB pad at the I-port is to provide a 50-Ohm termination at the I-port over a wide frequency range and to prevent the reflected sum frequency from generating secondary IF signals.

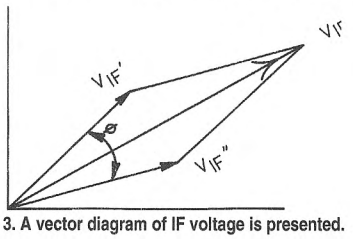
In practical systems, attenuation at the IF port is not tolerable, since it decreases the signal level and increases the noise figure. Instead, a filter is added directly at the I-port to prevent the sum and intermodulation products from entering the IF amplifier (fig. 2).



2. A practical mixer termination is shown.

The output at the I-port consists of fl = ± (fL - fR), the difference frequency, and fS = fL + fR, the sum frequency. The sum frequency is reflected back into the mixer, recombines with the second harmonic of the LO signal, and produces fl' = ±[2fL - (fL + fR)], a secondary IF signal that is at the same frequency as the IF.

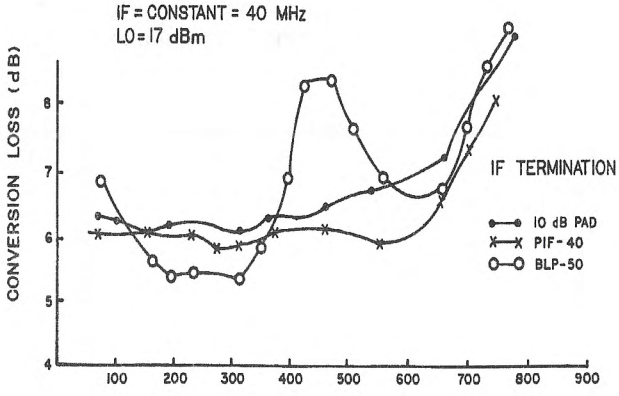
If V_{IF}' and V_{IF}'' are the voltage levels caused by IF and secondary IF and ø the phase angle between them, then VIF is the resultant IF voltage output, which is the vectorial sum of the two IF voltages (Fig. 3).



3. A vector diagram of IF voltage is presented.

When the IF frequency is held constant, and RF and LO frequencies are swept, then VIF', VIF", and ø all vary with frequency. The resultant IF voltage will vary not only because of conversion-loss variation with frequency, but also because of variation of ø. This could result in undesirable ripples in the conversion-loss response. Figure 4 shows the effect when a commercial mixer such as Mini-Circuits' ZFM-1H is followed by a low-pass filter, MCL BLP-50. As much as 3dB ripple in conversion-loss response can be seen.

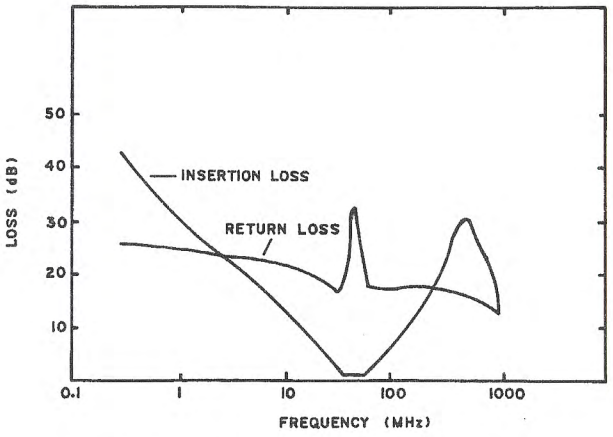
If the impedance at the I-port is held constant over a wide frequency range and the sum frequency is prevented from reentering the mixer, flat conversion loss can be realized.



4. Conversion loss is shown as a function of the IF filter.

Constant-Impedance Filters

Mini-Circuits has introduced a series of constant-impedance filters for different IF frequency ranges. These filters are a bandpass design with typically 1dB bandwidths of 30 percent. Stop-band return loss is 18-dB (typical), up to 10 times the IF center frequency. Insertion loss and return loss of a model PIF-40 IF filter with 40-MHz center frequency is shown in Figure 5.

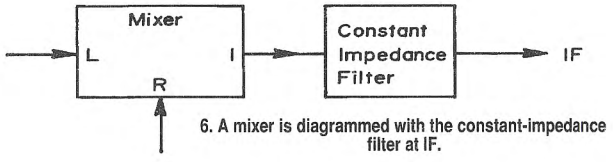


5. Insertion loss and return loss of a model PIF-40 IF filter are plotted.

If the I-port of a mixer is terminated with a constant-impedance filter (Fig. 6) such as the PIF-40, the filter attenuates the sum frequency by absorption. In Figure 4, the frequencies are:

RF = 80 to 500 MHz
LO = 120 to 540 MHz
If = 40 MHz
Sum = 200 to 1040 MHz

When the PIF-40 is used at the IF output, the sum frequency is attenuated by at least 14 dB. Also, the return



6. A mixer is diagrammed with the constant-impedance filter at IF.

loss is 13 dB up to 1040 MHz. The level of sum signal reflected into the mixer is determined by the return loss of the filter. Figure 4 shows how flat the conversion loss is as a function of frequency, which is within 0.3 dB p-p up to 500 MHz, a substantial improvement form 3dB p-p when the BLP-50 is used at the output.

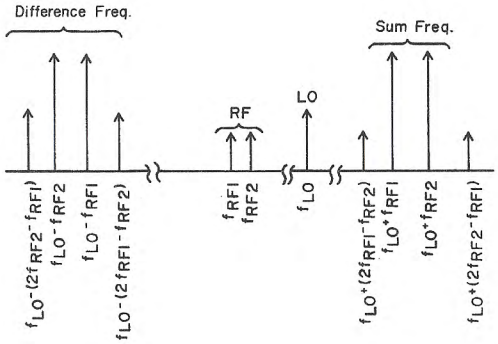
Constant-impedance filters are bandpass in nature; hence, signals outside the passband are attenuated. The LO and RF signals (which fall outside the passband) are attenuated, and isolation is improved.

Effect of IF Termination on Intermodulation

When the IF is terminated with conventional low-pass or bandpass filters, the sum frequency is reflected and reenters the mixer. This influences conversion loss. When more than one carrier is present at the input, the most serious intermodulation of concern is the two-tone, third-order intermodulation. This is because intermodulation frequencies are separated from the IF frequency by the same spacing as that of the RF carriers. Mathematically, the intermodulation frequencies are

$$f_{LO} \pm (2f_{RF1} - f_{RF2})$$

and $$f_{LO} \pm (2f_{RF2} - f_{RF1})$$



7. The mixer out put spectrum is presented.

Figure 7 shows the frequency spectrum at the IF with two IF signals. If the sum-frequency components are reflected back into the mixer, they combine with the second harmonic of the LO and produce the desired IF frequencies and associated intermodulations. The primary and secondary IF products add vectorially and affect the intermodulation level with reference to the IF output. With a constant-impedance filter at the IF, the sum products are absorbed and the intermodulations are not affected.

Besides the two-tone, third-order problem, the reflected signals mix with LO signals and generate secondary intermodulation products. Constant-impedance filters will minimize these effects and provide the ideal termination.

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SPECIFICATIONS CHECKLIST

Filters

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

☐ Low pass ☐ High pass ☐ Band Pass
Passband _____ MHz
Passband insertion loss _____ dB max.
Stopband _____ dB min. at _____ MHz
_____ dB min. at _____ MHz
_____ dB min. at _____ MHz
_____ dB min. at _____ MHz
Passband VSWR _____ max.
or return loss _____ dB min.
Impedance ☐ 50 ohms ☐ 75 ohms ☐ Other
Power input _____ dBm max.
Group delay (passband) _____ ns max.
Group delay variation (for flat delay)
DC-fco _____ ns max.
DC-2fco _____ ns max.
DC-2.67fco _____ ns max.
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting

☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
(Specify connector for input & output separately)

☐ BNC ☐ TNC ☐ Isolated female BNC
☐ SMA ☐ Type N ☐ Other

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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Filters
low pass
DC–1.2 GHz

50 ohms



case style selection

outline drawings see Table of Contents



SCLF

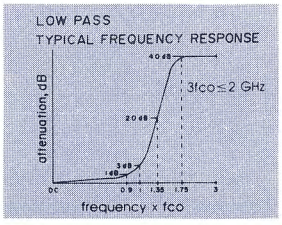


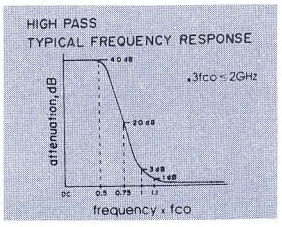
PLP
PHP

NLP
NHP

	MODEL NO.	PASSBAND, MHz (loss <1dB)	fco, MHz Nom. (loss 3 dB)	STOP BAND, MHz (loss>20dB)	STOP BAND, MHz (loss>40dB)	VSWR, Passband Typ.	VSWR, Stopband Typ.	PRICE $ Note 4 Qty. (1–9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
o□☆ SCLF	SCLF-21.4	DC-22	24.5	32-41	41-200	1.7:1	18:1	11.45	●	●
case YY161	SCLF-30	DC-30	35	47-61	61-200	1.7:1	18:1	11.45	●	●
	SCLF-45	DC-45	55	70-90	90-200	1.7:1	18:1	11.45	●	●
	SCLF-135	DC-135	155	210-300	300-600	1.7:1	18:1	11.45	●	●
	SCLF-190	DC-190	210	290-390	390-800	1.7:1	18:1	11.45	●	●
	SCLF-380	DC-380	440	580-750	750-1800	1.7:1	18:1	11.45	●	●
	SCLF-420	DC-420	570	750-920	920-2000	1.7:1	18:1	11.45	●	●
PLP	PLP-5	DC-5	6	8-10	10-200	1.7:1	18:1	11.45	●	●
	PLP-10.7	DC-11	14	19-24	24-200	1.7:1	18:1	11.45	●	●
	PLP-21.4	DC-22	24.5	32-41	41-200	1.7:1	18:1	11.45	●	●
case A01	PLP-30	DC-32	35	47-61	61-200	1.7:1	18:1	11.45	●	●
	PLP-50	DC-48	55	70-90	90-200	1.7:1	18:1	11.45	●	●
	PLP-70	DC-60	67	90-117	117-300	1.7:1	18:1	11.45	●	●
	PLP-90	DC-81	90	121-157	157-400	1.7:1	18:1	11.45	●	●
	PLP-100	DC-98	108	146-189	189-400	1.7:1	18:1	11.45	●	●
	PLP-150	DC-140	155	210-300	300-600	1.7:1	18:1	11.45	●	●
	PLP-200	DC-190	210	290-390	390-800	1.7:1	18:1	11.45	●	●
	PLP-250	DC-225	250	320-400	400-1200	1.7:1	18:1	11.45	●	●
	PLP-300	DC-270	297	410-550	550-1200	1.7:1	18:1	11.45	●	●
	PLP-450	DC-400	440	580-750	750-1800	1.7:1	18:1	11.45	●	●
	PLP-550	DC-520	570	750-920	920-2000	1.7:1	18:1	11.45	●	●
	PLP-600	DC-580	640	840-1120	1120-2000	1.7:1	18:1	11.45	●	●
	PLP-750	DC-700	770	1000-1300	1300-2000	1.7:1	18:1	11.45	●	●
	PLP-800	DC-720	800	1080-1400	1400-2000	1.7:1	18:1	11.45	●	●
	PLP-850	DC-780	850	1100-1400	1400-2000	1.7:1	18:1	11.45	●	●
	PLP-1000	DC-900	990	1340-1750	1750-2000	1.7:1	18:1	11.45	●	●
	PLP-1200	DC-1000	1200	1620-2100	2100-2500	1.7:1	18:1	11.45	●	●
	_LP-5	DC-5	6	8-10	10-200	1.7:1	18:1	32.95	●	●
*BLP	_LP-10.7	DC-11	14	19-24	24-200	1.7:1	18:1	32.95	●	●
	_LP-21.4	DC-22	24.5	32-41	41-200	1.7:1	18:1	32.95	●	●
case FF55	_LP-30	DC-32	35	47-61	61-200	1.7:1	18:1	32.95	●	●
	_LP-50	DC-48	55	70-90	90-200	1.7:1	18:1	32.95	●	●
*NLP	_LP-70	DC-60	67	90-117	117-300	1.7:1	18:1	32.95	●	●
case FF57	_LP-90	DC-81	90	121-157	157-400	1.7:1	18:1	32.95	●	●
	_LP-100	DC-98	108	146-189	189-400	1.7:1	18:1	32.95	●	●
	_LP-150	DC-140	155	210-300	300-600	1.7:1	18:1	32.95	●	●
	_LP-200	DC-190	210	290-390	390-800	1.7:1	18:1	32.95	●	●
*SLP	_LP-300	DC-270	297	410-550	550-1200	1.7:1	18:1	32.95	●	●
case FF99	_LP-450	DC-400	440	580-750	750-1800	1.7:1	18:1	32.95	●	●
	_LP-550	DC-520	570	750-920	920-2000	1.7:1	18:1	32.95	●	●
	_LP-600	DC-580	640	840-1120	1120-2000	1.7:1	18:1	32.95	●	●
	_LP-750	DC-700	770	1000-1300	1300-2000	1.7:1	18:1	32.95	●	●
	_LP-800	DC-720	800	1080-1400	1400-2000	1.7:1	18:1	32.95	●	●
	_LP-850	DC-780	850	1100-1400	1400-2000	1.7:1	18:1	32.95	●	●
	_LP-1000	DC-900	990	1340-1750	1750-2000	1.7:1	18:1	32.95	●	●
	_LP-1200	DC-1000	1200	1620-2100	2100-2500	1.7:1	18:1	32.95	●	●

*Add prefix letter B, N, or S to _LP where applicable (see note 4)





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Filters, high pass

25 MHz–2.2 GHz

Mini-Circuits



SLP
SHP



BLP
BHP

		STOP BAND, MHz (loss>40dB)	STOP BAND, MHz (loss>20dB)	fco, MHz Nom. (loss 3dB)	PASSBAND, MHz (loss <1dB)	VSWR, Stopband Typ.	VSWR, Passband Typ.	PRICE $ (Note 4) Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
PHP	PHP-25	DC- 13	13- 19	25	27.5- 200	18:1	1.8:1	16.95	•	•
	PHP-50	DC- 20	20- 26	37	41- 200	17:1	1.5:1	14.95	•	•
case A01	PHP-100	DC- 40	40- 55	82	90- 400	17:1	1.5:1	14.95	•	•
	PHP-150	DC- 70	70- 95	120	133- 600	17:1	1.8:1	14.95	•	•
	PHP-175	DC- 70	70-105	140	160- 800	17:1	1.5:1	14.95	•	•
	PHP-200	DC- 90	90-116	164	185- 800	17:1	1.6:1	14.95	•	•
	PHP-250	DC-100	100-150	205	225-1200	17:1	1.3:1	14.95	•	•
	PHP-300	DC-145	145-170	245	290-•1200	17:1	1.7:1	14.95	•	•
	PHP-400	DC-210	210-290	360	395-1600	17:1	1.7:1	14.95	•	•
	PHP-500	DC-280	280-365	454	500-1600	17:1	1.8:1	14.95	•	•
	PHP-600	DC-350	350-440	545	600-1600	17:1	2.0:1	14.95	•	•
	PHP-700	DC-400	400-520	640	700-1800	17:1	1.6:1	14.95	•	•
	PHP-800	DC-445	445-570	710	780-2000	17:1	2.1:1	14.95	•	•
	PHP-900	DC-520	520-660	820	910-2100	17:1	1.8:1	14.95	•	•
	PHP-1000	DC-550	550-720	900	1000-2200	17:1	1.9:1	14.95	•	•
	_HP-25	DC- 13	13- 19	25	27.5- 200	18:1	1.7:1	38.95	•	•
*BHP	_HP-50	DC- 20	20- 26	37	41- 200	17:1	1.5:1	36.95	•	•
case FF55	_HP-100	DC- 40	40- 55	82	90- 400	17:1	1.5:1	36.95	•	•
	_HP-150	DC- 70	70- 95	120	133- 600	17:1	1.8:1	36.95	•	•
*NHP	_HP-175	DC- 70	70-105	140	160- 800	17:1	1.5:1	36.95	•	•
case FF57	_HP-200	DC- 90	90-116	164	185- 800	17:1	1.6:1	36.95	•	•
	_HP-250	DC-100	100-150	205	225-1200	17:1	1.3:1	36.95	•	•
*SHP	_HP-300	DC-145	145-190	245	290-•1200	17:1	1.7:1	36.95	•	•
case FF99	_HP-400	DC-210	210-290	360	395-1600	17:1	1.7:1	36.95	•	•
	_HP-500	DC-280	280-365	454	500-1600	17:1	1.9:1	36.95	•	•
	_HP-600	DC-350	350-440	545	600-1600	17:1	2.0:1	36.95	•	•
	_HP-700	DC-400	400-520	640	700-1800	17:1	1.6:1	36.95	•	•
	_HP-800	DC-445	445-570	710	780-2000	17:1	2.1:1	36.95	•	•
	_HP-900	DC-520	520-660	820	910-2100	17:1	1.8:1	36.95	•	•
	_HP-1000	DC-550	550-720	900	1000-2200	17:1	1.9:1	36.95	•	•

• insertion loss 1.5 dB max.

*Add prefix letter B, N, or S to _HP where applicable (see Note 4)

NOTES:

□ NON-HERMETIC
○ Available in tape and reel, please consult factory
☆ Surface-mount
▲ 35 dB for SCLF-380 and SCLF-420

1. For quality control procedures, environmental specifications, and Hi-Rel description see Table of Contents.
2. Absolute maximum ratings see section 1. In addition, maximum RF power 1/2 watt.
3. Models are available with male/female coax connectors. For other configurations and inter-series versions consult factory. See case style outline drawings.
4. For N prefix add $3, S prefix add $2 to price shown.
5. Prices and specifications subject to change without notice.

pin connections

see case style outline drawing

SERIES	In	Out	Ground
PLP	1	8	2,3,4,5,6,7
PHP	1	8	2,3,4,5,6,7
SCLF	1	8	2,3,4,5,6,7

NSN GUIDE

MCL No.	NSN
PLP-100	5915-01-332-1091
SLP-30	5915-01-327-4692

In Stock...Immediate Delivery

CAPD now available! computer-automated performance data see model index

Filters bandpass

50 ohm

10.7 MHz to 70 MHz Center Frequency

50 ohms

case style selection

outline drawings see Table of Contents



PIF
PBP
PBLP



NBLP
NIF
NBP

constant impedance

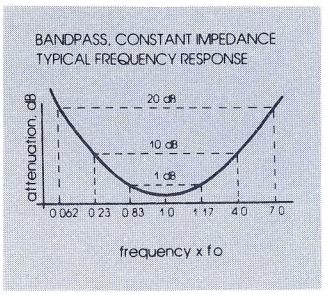
	MODEL NO.	CENTER FREQ. MHz	PASS BAND, MHz (loss < 1 dB)	STOP BANDS (loss > 10 dB) MHz	STOP BANDS (loss > 20 dB) at MHz	VSWR, 1.3:1, Typ. TOTAL BAND, MHz	PRICE $ (Note 4) Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
*PIF case A01	_IF-21.4	21.4	18-25	4.9 & 85	1.3 & 150	DC-220	14.95	•	•
*BIF case FF55	_IF-30	30	25-35	7 & 120	1.9 & 210	DC-330	14.95	•	•
	_IF-40	42	35-49	10 & 168	2.6 & 300	DC-400	14.95	•	•
*NIF case FF57	_IF-50	50	41-58	11.5 & 200	3.1 & 350	DC-440	14.95	•	•
	_IF-60	60	50-70	14 & 240	3.8 & 400	DC-500	14.95	•	•
*SIF case FF99	_IF-70	70	58-82	16 & 280	4.4 & 490	DC-550	14.95	•	•

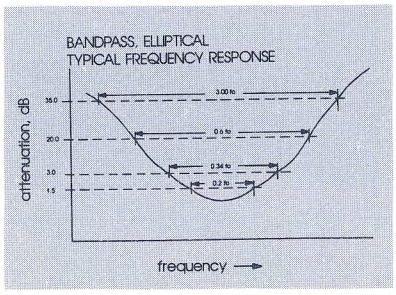
*Add prefix letter P, B, N or S to _IF where applicable (see note 4)

elliptic response

	MODEL NO.	CENTER FREQ. (MHz)	PASSBAND I.L. 1.5 dB MAX. (MHz)	3 dB BANDWIDTH TYPICAL (MHz)	STOP BANDS I.L. > 20 dB at MHz	STOP BANDS I.L. > 35 dB at MHz	PASS BAND VSWR MAX.	STOP BAND VSWR TYPICAL	PRICE $ (Note 5) Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
*PBP case A01	_BP-10.7	10.7	9.5-11.5	8.9-12.7	7.5 & 15	0.6 & 50-1000	1.7:1	16:1	18.95	•	•
	_BP-21.4	21.4	19.2-23.6	17.9-25.3	15.5 & 29	3.0 & 80-1000	1.7:1	16:1	18.95	•	•
*BBP case FF55	_BP-30	30.0	27.0-33.0	25-35	22 & 40	3.2 & 99-1000	1.7:1	16:1	18.95	•	•
*NBP case FF57	_BP-60	60.0	55.0-67.0	49.8-70.5	44 & 79	4.6 & 190-1000	1.7:1	16:1	18.95	•	•
*SBP case FF99	_BP-70	70.0	63.0-77.0	58.0-82.0	51 & 94	6.0 & 193-1000	1.7:1	16:1	18.95	•	•

*Add prefix letter P, B, N or S to _BP where applicable (see note 5)





pin connections

see case style outline drawing

SERIES	In	Out	Ground
PIF	1	6	2,3,4,5,7,8
PBP	1	8	2,3,4,5,6,7

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flat time delay

Filters low pass

DC–1.87 GHz

Mini-Circuits



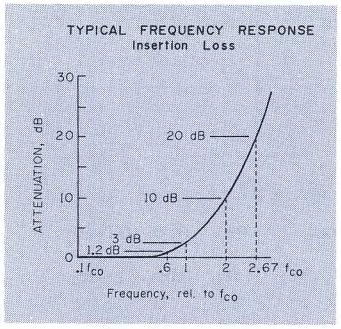
BBLP
BIF
BBP

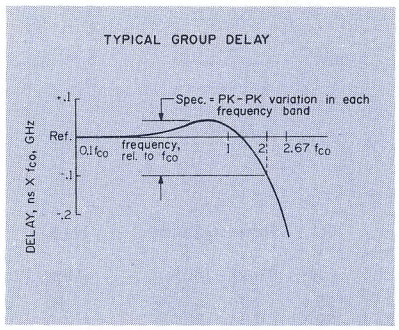


SBLP
SIF
SBP

MODEL NO.	PASSBAND, MHz (loss < 1.2dB) Min.	fco, MHz (loss = 3dB) Nom.	STOPBAND, MHz Loss > 10dB	STOPBAND, MHz Loss > 20dB	VSWR DC-0.2fco X	VSWR DC-0.6fco X	GROUP DELAY VARIATION, ns DC-fco X	GROUP DELAY VARIATION, ns DC-2fco X	GROUP DELAY VARIATION, ns DC-2.67fco X	PRICE $ (See Note 6) Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
*PBLP _BLP-39	DC-23	39	78- 117	117	1.3:1	2.3:1	0.7	4.0	5.0	19.95	●	●
case A01 _BLP-117	DC-65	117	234- 312	312	1.3:1	2.4:1	0.35	1.4	1.9	19.95	●	●
*BBLP _BLP-156	DC-94	156	312- 416	416	0.3:1	1.1:1	0.3	1.1	1.5	19.95	●	●
case FF55 _BLP-200	DC-120	200	400- 534	534	1.6:1	1.9:1	0.4	1.3	1.6	19.95	●	●
*NBLP _BLP-300	DC-180	300	600- 801	801	1.25:1	2.2:1	0.2	0.6	0.8	19.95	●	●
case FF57												
*SBLP _BLP-467	DC-280	467	934-1246	1246	1.25:1	2.2:1	0.15	0.4	0.55	19.95	●	●
case FF99▲ _BLP-933	DC-560	933	1866-2490	2490	1.3:1	2.2:1	0.09	0.2	0.28	38.95	●	●
▲ _BLP-1870	DC-850	1870	3740-5000	5000	1.45:1	2.9:1	0.05	0.1	0.15	38.95	●	●

*Add prefix letter P, B, N, or S to _BLP where applicable (see note 6)





features

- Flat group delay for low pulse distortion.
- Delay and selectivity are both controlled by design.
- Wide selection of cutoff frequencies, 48-to-1 range. Custom Fco values are available.
- Choice of pin package or connectorized models.

pin connections

for PBLP hermetically sealed

	PIN
In	1
Out	8
Case Ground	2,3,4,5,6,7

NOTES:

▲ _BLP-933 and _BLP-1870 available only with N and SMA connector.

1. For quality control procedures, environmental specifications, and Hi-Rel description see Table of Contents.
2. Absolute maximum ratings see Table of Contents. In addition, maximum RF power 0.5 watt.
3. Models are available with male/female coax connectors. For other configuration and inter-series versions consult factory. See case style outline drawings.
4. Price for PIF-series only, SIF $38.95, BIF $36.95, NIF $39.95.
5. Price for PBP-series only, SBP $42.95, BBP $40.95, NBP $43.95.
6. Price for PBLP-series only, SBLP $38.95, BBLP $36.95, NBLP $39.95.
7. Price and specifications subject to change without notice.
8. All filters, except pin units (PIF, PBP and PBLP) are non-hermetic.

In Stock...Immediate Delivery

CAPD now available! computer-automated performance data see model index

rugged, high selectivity

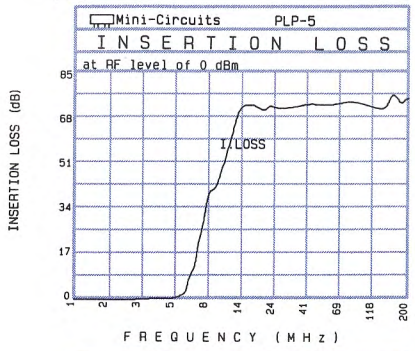
Low Pass Filters

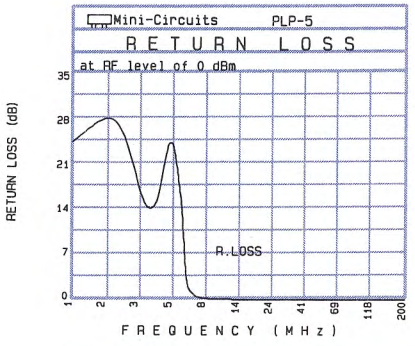
MODEL SELECTION

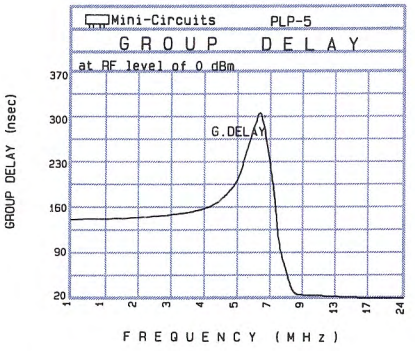
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

LP-5 DC-5 MHz

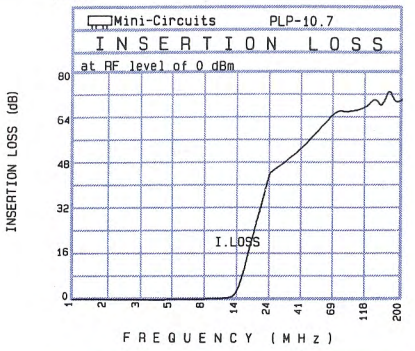


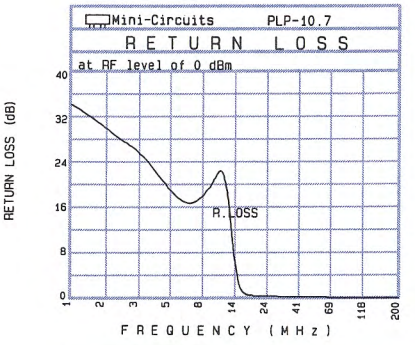


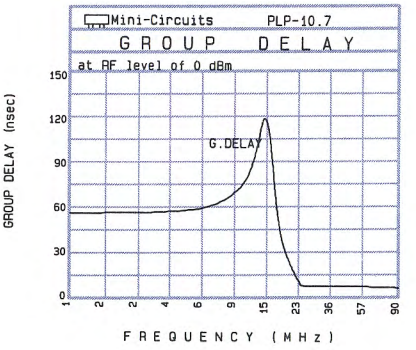


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.08	0.1	25.1	1.0	147.473
2.0	0.13	0.1	32.4	2.0	150.986
3.0	0.34	0.1	15.6	3.0	158.958
3.5	0.69	0.1	14.2	3.5	164.573
4.0	0.71	0.1	15.8	4.0	173.418
4.5	0.73	0.1	25.1	4.5	192.059
5.0	0.91	0.1	25.5	5.0	215.975
5.8	2.41	0.7	15.8	5.3	253.980
6.0	3.35	0.8	7.2	5.8	294.321
6.3	9.49	1.3	2.0	6.0	326.824
6.8	11.67	1.1	1.2	6.3	305.701
7.0	16.87	1.2	0.9	6.8	223.890
7.3	23.49	1.1	0.5	7.0	180.770
7.8	29.30	1.0	0.4	7.3	106.737
8.0	34.55	1.0	0.3	7.8	73.246
8.3	39.27	1.0	0.3	8.0	54.493
8.5	41.68	1.1	0.3	8.3	38.639
8.8	42.05	1.1	0.2	8.5	31.119
9.0	42.44	1.1	0.2	8.8	29.126
9.5	43.73	1.1	0.2	9.0	28.459
10.0	47.90	1.1	0.2	9.5	27.231
12.0	63.04	1.6	0.1	10.0	26.911
16.0	75.52	4.1	0.1	12.0	26.682
22.0	75.62	9.9	0.1	13.0	25.945
35.0	74.63	3.9	0.1	14.0	25.338
80.0	77.85	6.6	0.1	16.0	24.483
156.0	81.35	8.6	0.1	18.0	24.079
178.0	75.08	2.3	0.1	20.0	23.998
189.0	77.64	6.8	0.1	22.0	23.815
200.0	78.15	5.2	0.1	24.0	23.723

LP-10.7 DC-11 MHz

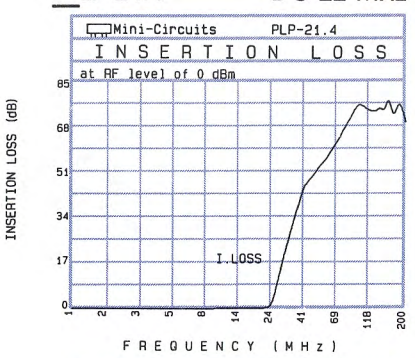


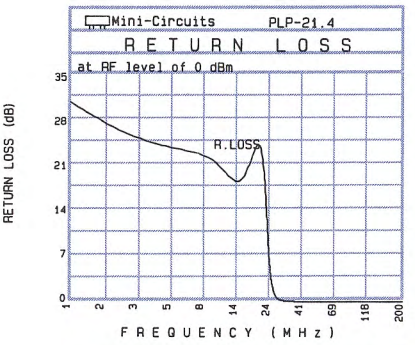


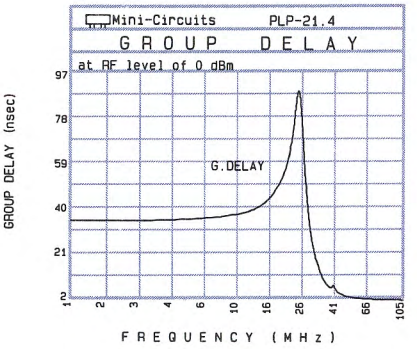


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.07	0.1	35.4	1.0	58.799
2.0	0.09	0.1	29.3	2.0	59.100
3.0	0.12	0.1	26.7	3.0	59.274
5.0	0.32	0.1	18.8	5.0	60.968
7.0	0.47	0.1	16.4	7.0	63.357
10.0	0.65	0.1	21.3	10.0	74.878
11.0	0.75	0.1	24.0	11.0	81.219
13.0	1.40	0.2	15.6	12.0	91.066
14.0	2.93	0.6	7.4	13.0	107.182
15.0	6.69	1.2	3.1	13.5	117.873
16.0	11.80	1.5	1.5	14.0	126.316
17.0	17.23	1.5	1.1	15.0	118.462
17.5	19.81	1.6	1.0	15.5	101.874
18.0	22.31	1.6	0.9	16.0	88.384
19.0	27.01	1.7	0.8	16.5	69.668
20.0	31.35	1.7	0.8	17.0	58.263
21.5	37.46	1.8	0.7	17.5	48.582
22.5	41.58	2.0	0.7	18.0	41.979
23.0	43.42	2.0	0.7	19.0	32.499
23.5	45.39	2.3	0.7	20.0	26.260
24.0	47.26	2.3	0.7	21.0	22.782
67.5	69.85	8.9	0.5	21.5	15.910
89.5	68.74	2.9	0.5	22.0	16.353
111.5	69.81	2.2	0.5	22.5	13.868
133.5	73.98	3.2	0.5	23.0	13.792
156.0	74.31	4.9	0.5	23.5	9.849
167.0	77.32	6.1	0.5	24.0	9.527
178.0	71.38	2.8	0.5	67.5	9.305
189.0	75.13	2.8	0.5	78.5	8.983
200.0	72.96	2.1	0.5	89.5	8.696

LP-21.4 DC-22 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.10	0.1	31.7	1.0	36.156
2.0	0.12	0.0	26.4	2.0	36.114
5.0	0.21	0.1	24.0	5.0	36.803
10.0	0.29	0.1	23.3	10.0	38.686
15.0	0.45	0.1	16.1	15.0	42.252
20.0	0.45	0.1	27.7	20.0	55.732
22.0	0.60	0.1	21.6	22.0	69.397
23.5	1.46	0.4	9.6	23.0	81.704
24.5	3.45	1.0	4.4	23.5	88.289
25.0	4.95	1.2	3.0	24.0	92.344
27.0	12.37	1.5	0.7	24.5	91.461
29.0	19.53	1.4	0.3	25.0	85.660
30.0	22.77	1.4	0.3	26.0	66.763
31.0	25.77	1.3	0.2	27.0	48.882
32.0	28.62	1.3	0.2	28.0	36.298
33.0	31.31	1.3	0.2	29.0	28.750
35.0	36.30	1.2	0.1	30.0	24.488
38.0	42.86	1.3	0.1	31.0	19.404
39.0	45.08	1.1	0.1	32.0	17.880
40.0	46.77	1.0	0.1	33.0	13.725
41.0	48.73	1.0	0.1	34.0	13.701
86.5	76.16	2.0	0.1	35.0	14.628
105.0	77.54	4.3	0.1	36.0	8.862
124.0	75.42	0.6	0.1	38.0	7.643
143.0	75.51	1.8	0.0	39.0	7.393
162.0	74.57	3.5	0.1	40.0	9.968
171.5	75.79	4.4	0.1	41.0	2.673
181.0	81.15	8.2	0.1	86.5	2.561
190.5	76.97	3.2	0.1	96.0	2.444
200.0	72.23	2.4	0.1	105.0	2.281

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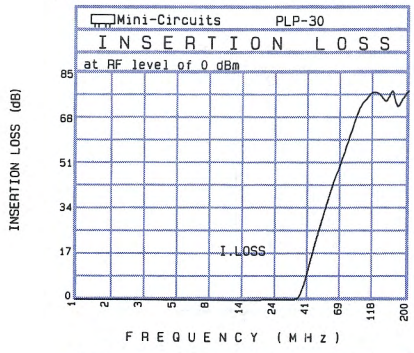
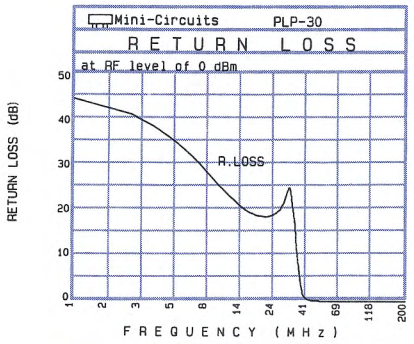
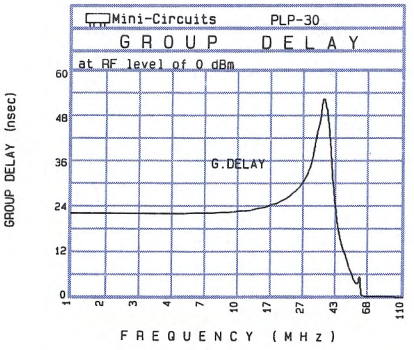
LP-30 DC-32 MHz

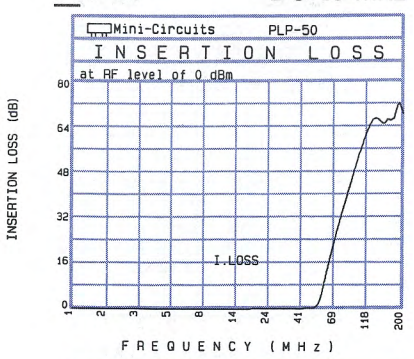


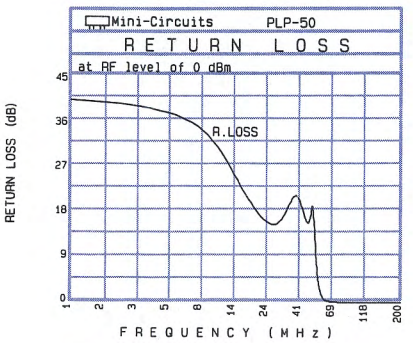


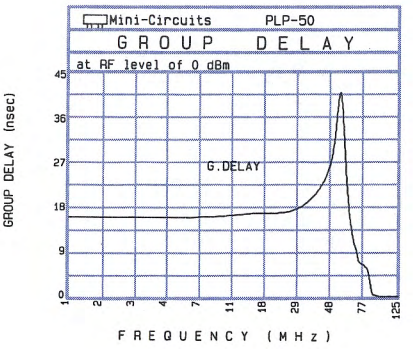


Freq.	I.Loss		R.L.	Freq.	G.Delay
	$\bar{x}$	σ	$\bar{x}$		$\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
1.0	0.07	0.1	45.8	1.0	23.199
10.0	0.21	0.1	23.5	10.0	23.469
19.0	0.29	0.1	18.2	19.0	26.059
28.0	0.37	0.1	20.4	28.0	32.447
31.0	0.48	0.1	28.1	31.0	41.587
32.0	0.55	0.1	21.8	32.0	45.564
33.5	0.62	0.1	18.8	33.5	48.791
34.0	0.76	0.1	16.1	34.0	51.333
35.0	1.30	0.3	9.9	35.0	56.959
38.0	6.09	0.9	2.1	38.0	47.730
40.0	10.78	0.9	0.9	39.0	39.870
43.0	17.56	0.8	0.4	40.0	32.354
45.0	21.65	0.7	0.3	42.0	23.788
46.0	23.56	0.7	0.3	43.0	19.717
47.0	25.39	0.7	0.2	44.0	17.974
48.0	27.19	0.7	0.2	45.0	15.872
50.0	30.58	0.6	0.2	46.0	14.294
55.0	38.32	0.6	0.1	47.0	12.983
59.0	43.69	0.7	0.2	48.0	12.683
60.0	45.01	0.7	0.1	49.0	10.484
61.0	46.27	0.5	0.1	50.0	11.503
91.5	76.88	4.1	0.1	52.0	7.622
109.5	80.77	5.3	0.1	55.0	4.408
127.5	79.89	2.8	0.1	58.0	4.043
145.5	77.20	3.0	0.1	59.0	7.931
164.0	74.52	3.4	0.1	60.0	1.036
173.0	74.92	3.8	0.1	61.0	0.989
182.0	78.05	5.9	0.1	91.5	0.881
191.0	79.62	6.8	0.1	100.5	0.791
200.0	80.65	6.9	0.1	109.5	0.750

LP-50 DC-48 MHz

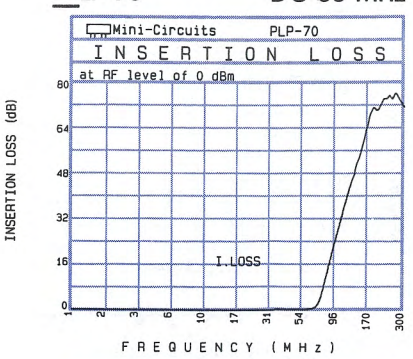


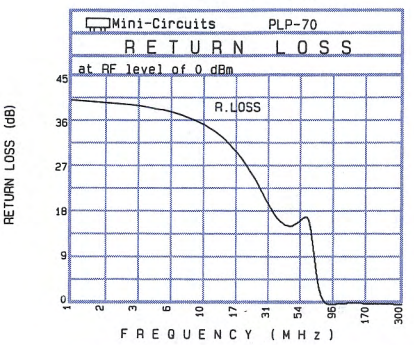


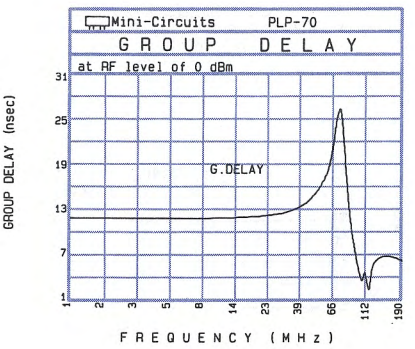


Freq.	I.Loss		R.L.	Freq.	G.Delay
	$\bar{x}$	σ	$\bar{x}$		$\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
1.0	0.05	0.0	41.2	1.0	16.618
15.5	0.23	0.1	22.7	8.5	16.728
23.0	0.37	0.1	15.7	15.5	17.871
30.5	0.43	0.1	15.4	23.0	17.451
38.0	0.40	0.1	25.1	30.5	18.789
45.0	0.65	0.1	14.8	38.0	21.888
48.0	0.70	0.1	17.1	45.0	25.865
52.0	1.46	0.2	9.9	48.0	30.556
55.0	4.65	0.3	3.0	49.5	33.922
57.0	7.96	0.4	1.5	52.0	42.092
61.0	14.84	0.5	0.5	53.5	42.832
65.0	20.96	0.6	0.3	55.0	38.774
67.0	23.73	0.6	0.2	57.0	29.196
69.0	26.33	0.7	0.2	59.0	22.033
70.0	27.59	0.7	0.2	61.0	16.656
72.5	30.55	0.8	0.2	63.0	14.036
80.0	38.67	1.2	0.1	65.0	11.169
82.5	41.07	1.4	0.1	67.0	10.620
85.0	43.54	1.6	0.1	69.0	8.062
87.5	45.78	1.8	0.1	70.0	7.565
90.0	47.97	2.2	0.1	72.5	7.701
100.0	56.91	4.1	0.1	75.0	7.136
133.5	68.38	5.2	0.1	80.0	6.566
150.0	67.23	4.2	0.1	81.0	4.925
163.0	68.62	4.6	0.1	82.5	3.609
170.5	69.35	3.3	0.1	85.0	0.835
175.0	69.36	5.8	0.1	87.5	1.233
185.5	77.07	8.8	0.1	90.0	0.728
192.5	69.51	5.2	0.1	100.0	0.697
200.0	71.27	9.7	0.1	125.0	0.692

LP-70 DC-60 MHz







Freq.	I.Loss		R.L.	Freq.	G.Delay
	$\bar{x}$	σ	$\bar{x}$		$\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
1.0	0.02	0.1	41.6	1.0	12.184
12.0	0.09	0.1	35.7	12.0	12.269
23.0	0.14	0.1	25.9	23.0	12.703
34.0	0.30	0.1	17.1	34.0	13.240
45.5	0.38	0.1	15.3	45.5	14.839
56.5	0.48	0.1	18.3	56.5	17.752
60.0	0.57	0.1	17.8	60.0	19.128
64.0	0.81	0.1	13.9	62.0	20.776
67.0	1.27	0.2	9.8	64.0	22.108
70.0	2.40	0.5	5.9	66.0	24.563
75.0	6.44	0.7	1.9	67.0	25.578
82.0	14.32	0.6	0.3	70.0	27.327
85.0	17.61	0.6	0.1	72.0	27.288
88.0	20.73	0.5	0.1	75.0	23.248
90.0	22.72	0.5	0.1	80.0	16.050
92.0	24.63	0.4	0.1	82.0	13.757
100.0	31.63	0.3	0.2	85.0	10.853
105.0	35.63	0.3	0.2	88.0	9.196
110.0	39.22	0.3	0.3	90.0	8.000
115.0	42.79	0.3	0.3	92.0	7.139
117.0	44.09	0.3	0.3	95.0	7.245
167.0	71.03	2.8	0.3	100.0	4.977
189.5	71.25	4.9	0.3	102.0	2.548
211.5	78.21	8.2	0.2	105.0	5.780
233.5	79.29	6.9	0.2	110.0	3.413
255.5	79.68	7.6	0.2	115.0	1.564
267.0	78.34	9.9	0.2	117.0	7.503
278.0	76.60	3.1	0.1	167.0	7.041
289.0	75.01	2.8	0.1	178.0	6.825
300.0	74.09	4.1	0.1	189.5	6.540

rugged, high selectivity

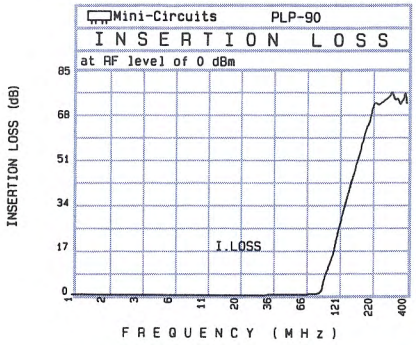
Low Pass Filters

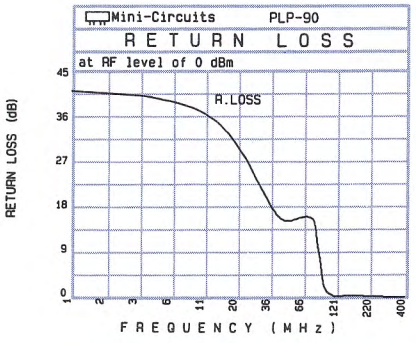
MODEL SELECTION

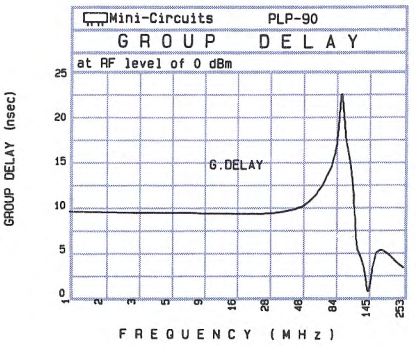
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

LP-90 DC-81 MHz

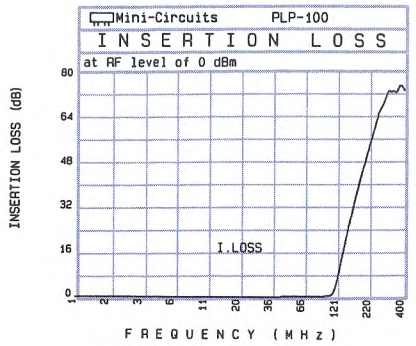


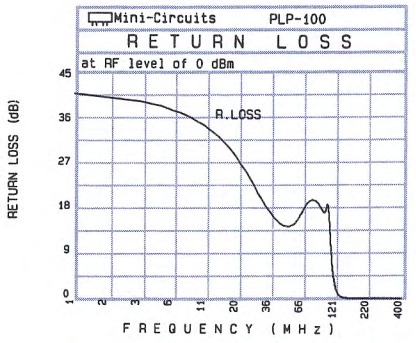


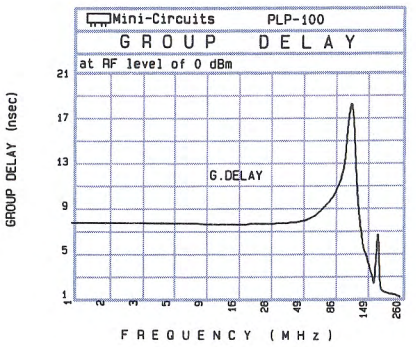


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.05	0.1	42.0	1.0	9.672
12.5	0.14	0.1	37.5	12.5	9.503
24.0	0.18	0.1	27.7	24.0	9.491
35.5	0.31	0.1	18.7	35.5	9.776
46.5	0.42	0.1	14.9	46.5	10.240
58.0	0.43	0.1	16.1	58.0	11.244
81.0	0.69	0.1	17.0	81.0	15.573
87.0	1.28	0.4	9.7	84.0	17.894
90.0	2.01	0.5	7.6	87.0	19.997
93.0	6.43	0.9	3.8	90.0	24.263
97.0	8.74	1.0	1.7	93.0	21.734
104.0	12.94	1.1	0.8	97.0	17.532
111.0	16.72	1.2	0.5	104.0	15.893
115.5	21.91	1.2	0.1	111.0	12.218
121.0	26.16	1.2	0.2	115.5	5.804
130.0	32.40	1.3	0.3	121.0	5.229
140.0	38.50	1.4	0.3	130.0	3.892
145.0	41.31	1.4	0.3	135.0	2.740
150.0	43.98	1.5	0.3	140.0	0.487
155.0	46.76	1.7	0.3	145.0	0.841
157.0	47.69	1.8	0.3	150.0	2.060
184.0	60.11	2.9	0.3	155.0	7.687
206.5	66.87	1.4	0.3	157.0	5.680
229.5	75.03	5.6	0.2	184.0	5.380
252.5	74.83	7.6	0.2	195.5	5.060
298.0	76.96	7.1	0.1	206.5	4.740
321.0	75.07	4.9	0.1	218.0	4.320
355.5	73.10	4.4	0.1	229.5	4.010
378.0	75.50	4.8	0.1	241.0	3.760
400.0	74.56	6.3	0.1	252.5	3.450

LP-100 DC-98 MHz

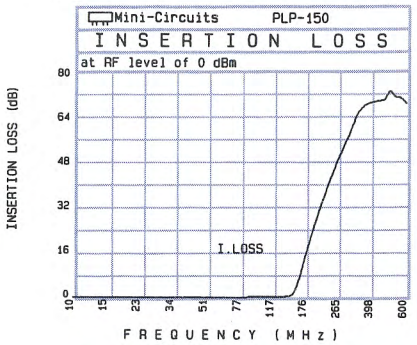


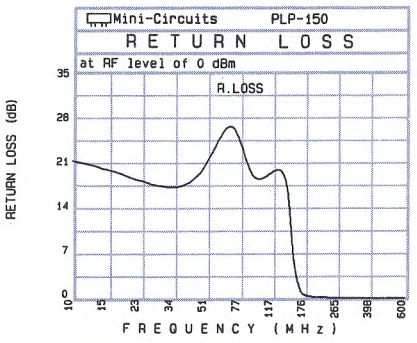


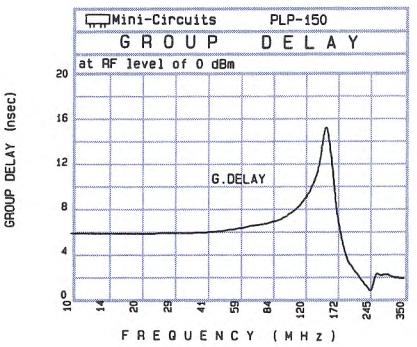


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.02	0.1	41.6	1.0	7.802
29.5	0.16	0.1	20.2	15.0	7.718
58.0	0.34	0.1	14.4	29.5	7.812
72.0	0.31	0.1	20.3	43.5	7.901
86.5	0.41	0.1	20.2	58.0	8.226
98.0	0.58	0.1	16.8	72.0	9.283
102.0	0.62	0.1	18.4	86.5	10.402
106.0	0.75	0.1	18.3	98.0	12.091
108.0	0.93	0.2	15.0	102.0	13.505
112.0	1.72	0.5	9.3	104.0	14.551
120.0	5.98	1.3	2.5	106.0	15.904
130.0	13.62	1.3	0.6	108.0	16.952
138.0	19.37	1.2	0.3	112.0	18.647
140.0	20.73	1.2	0.3	115.0	18.923
146.0	24.55	1.2	0.2	120.0	16.027
150.0	26.95	1.1	0.1	125.0	11.256
160.0	32.54	1.2	0.1	130.0	8.381
170.0	37.64	1.2	0.1	138.0	6.335
180.0	42.35	1.2	0.1	140.0	5.440
185.0	44.43	1.3	0.0	146.0	5.302
189.0	46.24	1.4	0.0	150.0	4.068
250.0	67.20	3.6	0.1	155.0	3.545
271.5	76.41	8.4	0.1	160.0	3.249
300.0	75.73	6.4	0.1	165.0	3.192
330.0	75.45	3.9	0.1	170.0	1.495
343.0	73.72	2.6	0.1	180.0	9.308
360.0	75.87	4.3	0.1	185.0	2.440
371.5	77.51	9.8	0.1	189.0	1.634
390.0	79.32	7.8	0.1	250.0	1.412
400.0	75.26	2.4	0.1	260.0	1.228

LP-150 DC-140 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	0.12	0.1	21.7	10.0	5.875
50.0	0.20	0.0	18.9	30.0	5.932
70.0	0.19	0.1	31.6	50.0	6.124
87.5	0.30	0.1	18.1	70.0	6.723
107.5	0.34	0.1	19.0	87.5	6.973
127.5	0.43	0.1	21.2	107.5	7.940
140.0	0.59	0.1	18.5	127.5	9.564
147.5	1.11	0.1	11.0	140.0	11.710
155.0	3.27	0.2	4.3	145.0	13.582
165.0	9.15	0.4	1.2	147.5	14.703
180.0	18.50	0.6	0.4	150.0	15.571
195.0	26.35	0.7	0.2	155.0	15.775
200.0	28.70	0.7	0.2	165.0	10.701
205.0	30.89	0.7	0.2	170.0	8.263
210.0	33.01	0.8	0.2	180.0	5.337
220.0	36.90	0.8	0.1	190.0	3.934
240.0	43.83	0.9	0.1	195.0	3.242
260.0	49.92	1.3	0.1	200.0	3.185
270.0	52.20	1.9	0.1	205.0	2.751
290.0	57.13	1.7	0.1	210.0	2.474
300.0	59.12	2.5	0.1	220.0	2.061
320.0	64.42	3.7	0.1	230.0	1.548
360.0	69.97	6.8	0.1	240.0	0.945
462.5	71.43	5.2	0.1	250.0	0.617
502.5	74.26	2.1	0.1	260.0	2.736
522.5	72.73	2.6	0.1	270.0	2.100
540.0	72.69	4.1	0.1	290.0	2.428
560.0	72.65	5.6	0.0	300.0	2.217
590.0	76.20	9.3	0.1	320.0	2.006
600.0	70.55	3.8	0.1	350.0	1.977

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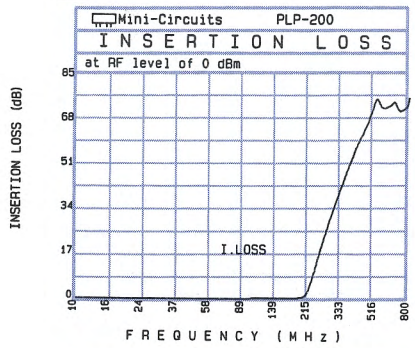
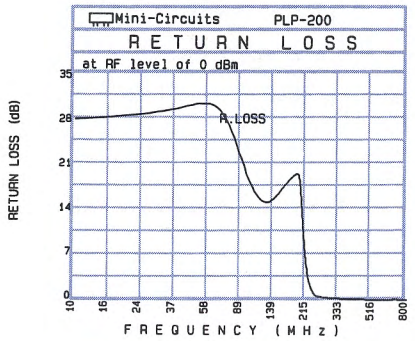
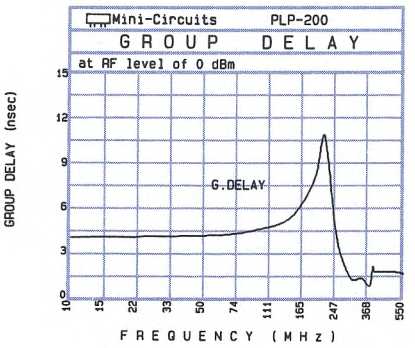
LP-200 DC-190 MHz

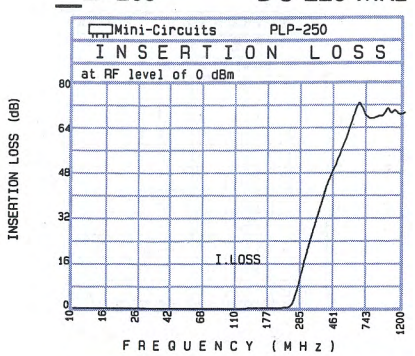


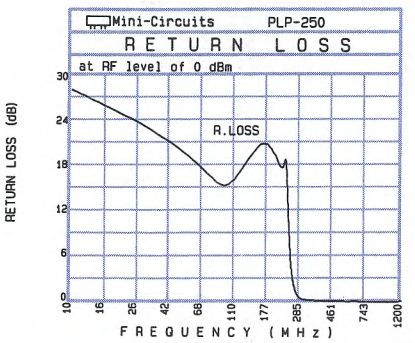


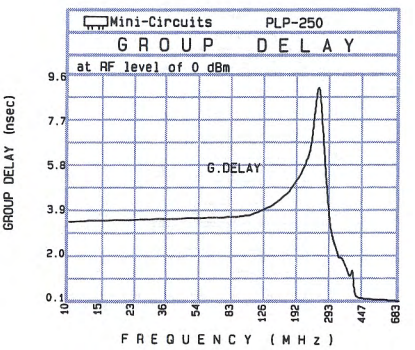


Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.08	0.1	28.6	10.0	4.181
37.5	0.12	0.1	30.1	37.5	4.307
67.5	0.15	0.1	32.8	67.5	4.375
95.0	0.26	0.1	18.5	95.0	4.777
122.5	0.43	0.1	14.3	122.5	5.092
150.0	0.39	0.1	17.4	150.0	5.752
190.0	0.58	0.1	21.0	190.0	8.298
200.0	0.96	0.2	13.6	195.0	9.067
210.0	2.52	0.7	5.9	200.0	10.178
220.0	6.01	1.1	2.4	205.0	11.129
240.0	15.07	1.3	0.7	210.0	11.423
250.0	19.34	1.3	0.6	220.0	9.611
260.0	23.25	1.4	0.5	235.0	5.782
280.0	30.20	1.5	0.4	240.0	4.995
290.0	33.33	1.5	0.4	245.0	4.341
300.0	36.17	1.5	0.3	250.0	3.626
320.0	41.60	1.8	0.3	260.0	2.947
370.0	53.41	2.3	0.2	280.0	1.790
380.0	55.00	2.8	0.2	290.0	1.539
385.0	56.23	2.7	0.2	300.0	1.210
390.0	57.87	4.0	0.2	310.0	0.877
490.0	71.86	7.9	0.1	320.0	0.152
550.0	72.71	1.6	0.1	340.0	1.772
602.5	74.42	2.5	0.1	370.0	0.312
660.0	77.14	4.3	0.0	380.0	2.764
715.0	72.38	5.7	0.1	385.0	1.862
750.0	73.49	3.5	0.1	390.0	1.941
780.0	73.91	4.7	0.1	490.0	1.922
790.0	80.33	5.3	0.1	517.5	1.909
800.0	77.51	9.6	0.1	550.0	1.810

LP-250 DC-225 MHz

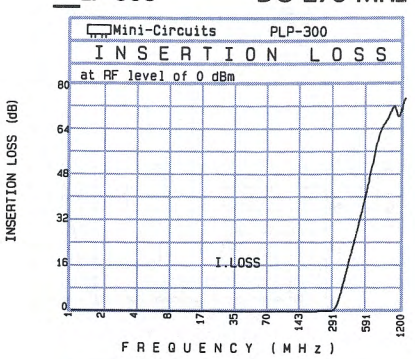


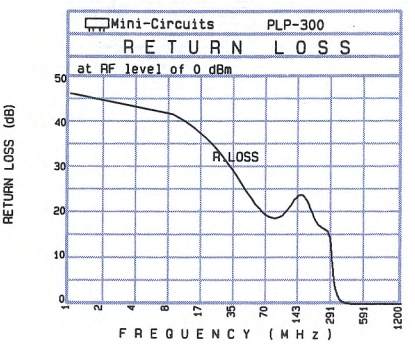


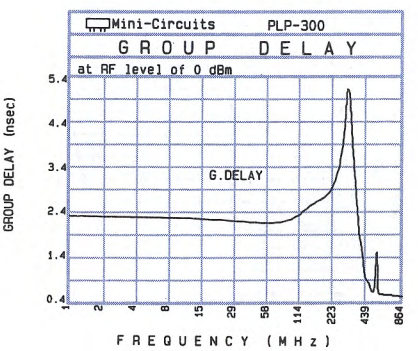


Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.03	0.1	28.7	10.0	3.536
20.0	0.03	0.1	24.7	20.0	3.664
80.0	0.20	0.1	16.1	80.0	3.780
100.0	0.28	0.1	14.8	100.0	3.799
165.0	0.27	0.1	24.4	165.0	4.630
217.5	0.60	0.1	16.4	217.5	6.373
225.0	0.64	0.1	20.4	225.0	7.252
240.0	1.59	0.3	8.3	230.0	7.997
250.0	3.87	0.6	3.6	240.0	9.420
260.0	7.27	0.9	1.6	245.0	9.371
280.0	14.62	1.0	0.5	250.0	8.907
300.0	21.27	1.1	0.3	260.0	6.898
310.0	24.28	1.2	0.3	270.0	5.183
315.0	25.71	1.2	0.3	280.0	3.908
320.0	27.12	1.3	0.3	290.0	3.016
330.0	29.77	1.3	0.3	300.0	2.657
350.0	34.87	1.6	0.2	310.0	2.334
370.0	39.35	1.9	0.2	315.0	2.139
380.0	41.63	2.0	0.2	320.0	1.982
390.0	43.91	2.3	0.2	330.0	2.131
400.0	46.09	2.7	0.2	340.0	1.529
580.0	69.80	3.0	0.1	350.0	1.299
682.5	69.02	1.5	0.1	360.0	1.371
785.0	69.27	2.4	0.1	370.0	1.149
890.0	69.72	4.5	0.1	380.0	1.777
992.5	70.16	5.1	0.1	390.0	0.460
1045.0	73.29	6.6	0.1	400.0	0.269
1097.5	70.40	5.6	0.0	580.0	0.252
1147.5	71.08	3.9	0.2	630.0	0.201
1200.0	71.31	2.1	0.2	682.5	0.195

LP-300 DC-270 MHz







Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
1.0	0.02	0.1	47.4	1.0	2.373
49.0	0.13	0.1	19.7	49.0	2.197
97.0	0.17	0.1	18.2	97.0	2.292
145.0	0.15	0.1	28.3	145.0	2.757
193.0	0.28	0.1	17.5	193.0	2.818
241.0	0.36	0.1	17.4	241.0	3.419
270.0	0.53	0.1	15.6	270.0	4.447
280.0	1.00	0.1	9.8	275.0	5.142
297.0	2.83	0.2	4.3	280.0	5.327
300.0	3.29	0.2	3.8	290.0	5.236
340.0	11.27	0.3	0.7	297.0	5.080
360.0	15.31	0.3	0.4	300.0	4.747
380.0	19.09	0.4	0.3	320.0	3.644
400.0	22.62	0.4	0.2	340.0	2.788
410.0	24.31	0.4	0.2	350.0	2.487
450.0	30.64	0.6	0.1	360.0	1.910
490.0	36.51	0.9	0.1	380.0	1.791
520.0	40.88	1.2	0.1	400.0	1.152
530.0	42.34	1.3	0.1	410.0	0.976
540.0	43.72	1.3	0.1	450.0	0.880
550.0	45.07	1.5	0.1	480.0	0.703
700.0	66.82	5.7	0.1	490.0	1.163
864.0	71.78	6.6	0.1	500.0	0.426
960.0	76.06	6.9	0.1	520.0	2.107
1056.0	70.05	3.2	0.1	530.0	0.673
1110.0	73.87	7.7	0.1	540.0	0.651
1120.0	72.31	5.1	0.1	550.0	0.630
1140.0	76.33	5.1	0.1	700.0	0.609
1150.0	72.33	3.5	0.1	800.0	0.592
1200.0	77.29	5.8	0.1	864.0	0.580

rugged, high selectivity

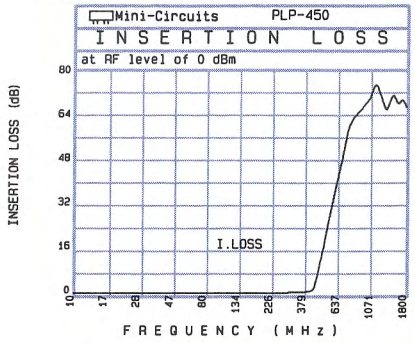
Low Pass Filters

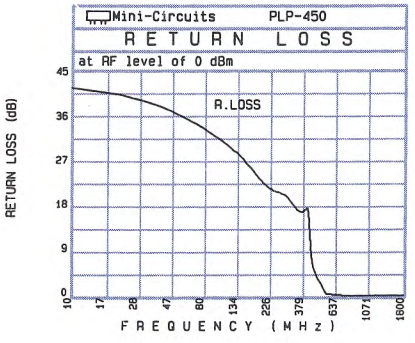
MODEL SELECTION

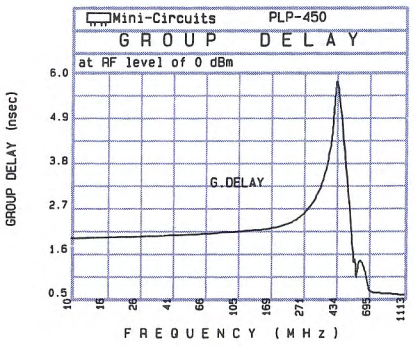
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

_LP-450 DC-400 MHz

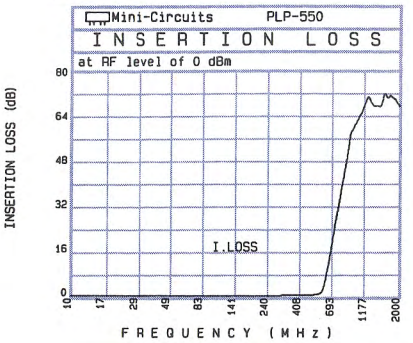


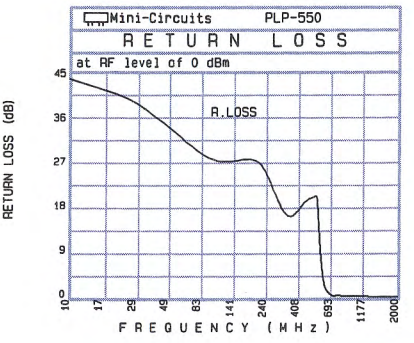


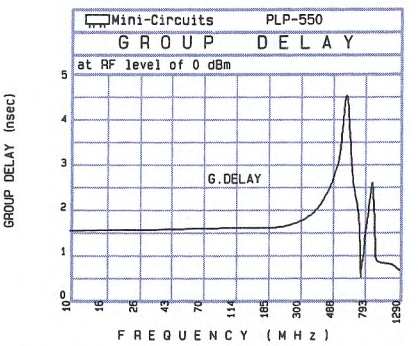


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	0.02	0.1	42.4	10.0	1.960
80.0	0.06	0.1	33.6	80.0	2.096
147.5	0.10	0.1	28.3	147.5	2.158
217.5	0.19	0.1	21.0	217.5	2.274
285.0	0.25	0.1	21.4	285.0	2.598
355.0	0.46	0.1	16.3	355.0	3.254
400.0	0.63	0.1	18.0	400.0	4.255
420.0	1.01	0.1	12.8	410.0	4.757
440.0	2.84	0.2	5.2	420.0	5.318
545.0	26.52	0.9	0.4	430.0	5.871
555.0	28.57	0.9	0.3	440.0	5.989
565.0	30.55	1.0	0.3	545.0	1.522
570.0	31.51	1.0	0.3	550.0	1.277
575.0	32.52	1.0	0.3	555.0	1.450
580.0	33.47	1.0	0.3	560.0	1.419
590.0	35.44	1.0	0.3	565.0	1.420
620.0	40.86	1.1	0.2	570.0	0.882
680.0	51.19	1.6	0.2	575.0	1.196
700.0	54.79	1.8	0.1	580.0	1.114
720.0	57.91	1.2	0.1	590.0	1.484
750.0	62.99	2.7	0.2	600.0	1.666
975.0	69.53	2.1	0.1	620.0	0.933
1112.5	78.46	9.9	0.1	640.0	1.237
1250.0	68.87	2.9	0.1	680.0	0.642
1387.5	69.76	8.2	0.1	700.0	0.615
1525.0	70.50	5.6	0.1	720.0	0.592
1592.5	68.09	0.9	0.1	750.0	0.581
1662.5	71.23	4.9	0.1	975.0	0.555
1730.0	72.22	6.0	0.1	1042.5	0.530
1800.0	67.80	4.1	0.1	1112.5	0.522

_LP-550 DC-520 MHz

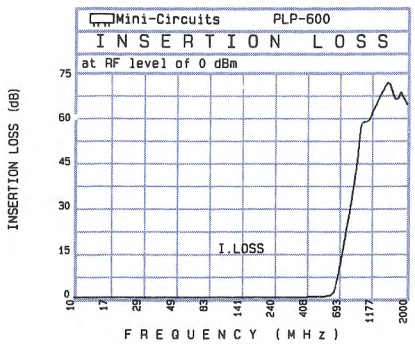


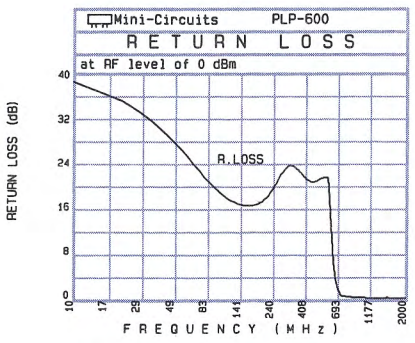


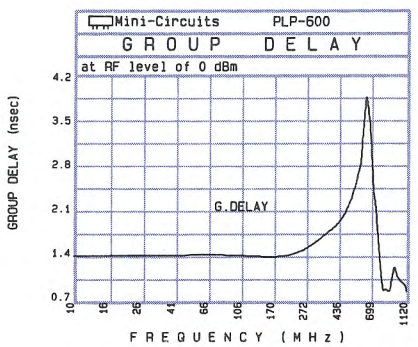


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	0.02	0.1	44.6	10.0	1.545
152.5	0.10	0.1	28.0	80.0	1.611
222.5	0.15	0.1	28.8	152.5	1.611
295.0	0.27	0.1	18.0	222.5	1.605
365.0	0.38	0.1	15.3	295.0	1.750
437.5	0.36	0.1	19.6	365.0	1.929
520.0	0.57	0.1	20.4	437.5	2.318
550.0	0.75	0.1	20.8	520.0	2.990
570.0	1.17	0.3	12.7	540.0	3.339
580.0	1.68	0.4	9.2	550.0	3.661
620.0	7.07	1.1	2.3	570.0	4.368
720.0	26.51	1.6	0.2	580.0	4.591
730.0	28.52	1.6	0.3	600.0	4.675
740.0	29.95	1.6	0.3	620.0	3.721
750.0	31.57	1.6	0.4	650.0	2.392
760.0	33.24	1.7	0.4	720.0	2.077
800.0	39.85	1.9	0.3	730.0	0.040
870.0	50.78	2.4	0.2	740.0	0.991
900.0	55.60	2.9	0.2	750.0	0.808
910.0	58.10	4.7	0.2	760.0	0.888
920.0	59.19	4.2	0.2	780.0	1.485
1147.5	68.70	3.0	0.2	800.0	1.712
1290.0	68.19	3.5	0.1	850.0	2.480
1432.5	69.02	4.4	0.1	870.0	2.813
1572.5	75.22	5.7	0.1	900.0	1.614
1715.0	73.18	5.2	0.1	910.0	0.907
1787.5	71.84	3.4	0.1	920.0	0.825
1857.5	71.44	3.7	0.1	1147.5	0.801
1930.0	71.78	6.9	0.1	1217.5	0.728
2000.0	68.82	2.1	0.1	1290.0	0.645

_LP-600 DC-580 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	0.01	0.1	39.3	10.0	1.412
152.5	0.22	0.2	16.2	80.0	1.438
295.0	0.20	0.1	25.3	152.5	1.382
437.5	0.28	0.1	20.5	222.5	1.417
507.5	0.37	0.1	21.9	295.0	1.590
577.5	0.59	0.1	22.0	365.0	1.787
580.0	0.60	0.1	21.9	437.5	1.948
620.0	1.50	0.3	9.6	507.5	2.267
640.0	2.98	0.4	5.1	577.5	2.856
670.0	7.09	0.6	2.1	580.0	2.854
720.0	15.52	2.0	0.4	600.0	3.364
800.0	28.44	4.7	0.3	620.0	3.840
820.0	31.52	5.4	0.3	630.0	3.984
830.0	33.06	5.7	0.3	640.0	3.809
840.0	34.63	6.1	0.3	670.0	3.367
880.0	41.22	8.0	0.2	700.0	2.262
920.0	48.84	9.9	0.2	720.0	2.297
960.0	58.62	9.9	0.2	750.0	1.483
1000.0	59.95	9.9	0.2	800.0	0.771
1100.0	59.89	8.4	0.1	820.0	0.930
1120.0	62.05	8.8	0.1	830.0	1.543
1360.0	71.05	2.3	0.1	840.0	1.004
1502.5	73.53	9.3	0.2	880.0	0.790
1572.5	70.71	4.9	0.1	900.0	1.010
1650.0	67.12	3.4	0.1	920.0	1.110
1750.0	67.73	7.7	0.1	940.0	1.281
1800.0	70.74	9.5	0.1	960.0	1.145
1850.0	68.64	9.1	0.1	1000.0	1.023
1950.0	68.21	7.1	0.1	1100.0	0.952
2000.0	65.82	4.6	0.1	1120.0	0.852

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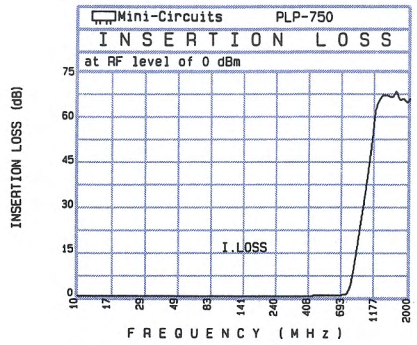
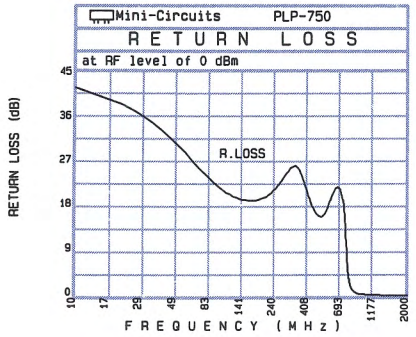
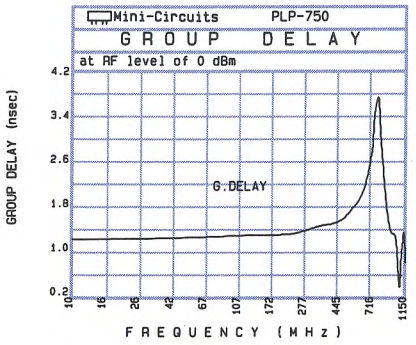
LP-750 DC-700 MHz

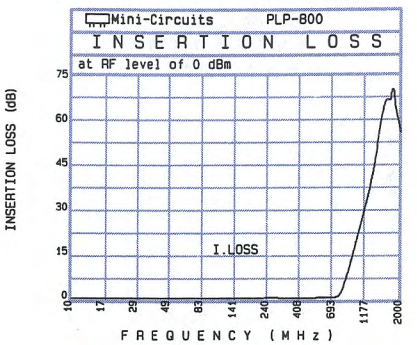


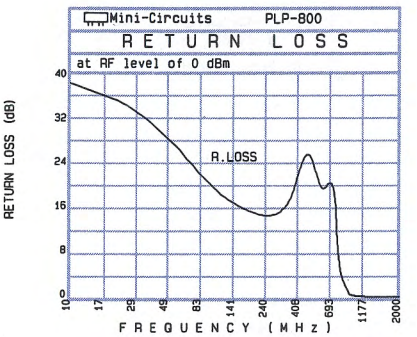


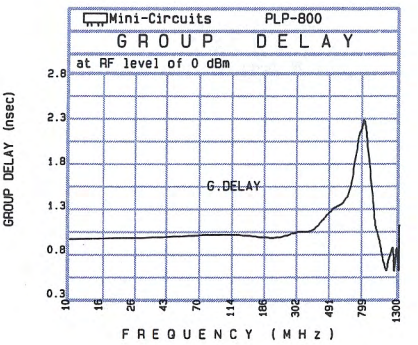


Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.01	0.1	42.4	10.0	1.219
142.5	0.13	0.1	18.9	77.5	1.270
275.0	0.13	0.1	24.0	142.5	1.312
407.5	0.24	0.1	19.5	210.0	1.290
540.0	0.34	0.1	16.1	275.0	1.377
672.5	0.50	0.1	22.5	342.5	1.480
700.0	0.61	0.1	19.6	407.5	1.492
720.0	0.75	0.1	18.8	475.0	1.583
770.0	3.29	0.2	4.7	540.0	1.802
780.0	4.47	0.2	3.5	607.5	1.959
820.0	10.67	0.5	1.2	672.5	2.423
900.0	23.62	0.9	0.5	700.0	2.776
920.0	26.64	1.0	0.4	710.0	2.807
940.0	29.60	1.1	0.4	720.0	3.177
1000.0	38.46	1.5	0.3	730.0	3.549
1040.0	44.45	1.5	0.3	770.0	3.814
1080.0	50.55	2.0	0.2	780.0	3.791
1100.0	54.84	3.5	0.2	800.0	2.986
1120.0	57.93	4.7	0.2	820.0	2.719
1150.0	64.79	5.8	0.3	870.0	1.693
1200.0	68.75	5.6	0.1	900.0	1.271
1300.0	69.77	6.9	0.1	920.0	1.114
1535.0	66.70	2.9	0.1	940.0	1.191
1602.5	70.91	7.5	0.2	1000.0	1.450
1667.5	67.12	3.1	0.1	1040.0	0.375
1735.0	66.47	6.6	0.1	1060.0	0.240
1800.0	67.59	9.9	0.1	1080.0	1.052
1867.5	66.42	3.7	0.1	1100.0	1.042
1932.5	65.70	7.4	0.1	1120.0	1.544
2000.0	67.17	5.8	0.1	1150.0	0.787

LP-800 DC-720 MHz

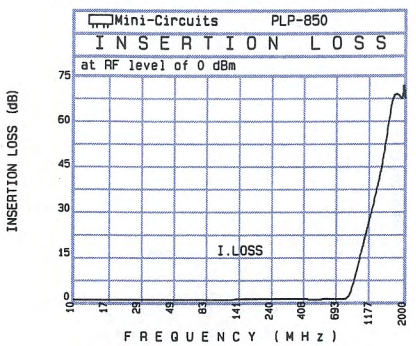


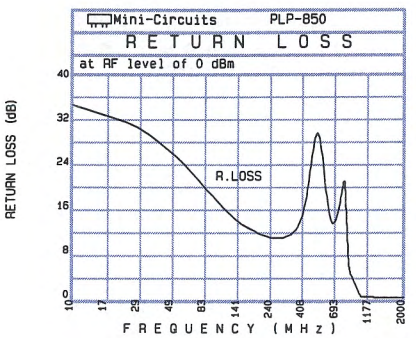


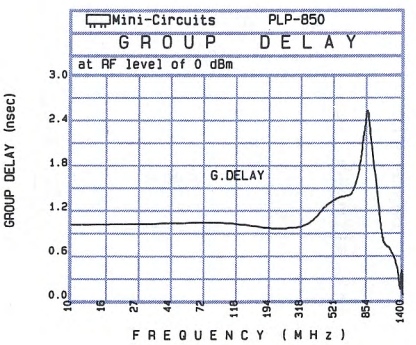


Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.04	0.1	38.9	10.0	0.962
152.5	0.20	0.1	16.2	80.0	1.025
295.0	0.26	0.1	15.0	152.5	0.997
437.5	0.18	0.1	26.9	222.5	0.960
577.5	0.32	0.1	18.2	295.0	1.066
650.0	0.35	0.1	21.2	365.0	1.025
720.0	0.48	0.1	20.1	437.5	1.215
760.0	1.36	0.2	8.0	507.5	1.333
800.0	3.45	0.3	3.7	577.5	1.358
900.0	11.91	0.5	0.6	650.0	1.550
950.0	16.24	0.5	0.4	720.0	2.161
1000.0	20.40	0.6	0.3	740.0	2.172
1010.0	21.22	0.6	0.2	760.0	2.231
1050.0	24.40	0.7	0.2	780.0	2.364
1080.0	26.70	0.7	0.2	800.0	2.211
1100.0	28.21	0.7	0.2	900.0	1.274
1190.0	34.98	1.0	0.1	910.0	1.122
1250.0	39.81	1.3	0.1	950.0	1.017
1290.0	43.03	1.5	0.1	970.0	0.961
1300.0	43.66	1.4	0.1	1000.0	0.825
1400.0	53.30	3.1	0.1	1010.0	0.890
1500.0	64.81	3.4	0.1	1050.0	0.804
1600.0	68.20	6.6	0.1	1080.0	0.526
1700.0	66.77	2.9	0.1	1100.0	0.733
1720.0	68.97	6.7	0.1	1150.0	0.789
1735.0	70.75	8.2	0.1	1190.0	0.958
1800.0	71.72	6.9	0.1	1200.0	0.377
1820.0	65.74	5.8	0.1	1250.0	1.115
1900.0	61.76	6.1	0.1	1290.0	0.345
2000.0	56.62	3.2	0.1	1300.0	1.116

LP-850 DC-780 MHz







Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.02	0.1	35.0	10.0	0.997
175.0	0.38	0.1	11.8	92.5	1.053
342.5	0.44	0.1	11.3	175.0	0.940
507.5	0.18	0.1	37.1	257.5	0.952
672.5	0.57	0.1	11.8	342.5	0.966
755.0	0.43	0.1	20.2	425.0	1.217
780.0	0.48	0.1	21.5	507.5	1.345
820.0	1.33	0.6	9.1	590.0	1.396
850.0	3.00	0.9	4.4	672.5	1.381
1010.0	17.47	1.1	0.3	755.0	1.847
1030.0	19.18	1.1	0.2	780.0	2.228
1050.0	20.83	1.1	0.2	790.0	2.221
1060.0	21.63	1.1	0.2	820.0	2.549
1070.0	22.41	1.1	0.2	840.0	2.573
1100.0	24.70	1.1	0.2	850.0	2.359
1110.0	25.52	1.1	0.2	1010.0	0.985
1150.0	28.51	1.2	0.2	1020.0	0.915
1350.0	43.25	1.6	0.1	1030.0	0.875
1360.0	44.10	1.9	0.1	1050.0	0.778
1380.0	45.39	1.8	0.1	1060.0	0.753
1400.0	47.43	2.2	0.1	1070.0	0.804
1420.0	48.89	2.1	0.1	1100.0	0.843
1667.5	69.86	3.1	0.1	1110.0	0.702
1750.0	70.13	6.6	0.1	1120.0	0.703
1835.0	69.30	4.7	0.1	1150.0	0.688
1900.0	67.90	2.7	0.1	1300.0	0.445
1920.0	70.63	3.5	0.1	1350.0	0.016
1930.0	69.67	2.6	0.1	1360.0	0.240
1950.0	74.71	7.2	0.1	1380.0	0.484
2000.0	68.74	4.9	0.1	1400.0	0.048

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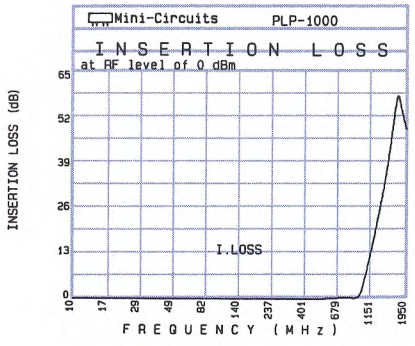
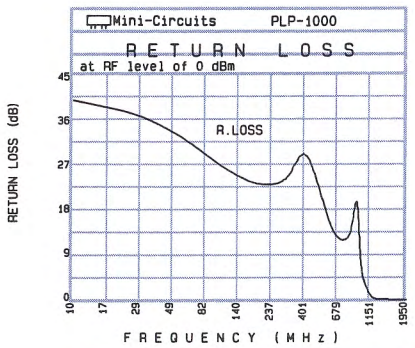
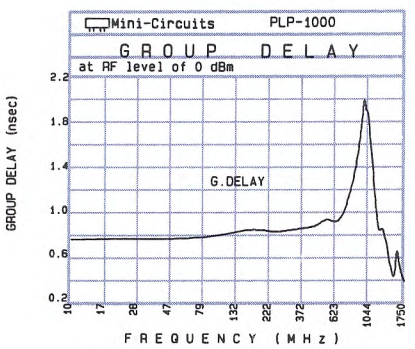
MODEL SELECTION
(choose prefix)
P = plug in N = type N
B = BNC S = SMA

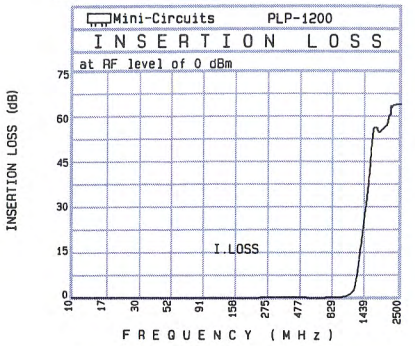
LP-1000 DC-900 MHz

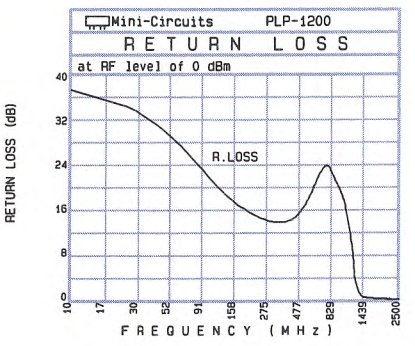


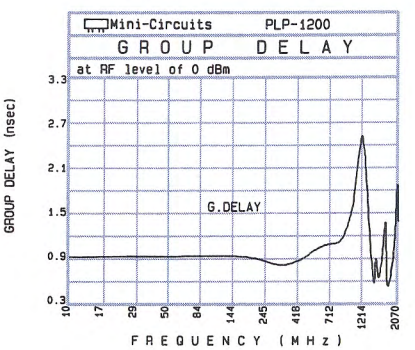




LP-1200 DC-1000 MHz







Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
10.0	0.01	0.0	40.9	10.0	0.765
82.5	0.02	0.0	28.4	82.5	0.773
305.0	0.07	0.1	24.5	157.5	0.880
525.0	0.17	0.1	20.0	230.0	0.825
747.5	0.54	0.1	12.2	305.0	0.856
900.0	0.40	0.1	23.8	377.5	0.872
930.0	0.75	0.1	12.4	452.5	0.886
970.0	2.06	0.2	5.9	525.0	0.970
990.0	3.10	0.2	4.1	600.0	0.912
1115.0	12.75	0.5	0.6	672.5	0.967
1250.0	23.28	0.7	0.2	747.5	1.171
1270.0	24.76	0.8	0.2	820.0	1.385
1280.0	25.53	0.8	0.2	900.0	1.786
1300.0	27.07	0.9	0.2	930.0	2.066
1340.0	30.19	1.0	0.2	950.0	2.007
1400.0	34.90	1.2	0.2	970.0	1.900
1500.0	43.32	1.8	0.2	990.0	1.986
1550.0	48.04	2.6	0.1	1115.0	1.084
1600.0	53.09	3.9	0.2	1190.0	0.764
1700.0	61.90	8.3	0.2	1250.0	0.977
1750.0	58.54	3.6	0.1	1270.0	0.807
1760.0	58.62	6.4	0.1	1280.0	0.338
1790.0	57.18	2.8	0.1	1300.0	0.978
1800.0	56.81	1.9	0.1	1340.0	0.501
1820.0	55.81	3.2	0.1	1400.0	0.795
1850.0	54.77	2.3	0.1	1500.0	0.213
1860.0	53.85	1.3	0.1	1550.0	0.769
1880.0	53.19	1.8	0.1	1600.0	0.547
1900.0	52.56	1.6	0.1	1700.0	0.425
1950.0	50.28	1.1	0.1	1750.0	0.391

Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
10.0	0.03	0.0	38.3	10.0	0.937
195.0	0.16	0.1	15.7	100.0	0.964
380.0	0.43	0.1	14.0	195.0	0.952
565.0	0.24	0.1	19.0	285.0	0.806
750.0	0.29	0.1	25.3	380.0	0.853
930.0	0.48	0.1	20.1	470.0	0.960
1000.0	0.55	0.1	18.1	565.0	1.074
1180.0	4.25	1.9	5.3	655.0	1.112
1200.0	5.69	2.2	3.4	750.0	1.123
1300.0	17.67	3.0	0.7	840.0	1.158
1420.0	32.19	3.6	0.5	930.0	1.432
1500.0	43.83	5.7	0.4	1000.0	1.598
1550.0	53.20	7.9	0.3	1150.0	2.814
1600.0	58.27	7.5	0.3	1180.0	2.356
1620.0	57.94	6.7	0.3	1200.0	2.494
1690.0	58.01	8.4	0.3	1300.0	1.154
1720.0	55.64	6.2	0.2	1400.0	0.488
2000.0	58.68	3.8	0.2	1420.0	0.639
2050.0	61.62	3.9	0.1	1440.0	1.092
2070.0	62.15	5.5	0.1	1500.0	0.447
2100.0	62.95	5.6	0.1	1550.0	0.835
2110.0	62.89	5.0	0.1	1600.0	1.320
2120.0	61.95	4.1	0.1	1620.0	1.060
2130.0	64.71	5.4	0.1	1690.0	1.590
2140.0	66.13	8.4	0.1	1700.0	1.012
2150.0	64.30	6.7	0.1	1720.0	0.307
2160.0	65.10	7.9	0.1	1945.0	1.001
2200.0	65.98	8.1	0.1	2000.0	1.674
2300.0	70.50	9.9	0.1	2050.0	2.089
2500.0	65.98	4.1	0.1	2070.0	1.421

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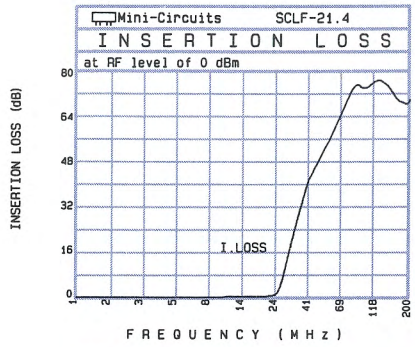
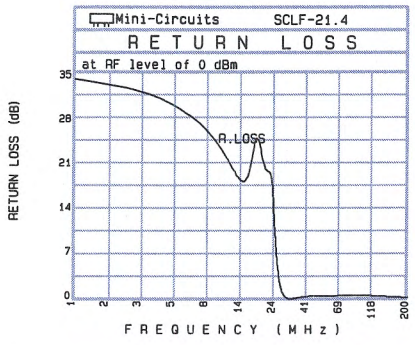
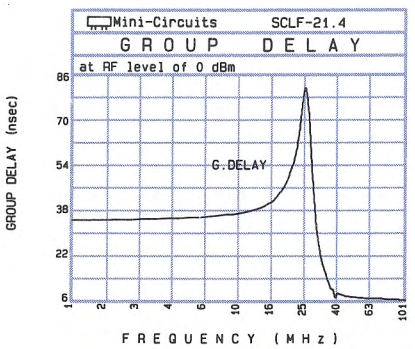
SCLF-21.4 DC-22 MHz

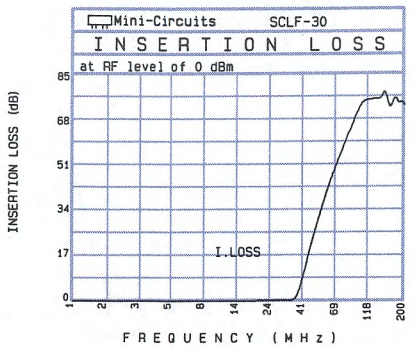


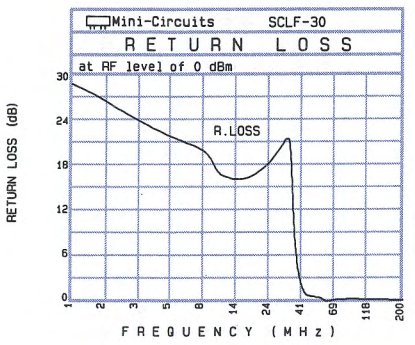


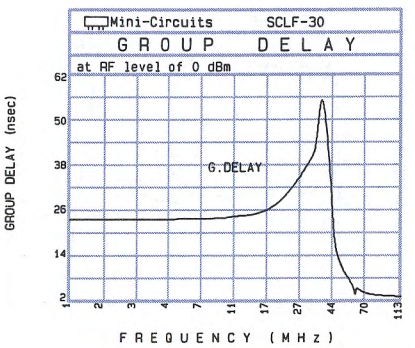


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.06	0.1	35.0	1.0	35.416
9.0	0.21	0.1	26.3	9.0	37.240
14.0	0.39	0.1	17.5	14.0	40.345
16.0	0.36	0.1	19.2	16.0	42.374
18.0	0.37	0.1	28.4	18.0	46.100
20.0	0.48	0.1	20.3	20.0	51.538
22.0	0.65	0.2	20.3	22.0	59.541
23.5	1.08	0.7	14.3	23.0	68.489
24.5	2.05	1.4	8.1	23.5	73.990
25.0	2.91	1.8	5.7	24.0	78.724
27.0	8.86	2.6	1.1	24.5	83.206
29.0	15.82	2.4	0.2	25.0	84.645
30.0	19.04	2.2	0.1	26.0	77.179
31.0	22.06	2.1	0.1	27.0	61.074
32.0	24.85	2.0	0.1	28.0	45.408
33.0	27.50	1.9	0.2	29.0	34.080
35.0	32.41	1.8	0.3	30.0	27.394
37.0	36.86	1.8	0.4	31.0	22.402
38.0	38.91	1.7	0.4	32.0	19.250
39.0	40.92	1.8	0.5	33.0	16.673
41.0	44.83	1.8	0.5	34.0	15.020
80.5	78.86	3.9	0.7	35.0	13.226
100.5	75.36	2.7	0.6	36.0	9.823
120.5	79.79	7.4	0.6	37.0	11.227
140.5	76.97	3.0	0.5	38.0	6.123
160.0	72.23	2.6	0.4	39.0	10.209
170.0	70.86	2.9	0.4	41.0	7.399
180.0	70.87	3.9	0.4	80.5	7.087
190.0	69.67	3.2	0.3	90.5	6.865
200.0	71.47	3.1	0.3	100.5	6.532

SCLF-30 DC-30 MHz

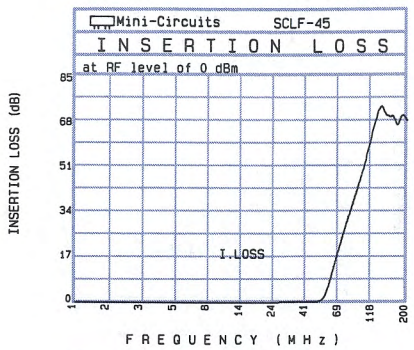


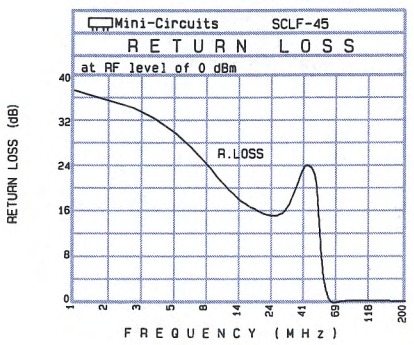


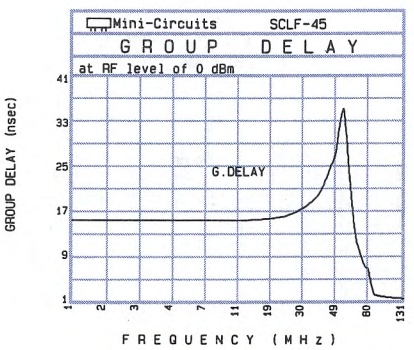


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.04	0.1	29.6	1.0	24.228
3.0	0.07	0.1	22.8	3.0	24.243
9.0	0.13	0.1	20.6	9.0	24.543
10.0	0.15	0.1	18.2	10.0	24.963
11.0	0.17	0.1	16.7	11.0	25.193
18.0	0.27	0.1	16.3	18.0	26.132
30.0	0.45	0.1	21.6	30.0	39.463
34.0	0.59	0.1	17.0	33.0	42.267
35.0	0.90	0.2	11.7	34.0	47.672
36.0	1.64	0.5	7.6	35.0	52.776
42.0	14.01	1.8	1.0	36.0	58.136
44.0	18.75	1.7	0.8	38.0	54.816
45.0	20.87	1.7	0.8	42.0	31.194
46.0	22.85	1.6	0.7	43.0	22.827
47.0	24.78	1.6	0.7	44.0	18.487
49.0	28.37	1.5	0.6	45.0	15.486
54.0	36.33	1.4	0.5	46.0	14.406
58.0	41.83	1.1	0.1	47.0	12.883
59.0	43.10	1.1	0.1	49.0	11.296
60.0	44.18	1.1	0.1	51.0	9.209
61.0	45.51	0.9	0.0	54.0	6.247
70.0	55.55	1.5	0.3	56.0	6.906
105.0	77.30	9.9	0.3	58.0	6.151
122.0	73.76	4.4	0.3	59.0	2.730
139.0	78.03	9.1	0.3	60.0	5.775
157.0	74.23	4.8	0.2	61.0	5.248
174.0	79.94	4.8	0.2	70.0	3.564
183.0	75.66	3.0	0.2	96.0	3.381
191.0	77.64	7.0	0.2	105.0	3.208
200.0	75.91	6.0	0.2	113.0	3.120

SCLF-45 DC-45 MHz



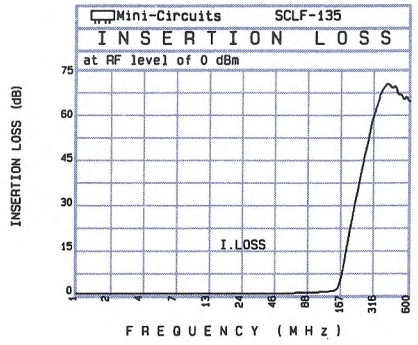


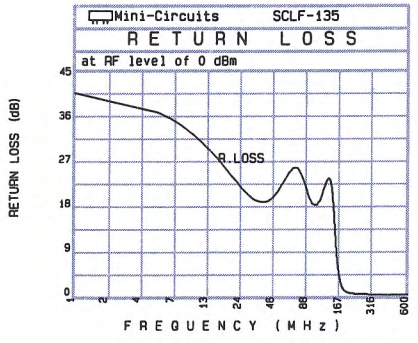


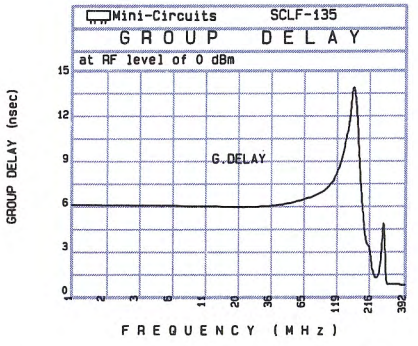
Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	0.03	0.0	38.4	1.0	15.995
10.0	0.12	0.1	20.7	10.0	15.850
16.5	0.18	0.1	17.1	16.5	16.144
24.0	0.30	0.1	15.2	24.0	16.723
31.5	0.31	0.1	16.8	31.5	18.499
39.5	0.31	0.1	25.9	39.5	21.040
45.0	0.49	0.1	24.4	45.0	26.383
52.0	1.22	0.2	9.9	48.0	27.157
55.0	3.37	0.6	3.8	50.0	31.441
58.0	7.23	0.8	1.3	52.0	34.883
61.0	11.68	0.9	0.4	54.0	36.740
64.0	15.98	0.9	0.1	55.0	35.950
66.0	18.68	0.8	0.1	58.0	27.094
68.0	21.26	0.8	0.2	60.0	21.940
70.0	23.69	0.8	0.3	61.0	20.016
72.0	26.02	0.8	0.3	63.0	15.603
76.0	30.42	0.8	0.4	64.0	14.207
80.0	34.44	0.8	0.4	66.0	11.743
85.0	39.13	0.7	0.5	68.0	10.933
87.0	41.06	0.8	0.5	70.0	9.311
90.0	43.71	0.9	0.5	72.0	7.857
100.0	51.96	1.5	0.5	74.0	6.262
135.0	75.54	9.9	0.5	76.0	7.016
150.0	72.20	4.3	0.4	78.0	7.756
161.5	72.82	3.9	0.4	80.0	5.539
170.0	67.46	2.8	0.4	85.0	2.623
177.0	70.41	5.0	0.4	87.0	2.405
184.5	73.51	4.8	0.3	90.0	2.378
192.5	70.37	4.7	0.3	100.0	2.041
200.0	70.36	5.5	0.3	131.0	1.807

Low Pass Filters

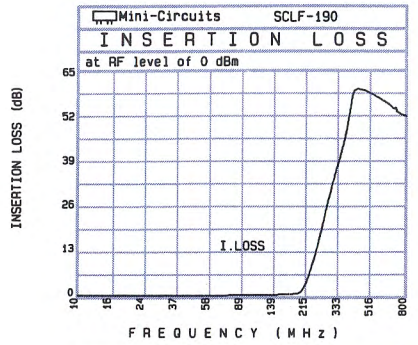
SCLF-135 DC-135 MHz

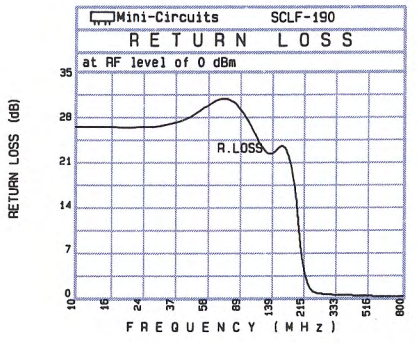


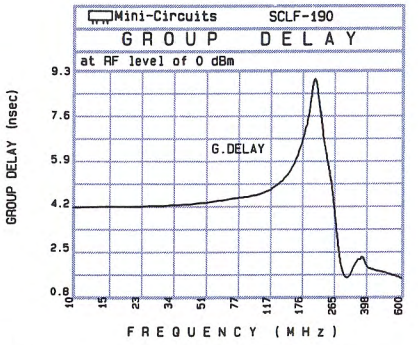




SCLF-190 DC-190 MHz







Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	0.03	0.1	41.3	1.0	6.053
25.0	0.18	0.1	17.8	25.0	5.852
48.0	0.22	0.1	18.7	48.0	6.148
71.0	0.25	0.1	30.3	71.0	6.567
94.0	0.45	0.1	16.3	94.0	6.982
117.0	0.57	0.1	19.7	117.0	8.089
135.0	0.87	0.1	26.2	135.0	10.404
149.0	1.42	0.1	13.1	145.0	11.861
155.0	2.54	0.2	7.4	149.0	12.964
160.0	4.29	0.4	4.4	152.0	13.888
175.0	12.53	0.7	1.1	155.0	14.123
189.0	20.35	0.8	0.6	160.0	13.839
196.0	23.89	0.8	0.5	168.0	10.809
203.0	27.23	0.8	0.4	175.0	7.919
210.0	30.34	0.9	0.3	182.0	6.031
220.0	34.51	0.9	0.3	189.0	4.243
243.0	43.15	1.1	0.2	196.0	3.351
266.0	50.60	1.1	0.2	203.0	3.348
278.0	54.30	2.2	0.2	210.0	2.977
289.0	58.28	3.6	0.1	220.0	0.924
300.0	60.35	2.8	0.1	232.0	1.884
350.0	69.91	4.3	0.1	243.0	0.039
392.0	72.49	2.5	0.1	255.0	1.016
434.0	69.22	3.4	0.1	266.0	6.799
475.0	67.52	1.5	0.1	278.0	0.422
517.0	67.56	2.1	0.1	289.0	0.702
538.0	65.57	1.8	0.1	300.0	0.652
559.0	67.78	3.0	0.1	350.0	0.631
580.0	65.80	2.4	0.1	371.0	0.608
600.0	65.48	2.6	0.1	392.0	0.599

Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
10.0	0.12	0.1	27.0	10.0	4.198
40.0	0.19	0.1	26.6	40.0	4.252
70.0	0.21	0.1	33.5	70.0	4.536
100.0	0.27	0.1	28.2	100.0	4.633
132.5	0.41	0.1	20.5	132.5	5.079
162.5	0.49	0.1	26.3	162.5	5.932
190.0	0.77	0.1	17.6	190.0	7.687
200.0	1.38	0.1	10.4	195.0	8.442
210.0	3.05	0.1	5.4	200.0	9.065
220.0	5.72	0.1	2.7	205.0	9.197
240.0	11.88	0.1	0.9	210.0	8.881
260.0	18.95	0.3	0.5	220.0	7.664
270.0	22.68	0.4	0.5	230.0	6.614
280.0	26.25	0.5	0.5	240.0	5.956
290.0	29.54	0.6	0.4	250.0	5.216
310.0	35.11	0.8	0.4	260.0	4.318
340.0	42.33	1.2	0.3	270.0	3.160
360.0	47.49	1.6	0.3	280.0	2.123
370.0	50.87	2.4	0.3	290.0	1.620
380.0	54.42	3.6	0.3	310.0	1.339
390.0	57.49	3.2	0.3	320.0	0.852
400.0	62.02	5.2	0.3	340.0	2.479
600.0	57.37	2.3	0.1	350.0	2.312
647.5	56.32	1.4	0.1	360.0	2.108
687.5	55.21	1.8	0.1	370.0	2.379
702.5	54.51	0.9	0.1	380.0	2.112
710.0	54.45	1.3	0.1	390.0	1.943
740.0	53.58	1.3	0.1	400.0	1.816
770.0	53.44	1.4	0.1	500.0	1.681
800.0	53.04	1.1	0.1	600.0	1.454

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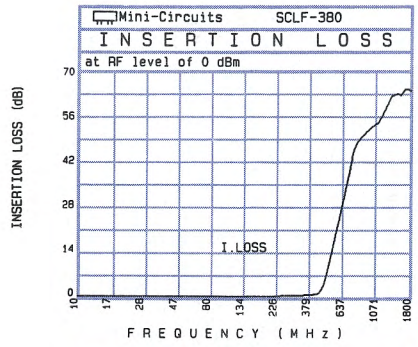
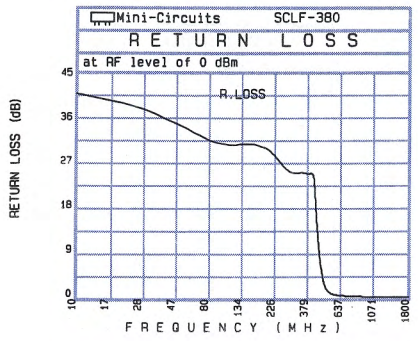
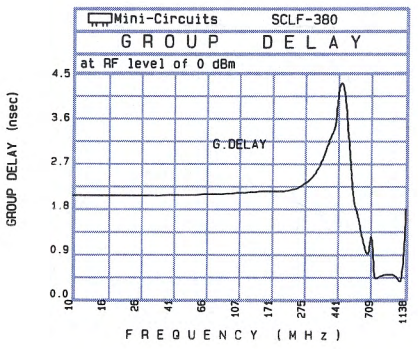
Mini-Circuits

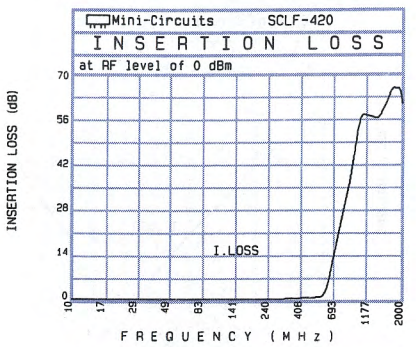
SCLF-380 DC-380 MHz

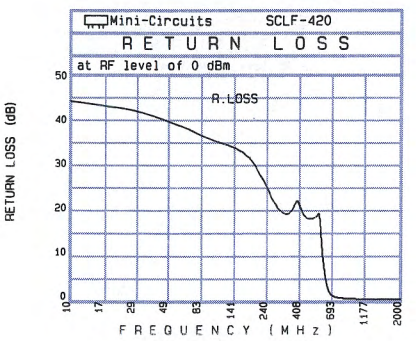


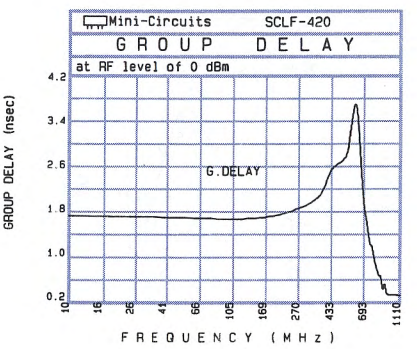




SCLF-420 DC-420 MHz







Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.02	0.1	41.4	10.0	2.085
142.5	0.13	0.1	31.6	77.5	2.111
210.0	0.20	0.1	30.5	142.5	2.192
275.0	0.29	0.1	24.6	210.0	2.162
342.5	0.44	0.1	25.6	275.0	2.315
380.0	0.67	0.1	24.9	342.5	2.707
410.0	0.74	0.1	25.6	380.0	3.242
430.0	1.03	0.2	16.4	410.0	3.437
440.0	1.34	0.2	12.2	420.0	3.606
460.0	2.74	0.5	6.5	430.0	4.079
500.0	8.54	0.7	1.8	440.0	4.369
540.0	15.86	0.7	0.8	460.0	4.447
560.0	19.27	0.7	0.6	480.0	4.118
570.0	20.89	0.7	0.5	500.0	3.250
580.0	22.44	0.7	0.5	520.0	2.598
600.0	25.63	0.7	0.4	540.0	1.853
640.0	31.77	0.9	0.4	560.0	1.817
680.0	37.56	1.0	0.3	570.0	1.679
700.0	40.46	1.1	0.3	580.0	1.555
720.0	43.62	1.5	0.2	600.0	1.295
750.0	49.16	2.2	0.2	620.0	1.241
1005.0	54.51	2.7	0.1	640.0	1.022
1137.5	57.05	4.5	0.1	660.0	0.731
1270.0	61.62	6.5	0.1	680.0	1.222
1402.5	63.80	6.1	0.1	700.0	1.336
1535.0	63.45	3.2	0.1	720.0	0.318
1600.0	65.10	3.1	0.1	750.0	0.456
1667.5	66.20	5.4	0.1	1005.0	0.557
1732.5	67.00	7.9	0.1	1070.0	0.084
1800.0	65.32	7.1	0.1	1137.5	1.829

Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.01	0.1	45.1	10.0	1.742
95.0	0.05	0.1	34.9	95.0	1.666
180.0	0.09	0.1	34.3	180.0	1.716
265.0	0.18	0.1	20.5	265.0	1.869
350.0	0.30	0.1	18.2	350.0	2.035
390.0	0.37	0.1	24.5	390.0	2.287
420.0	0.67	0.1	17.9	420.0	2.660
545.0	0.82	0.1	20.1	530.0	2.751
570.0	1.31	0.4	13.6	545.0	3.156
580.0	1.72	0.5	10.3	557.5	3.343
630.0	6.88	1.3	2.5	570.0	3.560
677.5	14.04	1.4	0.9	580.0	3.741
702.5	17.58	1.4	0.7	605.0	3.837
727.5	20.96	1.5	0.6	630.0	3.082
750.0	23.86	1.5	0.5	655.0	2.355
760.0	25.09	1.5	0.4	677.5	1.825
807.5	31.09	1.6	0.3	702.5	1.611
852.5	35.86	1.6	0.3	727.5	1.171
875.0	38.46	1.8	0.3	750.0	1.248
897.5	41.69	1.9	0.2	760.0	1.074
920.0	44.88	2.0	0.2	785.0	0.937
930.0	45.81	1.9	0.2	807.5	0.523
1110.0	58.81	1.8	0.1	830.0	0.573
1287.5	57.73	2.2	0.1	852.5	0.722
1465.0	60.69	5.6	0.1	875.0	0.283
1645.0	66.12	5.4	0.1	897.5	0.589
1732.5	67.71	3.7	0.1	920.0	0.336
1822.5	67.01	4.0	0.1	930.0	0.302
1912.5	67.81	6.3	0.2	1020.0	0.300
2000.0	62.49	1.6	0.2	1110.0	0.295

constant impedance

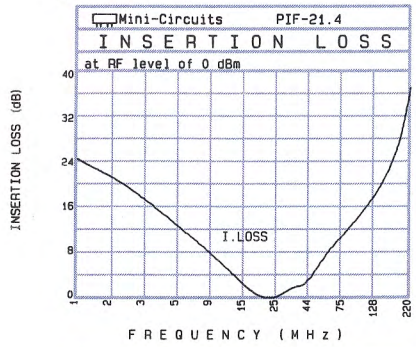
Bandpass Filters

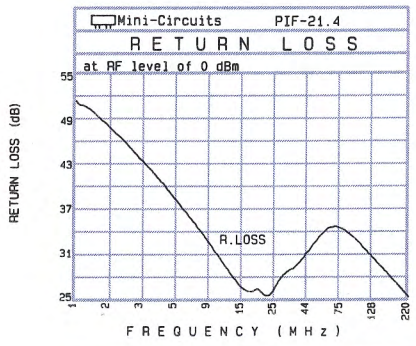
MODEL SELECTION

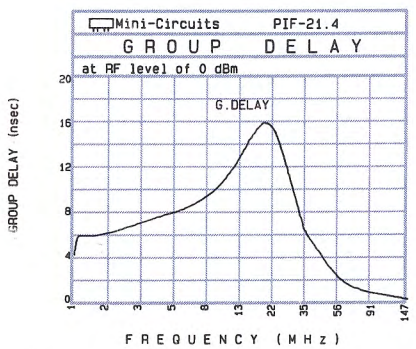
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

IF-21.4 18-25 MHz

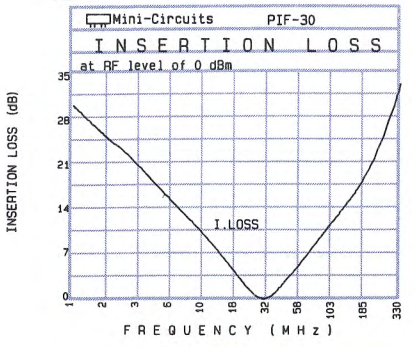


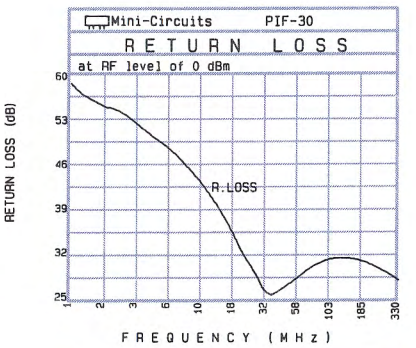


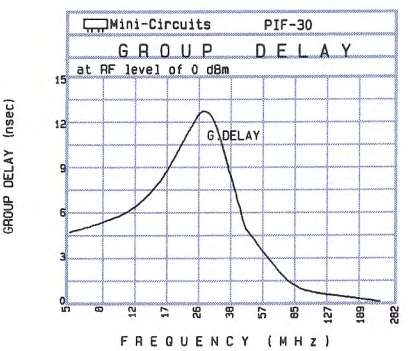


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	25.27	0.2	52.2	1.2	4.399
1.1	24.91	0.2	51.6	1.3	6.493
1.1	24.55	0.2	51.7	1.4	5.803
1.2	24.24	0.2	51.4	2.6	6.877
1.2	23.93	0.2	51.2	3.7	7.658
1.3	23.64	0.2	50.9	4.9	8.204
1.4	23.17	0.2	50.1	5.0	8.142
3.7	15.71	0.1	41.8	7.9	9.473
4.9	13.27	0.1	39.0	11.0	11.528
6.0	11.38	0.1	36.8	14.0	14.015
8.7	7.85	0.1	32.8	15.0	14.909
11.3	5.18	0.1	29.5	17.9	16.385
14.0	2.92	0.1	27.2	18.8	16.348
18.0	0.72	0.1	26.5	19.8	16.309
20.3	0.14	0.1	26.2	20.9	15.915
21.5	0.01	0.1	25.8	21.6	15.629
23.8	0.05	0.1	26.0	22.4	15.139
40.0	2.02	0.2	31.0	23.2	14.502
55.0	7.93	0.2	34.8	24.0	13.843
70.0	10.88	0.2	35.6	24.8	13.162
85.0	13.23	0.2	34.4	26.2	11.927
100.0	15.41	0.2	32.9	32.7	6.934
116.7	17.64	0.2	31.4	33.9	6.349
133.3	19.87	0.1	30.2	51.3	2.263
150.0	22.27	0.1	29.2	67.6	1.347
175.0	26.56	0.2	27.7	84.6	0.959
186.3	28.96	0.2	27.1	86.1	0.936
197.5	31.82	0.3	26.6	107.8	0.693
208.8	35.24	0.6	26.0	128.1	0.484
220.0	38.08	1.4	25.6	147.1	0.321

IF-30 25-35 MHz

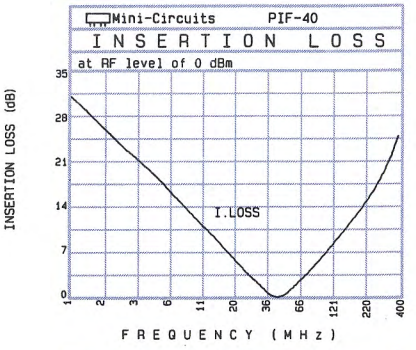


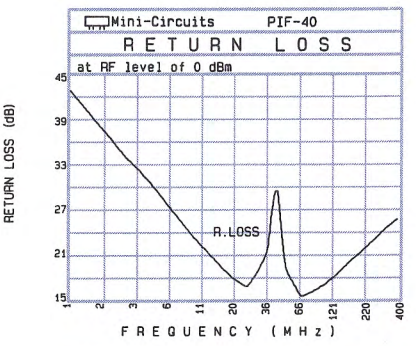


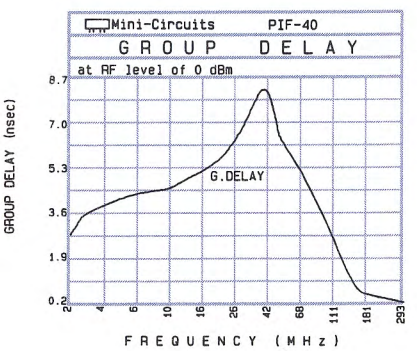


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	30.97	0.1	59.5	5.3	4.911
1.2	29.52	0.1	57.9	7.0	5.392
1.4	28.29	0.1	57.1	8.0	5.612
1.5	27.23	0.1	56.5	12.0	6.685
1.7	26.25	0.1	56.0	16.0	8.448
1.9	25.40	0.1	55.5	20.0	10.612
2.0	24.95	0.1	55.8	21.0	11.190
5.3	16.33	0.1	49.5	25.0	12.864
7.0	13.88	0.1	47.5	26.0	13.075
8.0	12.64	0.1	46.0	27.3	13.145
12.0	8.66	0.1	41.6	28.8	12.980
16.0	5.59	0.1	37.4	30.0	12.639
20.0	3.10	0.1	33.5	31.0	12.237
26.0	0.66	0.1	29.6	32.3	11.647
28.7	0.26	0.1	28.0	33.8	10.775
31.0	0.25	0.1	26.7	35.0	10.047
33.7	0.55	0.1	26.1	36.0	9.449
44.0	2.99	0.1	27.1	44.0	5.471
45.0	3.25	0.1	27.2	45.0	5.093
70.0	8.33	0.1	30.4	70.0	1.581
95.0	11.72	0.1	31.5	95.0	0.883
120.0	14.33	0.1	31.8	120.0	0.718
121.0	14.43	0.1	31.8	121.0	0.703
180.3	19.47	0.1	31.2	150.8	0.518
210.0	21.85	0.1	30.8	180.3	0.428
211.0	21.93	0.1	30.8	210.0	0.305
258.6	26.09	0.2	29.8	233.8	0.196
282.4	28.52	0.2	29.3	234.0	0.246
306.2	31.23	0.3	28.7	258.0	0.031
330.0	34.20	0.4	28.2	282.0	0.378

IF-40 35-49 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	31.97	0.1	43.7	2.3	2.895
1.3	29.62	0.1	41.1	2.6	3.319
1.6	27.72	0.1	39.1	2.7	3.755
2.0	26.20	0.1	37.6	5.2	4.422
2.3	24.90	0.1	36.1	7.5	4.574
2.6	23.77	0.1	34.9	9.9	4.649
3.0	22.54	0.1	33.7	11.0	4.904
5.3	17.56	0.1	28.5	16.1	5.402
7.7	14.41	0.1	25.3	20.9	5.852
10.0	12.05	0.1	23.0	26.2	6.700
11.0	11.21	0.1	22.2	27.1	6.840
15.3	8.20	0.1	19.5	35.1	8.288
19.7	5.92	0.1	17.8	36.3	8.399
35.0	0.86	0.1	21.4	37.6	8.498
40.3	0.23	0.1	30.0	39.6	8.488
44.7	0.31	0.1	25.5	41.7	8.249
50.0	0.88	0.1	18.9	43.2	7.937
65.0	3.17	0.1	15.6	45.4	7.393
99.3	7.37	0.2	17.3	47.0	6.910
133.7	10.43	0.2	19.4	48.7	6.395
168.0	12.93	0.3	21.1	50.4	5.956
212.0	15.76	0.3	22.7	63.1	3.323
256.0	18.46	0.4	24.0	64.2	3.167
300.0	21.25	0.5	25.1	98.9	1.296
301.0	21.32	0.5	25.0	132.6	0.812
320.8	22.67	0.6	25.4	168.9	0.599
340.6	24.13	0.7	25.8	207.7	0.474
360.4	25.67	0.9	26.1	211.3	0.462
380.2	27.40	1.1	26.2	255.6	0.363
400.0	29.24	1.4	26.3	293.4	0.264

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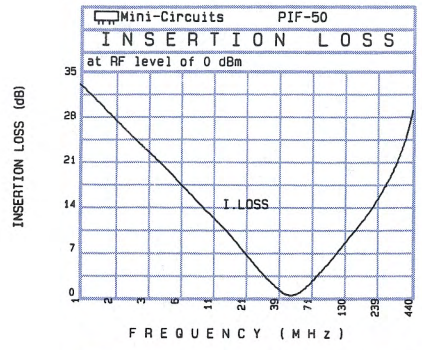
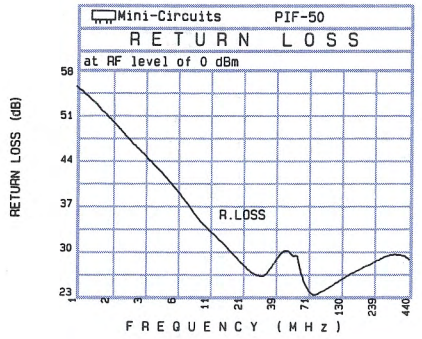
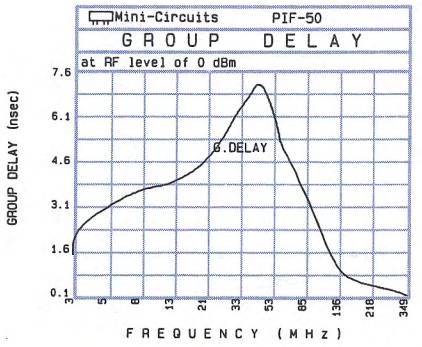
Mini-Circuits

IF-50 41-58 MHz

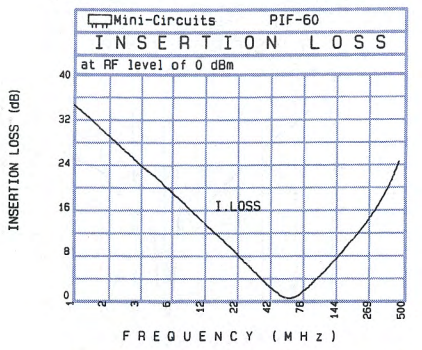


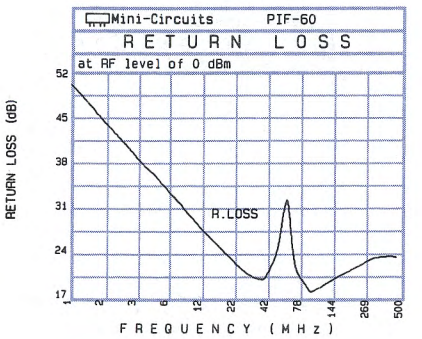


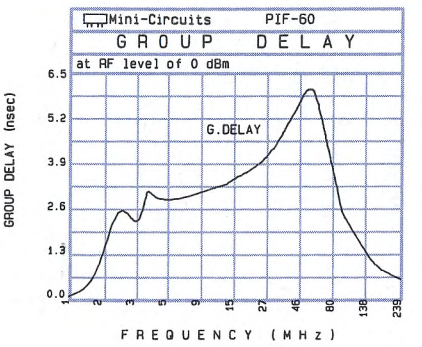


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	33.62	0.2	56.3	3.1	1.540
1.4	30.60	0.2	53.5	3.2	2.572
1.8	28.39	0.2	51.1	5.9	3.434
2.3	26.60	0.2	49.3	8.7	3.800
2.7	25.16	0.2	47.6	11.4	3.893
3.1	23.91	0.2	46.4	11.6	3.910
4.0	21.72	0.3	43.9	18.2	4.448
9.0	14.63	0.2	35.6	24.4	5.257
11.5	12.44	0.2	33.2	31.1	6.290
20.0	7.25	0.2	28.5	32.2	6.428
23.7	5.61	0.2	27.1	41.0	7.293
27.3	4.18	0.2	26.3	41.7	7.342
31.0	2.95	0.2	26.2	43.9	7.325
41.0	0.70	0.1	29.3	46.2	7.197
45.5	0.28	0.1	30.2	48.7	6.905
50.0	0.21	0.1	30.0	51.3	6.571
53.0	0.34	0.1	29.3	53.1	6.309
77.0	3.12	0.1	23.2	55.9	5.874
80.0	3.52	0.1	23.1	57.9	5.441
120.0	7.84	0.1	25.4	58.9	5.242
160.0	10.99	0.2	27.0	77.6	2.769
200.0	13.61	0.2	27.5	117.5	1.114
250.0	16.51	0.2	28.8	119.5	1.093
316.7	20.38	0.4	29.6	160.3	0.679
350.0	22.46	0.4	29.7	200.7	0.525
390.0	25.29	0.6	29.5	246.9	0.414
402.5	26.25	0.7	29.5	251.2	0.408
415.0	27.29	0.8	29.3	298.5	0.306
427.5	28.35	0.9	29.2	342.8	0.185
440.0	29.49	1.0	28.9	348.7	0.163

IF-60 50-70 MHz

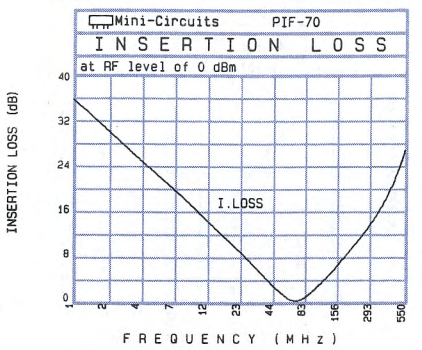


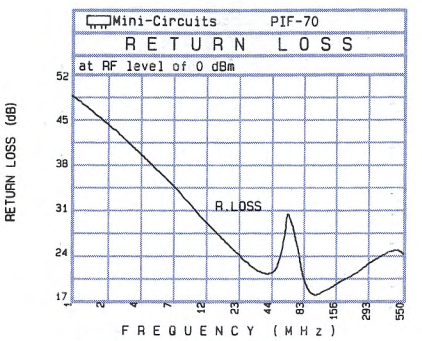


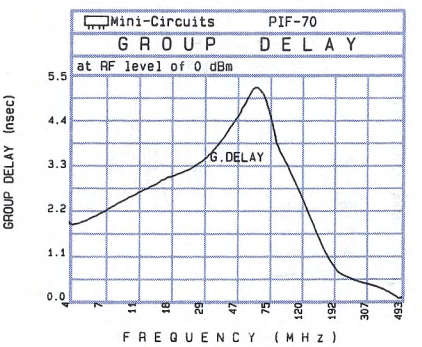


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	35.25	0.1	50.9	1.0	0.036
1.6	31.45	0.1	46.7	1.6	0.385
2.1	28.84	0.1	43.8	2.1	2.704
2.7	26.81	0.1	41.8	2.7	2.564
3.2	25.18	0.1	40.0	3.2	1.978
3.8	23.80	0.1	38.6	3.8	3.449
4.0	23.37	0.1	37.9	3.9	2.820
10.7	14.83	0.1	29.0	7.3	2.963
14.0	12.40	0.1	26.6	10.7	3.244
20.0	9.15	0.1	23.6	14.0	3.331
26.0	6.66	0.1	21.4	15.0	3.511
32.0	4.65	0.1	20.2	22.8	3.863
38.0	3.00	0.1	19.9	30.5	4.455
50.0	0.75	0.1	24.5	38.2	5.190
56.4	0.27	0.1	31.0	38.9	5.236
61.9	0.26	0.1	31.0	50.4	6.121
67.3	0.54	0.0	23.7	51.3	6.127
92.0	3.08	0.1	18.0	54.0	6.168
94.0	3.30	0.1	17.9	56.9	6.165
142.7	7.76	0.1	20.3	58.9	6.001
191.3	11.04	0.1	21.4	62.0	5.775
240.0	13.71	0.2	22.5	64.2	5.461
260.0	14.71	0.2	22.9	67.6	5.045
306.7	17.09	0.2	23.5	70.0	4.715
353.3	19.45	0.3	23.6	71.2	4.566
400.0	22.02	0.5	23.7	90.7	2.549
425.0	23.50	0.6	23.7	92.3	2.464
450.0	25.09	0.6	23.5	142.1	1.039
475.0	26.76	0.8	23.4	190.5	0.715
500.0	28.43	0.9	23.1	238.5	0.552

IF-70 58-82 MHz







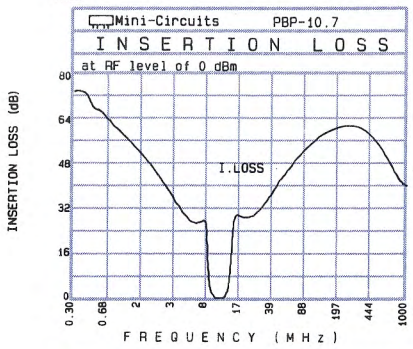
Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	36.56	0.2	49.5	4.4	1.965
1.7	32.08	0.2	45.9	4.5	1.803
2.4	29.16	0.2	43.7	8.4	2.416
3.0	27.01	0.2	41.6	12.2	2.736
3.7	25.26	0.2	40.1	16.1	2.984
4.4	23.82	0.2	38.7	17.0	3.059
6.0	21.13	0.2	36.2	26.2	3.326
12.7	14.61	0.2	29.4	35.1	3.817
16.0	12.53	0.2	27.5	43.9	4.422
20.0	10.51	0.2	25.5	44.7	4.419
28.3	7.27	0.2	22.7	57.9	5.270
36.7	4.76	0.2	21.3	58.9	5.288
45.0	2.79	0.1	21.3	62.0	5.357
58.0	0.77	0.1	27.9	65.3	5.248
63.7	0.34	0.1	29.7	68.8	5.146
70.0	0.24	0.1	26.9	72.4	4.843
74.7	0.35	0.1	25.1	75.0	4.639
105.0	2.87	0.1	17.9	79.0	4.231
110.0	3.34	0.2	18.0	81.8	3.959
166.7	7.80	0.2	20.2	83.2	3.803
223.3	11.10	0.2	21.3	105.9	2.168
280.0	13.80	0.3	23.0	107.8	2.082
290.0	14.28	0.3	23.1	166.0	0.886
423.3	20.50	0.9	24.9	222.6	0.581
490.0	24.04	1.4	25.1	278.6	0.458
500.0	24.60	1.5	25.0	342.8	0.360
512.5	25.30	1.5	24.9	348.7	0.351
525.0	25.98	1.6	24.8	421.7	0.199
537.5	26.70	1.6	24.6	484.2	0.031
550.0	27.34	1.4	24.5	492.6	0.079

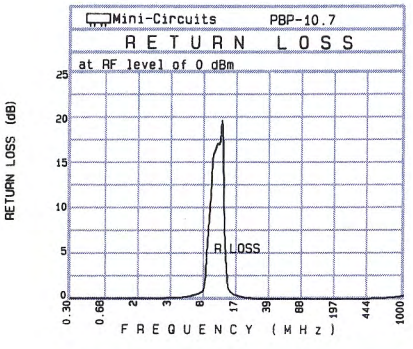
elliptic response

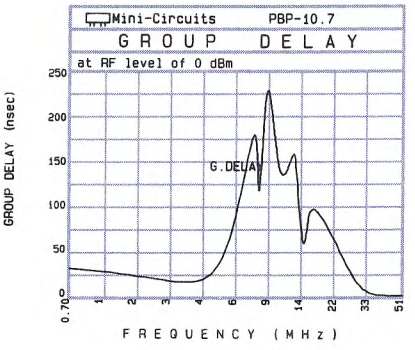
Bandpass Filters

MODEL SELECTION
(choose prefix)
P = plug in N = type N
B = BNC S = SMA

BP-10.7 9.5-11.5 MHz

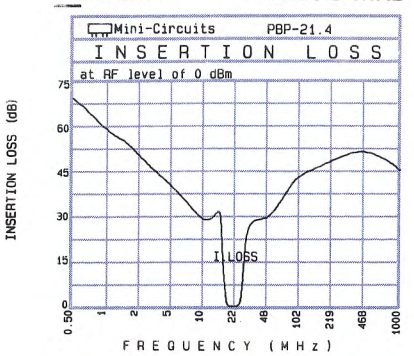


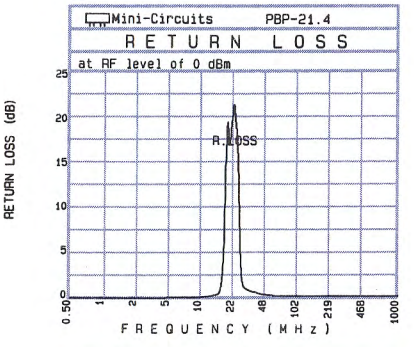


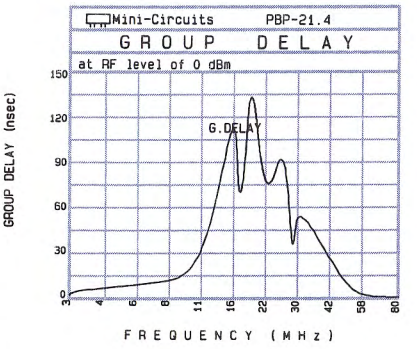


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
0.3	75.80	2.6	0.1	0.7	32.371
0.4	76.10	4.5	0.1	3.0	12.114
0.4	74.62	4.4	0.1	5.2	24.403
0.5	69.06	2.7	0.1	7.5	215.923
0.5	69.33	1.0	0.1	7.9	159.468
0.6	67.91	1.5	0.1	8.0	91.912
1.0	57.74	0.3	0.1	8.5	212.732
5.3	25.94	0.6	0.2	8.9	237.192
7.5	30.37	2.8	0.8	9.1	235.123
7.6	26.43	4.9	0.9	9.4	213.803
8.2	7.00	1.5	3.3	9.6	197.449
8.5	3.15	0.8	7.6	9.8	180.177
8.9	2.45	0.7	9.6	10.2	153.153
9.5	0.99	0.1	16.3	10.4	145.221
9.6	0.97	0.1	16.4	10.6	140.803
10.7	0.86	0.1	17.6	10.9	138.559
11.5	0.92	0.1	18.2	11.3	141.337
12.7	3.16	0.8	7.0	11.5	145.896
13.1	3.82	1.0	5.7	12.5	165.780
13.7	10.81	2.5	1.6	12.8	163.590
14.4	22.10	4.6	0.7	13.3	145.784
15.0	33.97	4.4	0.4	13.6	127.403
20.0	26.84	0.5	0.1	14.1	36.953
40.0	41.22	0.5	0.1	15.0	85.658
50.0	46.00	0.7	0.1	16.0	118.360
100.0	62.57	1.7	0.1	27.1	4.513
325.0	66.25	3.8	0.1	39.0	2.558
550.0	51.22	1.1	0.1	48.7	2.259
775.0	43.48	1.5	0.4	49.7	2.045
1000.0	41.66	1.9	0.4	50.7	2.283

BP-21.4 19.2-23.6 MHz

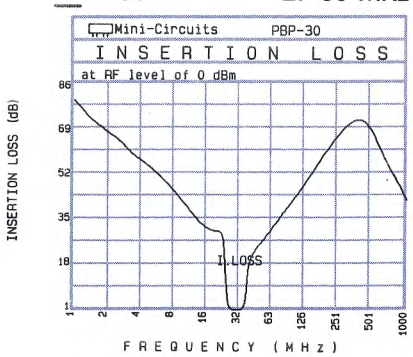


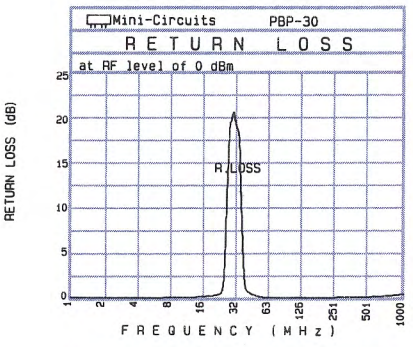


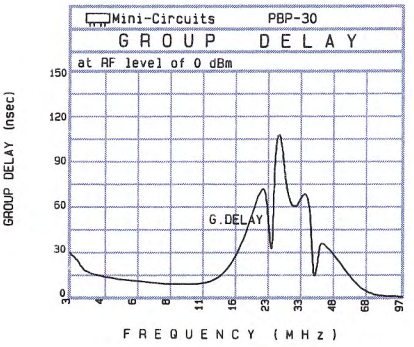


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
0.5	71.63	9.9	0.1	3.0	1.719
1.0	60.77	9.9	0.1	3.1	6.056
1.5	57.59	9.9	0.1	7.3	11.010
2.0	54.26	9.9	0.1	11.4	16.139
2.5	51.03	9.9	0.1	15.6	142.895
3.0	48.32	9.1	0.1	16.1	85.576
4.0	44.25	7.7	0.1	16.4	67.524
7.8	33.81	4.4	0.1	17.3	80.808
11.7	27.91	1.1	0.2	17.9	138.773
15.5	34.76	8.5	0.4	18.8	137.539
16.0	30.17	9.6	0.6	19.2	129.275
16.8	14.18	4.6	1.2	19.5	118.671
17.9	5.30	3.1	4.8	19.8	107.675
19.2	1.05	0.2	21.1	20.5	90.324
20.2	0.95	0.2	16.7	21.3	80.937
21.4	0.86	0.2	20.4	21.6	78.721
22.2	0.85	0.2	22.9	22.4	78.107
25.3	1.90	0.5	11.1	23.2	82.720
26.0	4.97	2.3	5.2	23.6	86.828
27.0	10.74	4.2	2.4	24.8	98.805
28.0	19.34	5.7	1.4	25.3	100.146
29.0	33.39	7.4	1.1	26.2	95.668
30.0	30.79	2.4	0.9	26.6	87.074
63.3	36.27	0.7	0.3	28.0	25.106
80.0	41.42	0.5	0.3	29.0	49.929
100.0	47.07	1.7	0.3	30.0	64.699
325.0	54.13	8.6	0.3	47.0	3.795
550.0	53.01	7.0	0.3	63.1	1.797
775.0	50.30	4.1	0.3	79.0	1.341
1000.0	47.08	3.5	0.3	80.4	1.116

BP-30 27-33 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	81.68	9.6	0.2	2.8	30.059
1.4	73.69	2.1	0.2	3.2	21.884
1.9	70.39	1.8	0.2	3.3	12.226
2.3	67.50	1.2	0.2	9.6	7.216
2.8	65.09	0.9	0.2	15.8	11.923
3.2	61.70	1.3	0.2	22.0	89.768
4.0	58.09	0.6	0.2	23.2	56.479
16.0	30.42	0.6	0.4	23.6	40.798
22.0	32.26	2.3	0.6	24.4	22.806
23.0	26.30	1.7	0.8	24.8	103.619
23.7	15.68	1.1	1.2	26.2	115.164
24.3	8.44	1.0	2.5	27.1	99.025
25.0	3.86	0.6	6.3	28.0	78.962
27.0	1.28	0.1	20.8	28.5	72.223
29.3	1.02	0.1	21.6	29.5	64.660
30.5	1.02	0.1	20.0	30.0	62.760
32.8	1.16	0.1	18.6	31.1	61.836
35.0	2.37	0.3	8.8	31.6	62.724
36.0	4.69	0.5	4.5	32.2	64.652
37.3	11.24	0.9	1.7	32.7	67.765
38.7	21.64	1.2	0.9	33.9	76.095
40.0	38.75	2.0	0.7	35.1	80.917
50.0	26.83	0.5	0.3	36.3	75.838
82.7	39.42	0.4	0.3	37.6	9.558
99.0	43.92	0.6	0.3	38.9	16.978
190.0	65.36	2.3	0.3	40.3	34.601
392.5	80.00	3.9	0.4	41.0	41.413
595.0	59.40	2.2	0.4	59.9	3.448
797.5	50.83	1.8	0.6	80.4	1.230
1000.0	43.35	2.3	0.8	97.2	0.971

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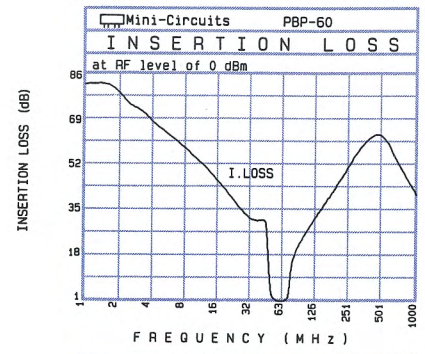
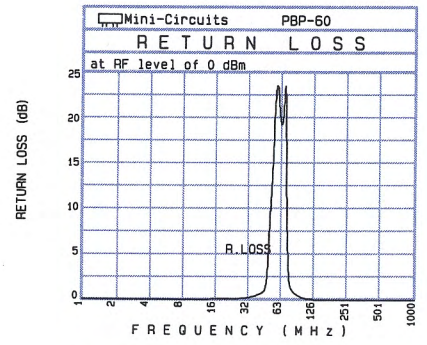
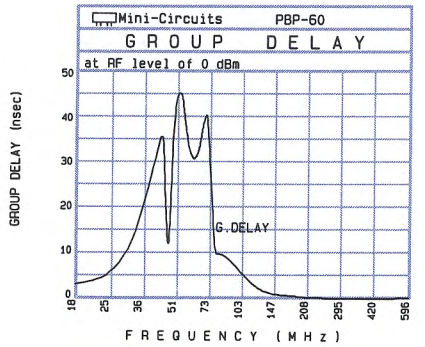
Mini-Circuits

BP-60 55-67 MHz

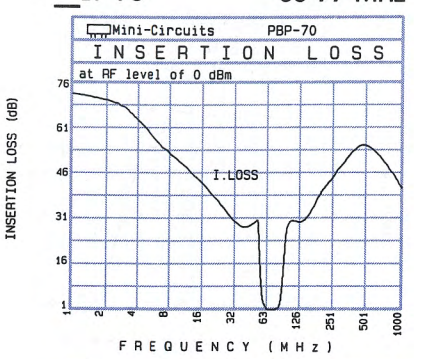


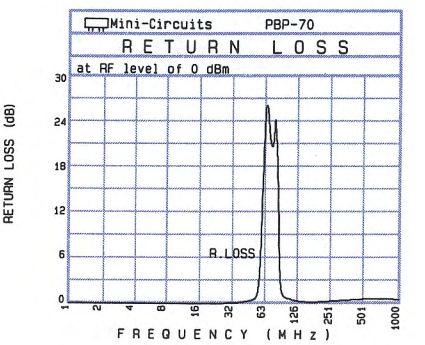


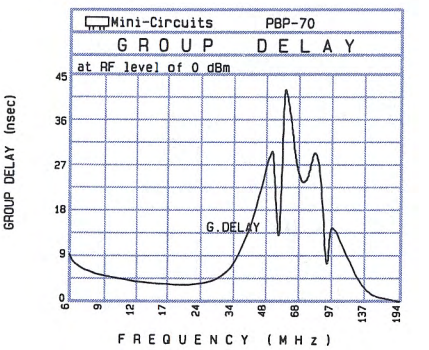


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	84.04	7.1	0.1	17.9	3.240
1.7	85.43	7.0	0.1	31.1	5.995
2.4	76.11	2.6	0.1	43.9	39.921
3.2	74.96	2.8	0.1	44.7	35.653
3.9	71.07	2.3	0.1	46.2	16.491
4.6	67.50	1.7	0.1	47.9	6.771
10.0	54.99	0.4	0.1	49.5	46.457
32.7	30.64	0.9	0.2	54.0	47.142
44.0	33.27	4.8	0.9	55.0	43.528
45.0	29.89	6.3	1.1	55.9	40.065
47.0	15.98	3.6	2.0	57.9	34.902
48.6	7.60	2.1	4.7	58.9	33.283
49.8	3.27	0.7	9.8	61.0	31.633
55.0	1.36	0.1	23.3	62.0	31.517
58.7	1.16	0.1	23.8	64.2	32.819
60.3	1.14	0.1	21.0	65.3	34.547
63.7	1.20	0.1	19.8	66.5	36.948
70.5	2.89	0.3	9.8	67.6	39.519
71.0	3.45	0.3	8.0	70.0	42.124
73.7	9.21	0.6	2.4	71.2	41.298
76.3	18.97	0.8	0.9	73.7	26.181
79.0	34.96	1.1	0.5	76.3	1.540
100.0	27.50	0.5	0.1	77.6	7.179
160.0	40.78	0.6	0.1	79.0	12.528
190.0	45.59	0.7	0.1	115.5	1.937
300.0	61.77	1.7	0.1	152.2	0.901
475.0	68.58	5.7	0.1	187.3	0.734
650.0	53.94	1.4	0.1	190.5	0.405
825.0	46.86	1.7	0.1	393.6	0.055
1000.0	42.22	1.9	0.1	595.7	0.502

BP-70 63-77 MHz







Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	74.05	9.9	0.1	6.0	9.637
2.0	72.12	9.9	0.1	7.0	4.541
3.0	70.17	9.9	0.1	21.6	3.025
4.0	65.27	9.9	0.1	36.3	5.629
5.0	62.16	9.9	0.1	51.3	33.642
6.0	58.09	9.9	0.1	52.2	29.619
10.0	49.84	8.7	0.1	54.0	17.384
37.3	26.90	2.5	0.2	55.9	8.664
51.0	31.67	1.6	0.6	57.9	42.682
52.0	31.71	6.1	0.8	58.9	44.815
55.3	10.89	2.4	2.2	63.1	36.286
57.0	5.56	1.5	4.8	64.2	32.857
58.0	3.59	1.0	7.7	65.3	30.036
63.0	1.24	0.1	26.8	67.6	26.418
66.2	1.10	0.1	27.1	70.0	24.706
70.0	1.11	0.1	22.3	71.2	24.425
72.7	1.18	0.1	21.2	73.7	24.966
82.0	2.13	0.6	18.8	75.0	25.878
85.0	6.18	2.4	5.1	77.6	28.843
88.0	12.70	3.1	2.1	80.4	31.882
91.0	22.06	4.0	1.2	81.8	32.569
94.0	32.17	1.3	0.9	83.2	32.242
95.0	33.31	2.7	0.8	86.1	26.228
160.3	35.43	0.7	0.3	90.7	2.764
193.0	41.33	1.0	0.3	93.9	14.126
200.0	42.38	1.0	0.3	95.5	17.476
400.0	60.24	9.9	0.7	128.1	2.113
600.0	53.81	8.2	0.8	160.3	1.095
800.0	46.59	4.3	0.7	190.5	0.413
1000.0	42.50	2.9	0.7	193.9	0.375

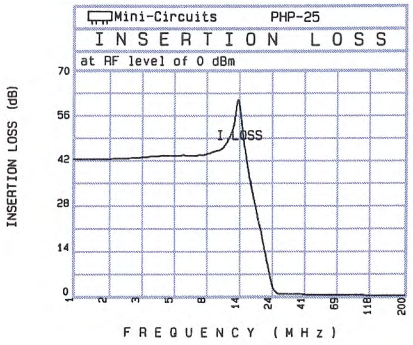
rugged, high selectivity

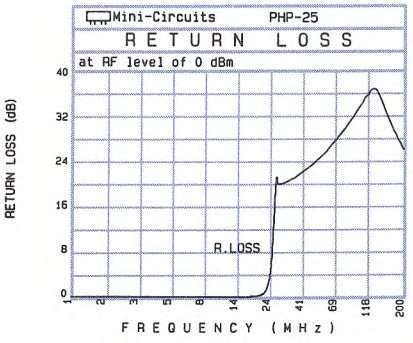
High Pass Filters

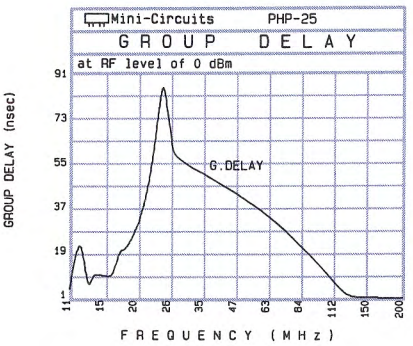
MODEL SELECTION
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

HP-25 27.5-200 MHz

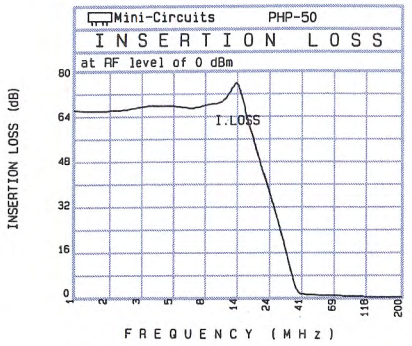


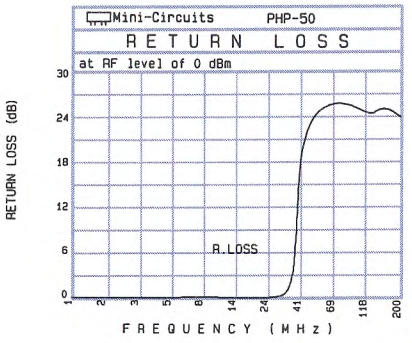


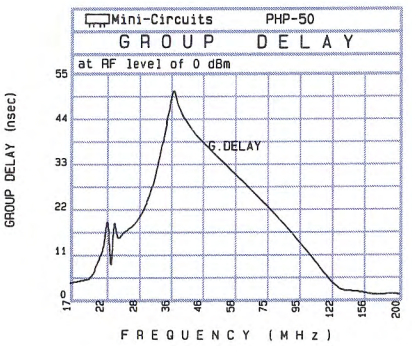


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	43.12	0.1	0.0	11.0	4.434
3.0	43.76	0.6	0.0	12.0	27.529
5.0	44.40	0.7	0.1	12.5	15.992
7.0	44.36	0.9	0.1	13.0	3.882
9.0	45.32	1.0	0.1	13.5	10.687
10.0	45.99	0.9	0.1	14.0	10.456
11.0	46.57	0.9	0.1	15.0	10.214
12.0	49.64	1.1	0.1	16.0	9.291
12.5	51.45	1.2	0.1	17.0	21.160
13.0	53.51	1.5	0.1	17.5	20.414
13.5	58.61	2.1	0.1	18.0	21.904
15.0	51.13	1.7	0.1	19.0	25.997
17.0	36.08	1.3	0.1	19.5	29.467
17.5	33.22	1.1	0.1	20.0	31.466
18.0	30.58	1.2	0.2	21.0	39.765
19.0	25.70	1.2	0.2	22.0	49.674
19.5	23.35	1.2	0.2	23.0	64.868
21.0	16.44	1.3	0.4	24.0	81.191
23.0	7.62	1.3	1.5	24.5	87.113
24.0	4.02	1.0	3.5	25.0	87.595
24.5	2.71	0.8	5.3	26.0	76.808
25.0	1.76	0.6	7.8	26.5	68.461
26.0	0.80	0.2	15.4	27.0	60.967
27.0	0.55	0.1	20.3	27.5	54.670
27.5	0.52	0.1	19.9	117.0	1.854
133.5	0.17	0.1	37.7	133.5	1.651
150.0	0.18	0.1	33.7	150.0	1.355
167.0	0.20	0.1	30.6	167.0	1.288
183.5	0.19	0.1	28.4	183.5	1.254
200.0	0.20	0.1	26.8	200.0	1.161

HP-50 41-200 MHz

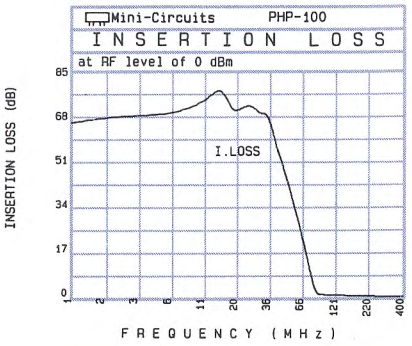


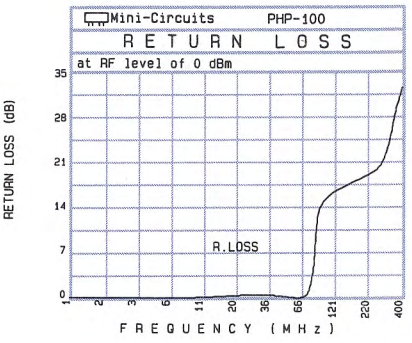


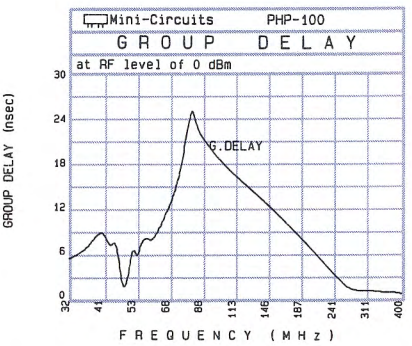


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	67.35	2.1	0.1	17.0	3.769
3.0	69.22	2.0	0.1	18.0	4.219
7.0	67.66	1.8	0.1	19.0	4.549
11.0	69.57	1.3	0.1	20.0	4.911
14.0	78.81	9.5	0.1	21.0	9.747
15.0	74.91	4.7	0.1	22.0	12.748
17.0	62.53	1.4	0.1	22.5	24.544
18.0	59.52	3.2	0.1	23.0	0.688
19.0	54.95	1.7	0.1	23.5	23.431
20.0	51.14	1.0	0.1	24.0	13.444
21.0	47.48	1.0	0.0	25.0	16.301
22.5	42.82	0.7	0.1	26.0	17.224
23.5	39.50	0.6	0.1	28.0	19.352
24.0	38.04	0.5	0.1	29.0	21.299
25.0	34.89	0.6	0.1	30.0	23.365
26.0	31.98	0.5	0.1	32.0	29.865
28.0	26.15	0.5	0.2	34.0	39.026
30.0	20.49	0.5	0.4	36.0	49.410
34.0	9.52	0.4	1.3	36.5	51.690
36.0	4.92	0.2	3.3	37.0	52.351
36.5	4.01	0.2	4.2	38.0	52.064
37.0	3.25	0.2	5.2	39.0	47.838
38.0	2.07	0.1	8.1	41.0	37.113
39.0	1.37	0.1	12.1	120.5	3.012
41.0	0.81	0.1	28.9	133.5	2.107
133.5	0.19	0.1	25.4	147.0	2.072
160.0	0.16	0.1	25.8	160.0	1.408
173.5	0.16	0.1	25.5	173.5	1.036
186.5	0.16	0.1	25.1	186.5	1.543
200.0	0.16	0.1	24.7	200.0	1.271

HP-100 90-400 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	66.80	1.3	0.0	32.0	5.381
5.0	69.56	0.5	0.0	35.0	6.183
12.0	76.93	5.0	0.2	38.0	7.454
18.0	72.01	4.0	0.4	40.0	8.914
25.0	74.64	7.6	0.5	42.0	9.149
30.0	70.54	2.0	0.6	44.0	6.488
32.0	70.63	3.7	0.6	46.0	8.820
35.0	70.04	3.6	0.6	48.0	0.923
38.0	63.40	2.1	0.5	50.0	1.834
40.0	59.85	0.7	0.5	52.0	7.907
42.0	55.56	0.6	0.5	54.0	5.058
46.0	49.83	0.5	0.4	55.0	7.570
50.0	43.77	0.6	0.3	58.0	8.594
52.0	40.75	0.6	0.2	60.0	7.486
54.0	37.94	0.5	0.2	65.0	10.515
55.0	36.57	0.6	0.2	70.0	13.562
58.0	32.40	0.6	0.1	72.0	15.205
65.0	22.98	0.7	0.1	75.0	18.218
72.0	13.63	0.6	0.5	80.0	25.450
75.0	9.75	0.5	1.0	82.0	26.109
80.0	4.23	0.1	3.4	84.0	24.717
82.0	2.74	0.1	5.3	86.0	23.578
84.0	1.74	0.1	8.0	90.0	17.768
86.0	1.16	0.1	11.5	250.5	1.916
90.0	0.72	0.1	17.3	275.5	1.257
275.5	0.23	0.1	21.4	300.0	1.138
325.0	0.21	0.1	25.8	325.0	1.183
350.0	0.21	0.1	29.9	350.0	0.946
375.0	0.21	0.1	32.9	375.0	1.012
400.0	0.21	0.1	33.5	400.0	0.784

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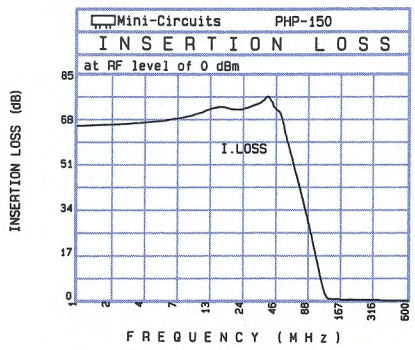
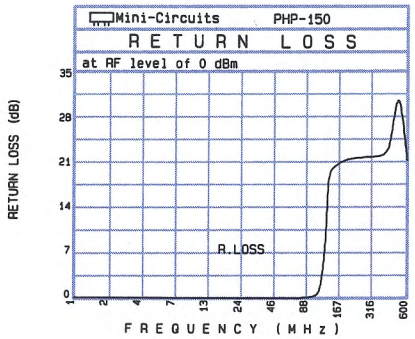
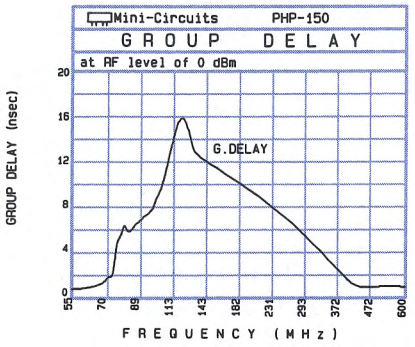
Mini-Circuits

HP-150 133-600 MHz

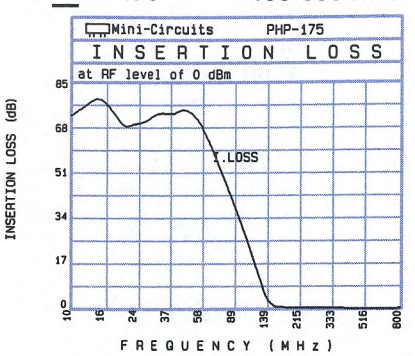


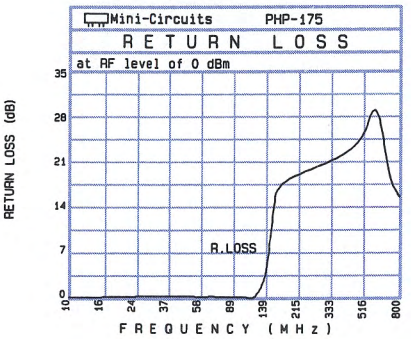


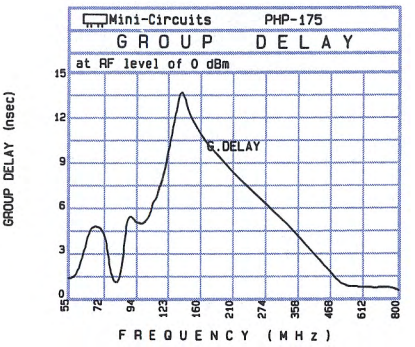


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	67.11	4.7	0.0	55.0	0.616
15.0	75.59	2.2	0.1	60.0	0.695
25.0	73.88	4.2	0.1	65.0	0.888
35.0	76.27	7.6	0.0	70.0	1.268
45.0	72.72	3.5	0.1	72.0	1.943
50.0	74.11	7.3	0.1	74.0	1.444
55.0	64.05	0.8	0.1	76.0	5.400
60.0	58.59	1.0	0.1	78.0	5.113
65.0	51.97	0.7	0.1	80.0	6.914
70.0	46.87	0.5	0.1	82.0	5.512
72.0	45.03	0.4	0.1	85.0	6.344
76.0	40.80	0.4	0.1	95.0	7.609
80.0	36.81	0.4	0.1	98.0	7.851
82.0	34.95	0.4	0.2	100.0	8.843
85.0	32.07	0.4	0.2	102.0	9.202
95.0	22.87	0.3	0.3	104.0	9.931
98.0	20.15	0.3	0.4	106.0	10.651
102.0	16.56	0.3	0.5	110.0	12.856
106.0	13.01	0.2	0.7	112.0	13.914
110.0	9.58	0.2	1.2	120.0	17.483
112.0	7.96	0.2	1.5	122.0	17.073
120.0	2.86	0.3	5.0	125.0	16.065
122.0	2.09	0.3	6.6	130.0	13.384
130.0	0.71	0.1	17.4	133.0	12.227
133.0	0.59	0.1	23.0	400.0	0.825
440.0	0.21	0.1	25.7	440.0	0.992
480.0	0.19	0.1	30.9	480.0	0.909
520.0	0.21	0.1	32.6	520.0	1.025
560.0	0.22	0.1	25.9	560.0	1.015
600.0	0.24	0.1	22.0	600.0	0.918

HP-175 160-800 MHz

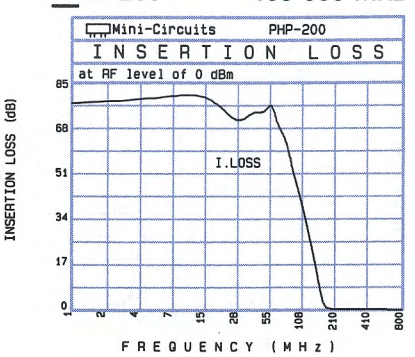


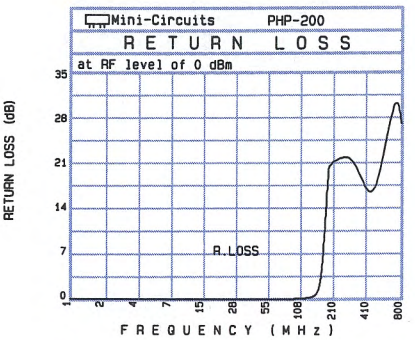


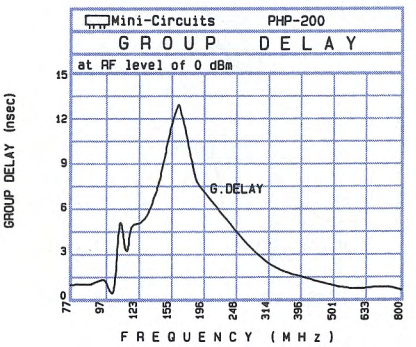


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	74.24	5.1	0.1	55.0	1.298
15.0	83.02	3.4	0.1	60.0	1.433
22.5	71.28	2.9	0.2	65.0	4.875
32.5	75.54	2.9	0.3	70.0	4.881
40.0	74.66	2.9	0.3	75.0	4.289
45.0	77.91	4.5	0.3	77.5	1.016
55.0	73.19	4.3	0.2	85.0	0.723
60.0	67.53	1.4	0.2	87.5	6.144
65.0	62.87	1.7	0.3	95.0	5.057
70.0	57.55	1.1	0.2	97.5	5.116
75.0	52.51	0.4	0.2	100.0	4.953
85.0	43.70	0.3	0.2	105.0	5.422
95.0	35.16	0.3	0.2	107.5	5.813
97.5	33.16	0.4	0.2	110.0	6.616
100.0	31.08	0.4	0.2	112.5	6.634
105.0	27.09	0.4	0.2	115.0	7.298
107.5	25.06	0.4	0.1	117.5	7.825
112.5	21.11	0.4	0.1	120.0	8.439
117.5	17.21	0.3	0.1	135.0	13.892
120.0	15.29	0.3	0.3	140.0	14.475
135.0	5.06	0.1	2.6	145.0	13.770
140.0	2.90	0.1	4.8	155.0	10.475
145.0	1.60	0.1	7.9	160.0	8.958
155.0	0.67	0.1	15.8	485.0	0.978
160.0	0.54	0.1	19.6	537.5	0.861
537.5	0.18	0.1	29.2	590.0	0.818
642.5	0.21	0.1	26.1	642.5	0.768
695.0	0.26	0.1	18.5	695.0	0.777
747.5	0.27	0.1	18.0	747.5	0.821
800.0	0.31	0.1	16.1	800.0	0.600

HP-200 185-800 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	79.13	4.3	0.0	77.0	0.978
15.0	82.18	2.2	0.0	84.0	0.989
29.0	71.32	5.5	0.0	90.0	1.005
43.0	76.14	5.3	0.1	91.0	1.105
56.0	80.66	8.1	0.1	95.0	1.256
63.0	71.77	4.8	0.1	99.0	1.433
70.0	68.26	1.4	0.1	102.0	0.436
77.0	64.30	1.4	0.1	106.0	0.133
84.0	57.15	0.6	0.1	109.0	6.766
90.0	51.69	0.7	0.1	113.0	3.226
91.0	51.14	0.4	0.1	116.0	3.155
99.0	45.20	0.4	0.2	117.0	5.120
106.0	40.04	0.5	0.2	124.0	5.092
109.0	37.91	0.4	0.2	131.0	5.424
113.0	35.09	0.5	0.2	138.0	6.789
116.0	32.89	0.5	0.2	144.0	8.014
117.0	32.20	0.5	0.2	151.0	10.279
131.0	22.48	0.4	0.4	158.0	12.335
144.0	13.65	0.3	0.8	164.0	13.131
151.0	9.11	0.2	1.4	165.0	13.510
158.0	5.16	0.2	2.9	172.0	11.709
164.0	2.79	0.3	5.4	179.0	9.377
165.0	2.50	0.3	5.9	185.0	8.237
179.0	0.74	0.1	16.9	186.0	7.899
185.0	0.60	0.1	20.8	289.0	2.270
289.0	0.32	0.1	23.8	391.0	1.608
493.0	0.34	0.1	17.0	493.0	0.931
596.0	0.29	0.1	21.2	596.0	0.716
698.0	0.26	0.1	34.4	698.0	1.034
800.0	0.27	0.1	27.9	800.0	0.700

rugged, high selectivity

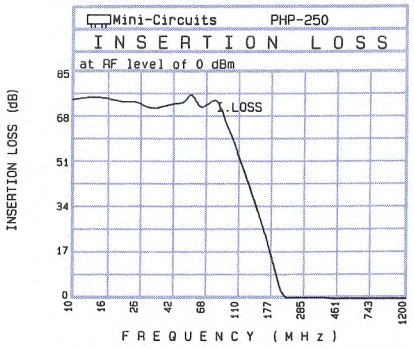
High Pass Filters

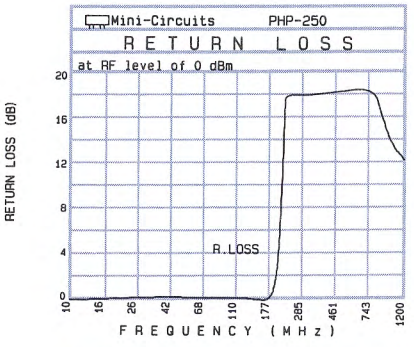
MODEL SELECTION

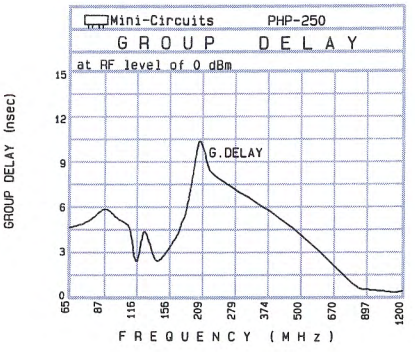
(choose prefix)

P = plug in N = type N
B = BNC S = SMA

HP-250 225-1200 MHz

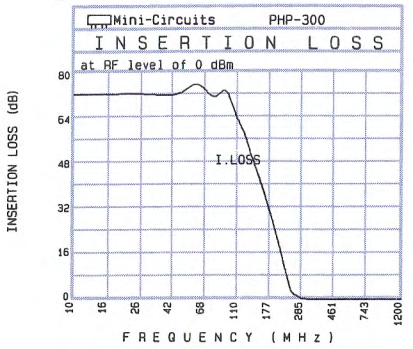


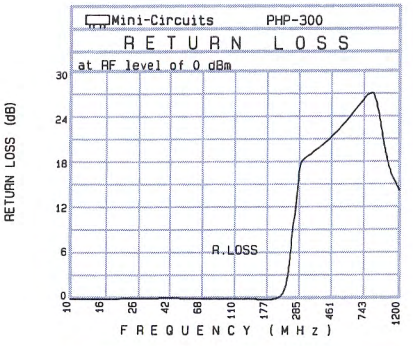


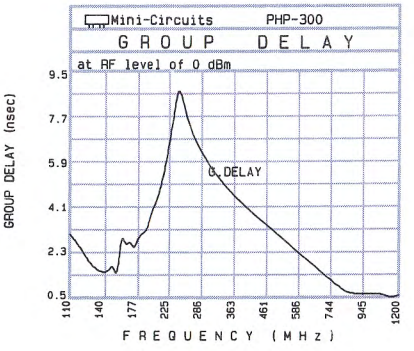


Freq.	I.Loss x̄	I.Loss σ	R.L. x̄	Freq.	G.Delay x̄
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	76.72	4.7	0.1	65.0	4.870
20.0	75.31	6.1	0.2	80.0	5.308
30.0	72.93	2.4	0.3	90.0	6.580
45.0	75.64	7.5	0.3	100.0	5.254
55.0	80.00	7.3	0.3	112.5	5.321
60.0	75.56	5.5	0.2	115.0	2.790
65.0	72.15	5.4	0.3	120.0	2.303
80.0	79.38	6.5	0.2	125.0	5.094
90.0	67.76	2.6	0.3	130.0	4.282
100.0	62.37	1.3	0.3	135.0	3.361
112.5	52.78	0.8	0.3	140.0	2.445
120.0	48.75	1.0	0.3	150.0	2.972
130.0	42.50	1.0	0.2	160.0	3.831
135.0	39.68	0.9	0.2	170.0	4.422
140.0	36.80	0.9	0.2	175.0	5.338
150.0	31.25	0.8	0.1	180.0	5.609
160.0	25.78	0.9	0.1	185.0	6.712
175.0	17.58	0.8	0.2	190.0	7.715
185.0	12.12	0.7	0.6	200.0	10.392
190.0	9.45	0.6	1.0	205.0	11.221
200.0	4.68	0.4	2.9	210.0	11.206
205.0	2.91	0.2	5.0	215.0	10.425
210.0	1.73	0.2	8.2	220.0	9.178
220.0	0.78	0.1	19.1	225.0	7.948
225.0	0.69	0.1	18.3	775.0	0.731
860.0	0.38	0.1	16.9	860.0	0.764
945.0	0.43	0.1	15.2	945.0	0.678
1030.0	0.48	0.1	13.9	1030.0	0.631
1115.0	0.52	0.1	12.9	1115.0	0.507
1200.0	0.56	0.1	12.8	1200.0	0.637

HP-300 290-1200 MHz

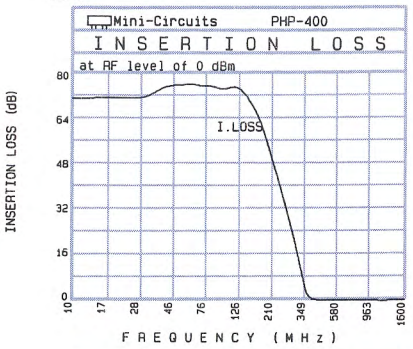


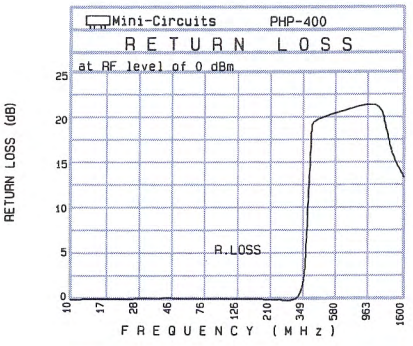


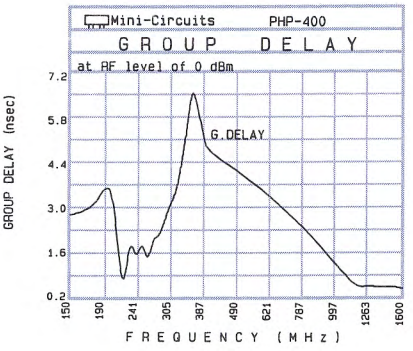


Freq.	I.Loss x̄	I.Loss σ	R.L. x̄	Freq.	G.Delay x̄
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	74.21	2.4	0.1	110.0	3.166
30.0	74.57	4.0	0.2	120.0	2.555
50.0	75.03	6.1	0.2	130.0	1.726
70.0	75.11	1.9	0.2	145.0	1.496
90.0	77.67	5.6	0.2	150.0	2.068
100.0	71.90	4.0	0.2	155.0	1.112
110.0	64.71	1.1	0.2	160.0	3.421
120.0	61.50	1.0	0.2	165.0	2.567
130.0	54.50	0.9	0.2	170.0	2.970
145.0	47.14	0.4	0.1	175.0	2.429
150.0	44.66	0.4	0.1	180.0	3.144
160.0	39.74	0.4	0.1	190.0	3.211
170.0	34.99	0.4	0.1	195.0	3.623
175.0	32.61	0.4	0.1	200.0	4.110
180.0	30.36	0.4	0.1	205.0	4.383
190.0	25.67	0.4	0.1	210.0	4.714
195.0	23.38	0.4	0.1	220.0	5.851
205.0	18.79	0.4	0.3	230.0	7.341
220.0	11.96	0.4	0.7	240.0	8.938
230.0	7.65	0.3	1.6	245.0	9.275
240.0	4.02	0.3	3.6	265.0	7.189
245.0	2.69	0.2	5.4	285.0	4.933
265.0	0.66	0.1	22.9	290.0	4.533
285.0	0.52	0.1	19.6	780.0	0.869
290.0	0.52	0.1	18.7	850.0	0.746
850.0	0.28	0.1	27.8	920.0	0.721
990.0	0.33	0.1	19.6	990.0	0.718
1060.0	0.38	0.1	17.1	1060.0	0.745
1130.0	0.42	0.1	15.3	1130.0	0.561
1200.0	0.47	0.1	15.0	1200.0	0.677

HP-400 395-1600 MHz







Freq.	I.Loss x̄	I.Loss σ	R.L. x̄	Freq.	G.Delay x̄
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	73.14	1.5	0.1	150.0	2.914
30.0	72.81	1.5	0.2	180.0	3.131
55.0	78.12	7.8	0.2	200.0	4.272
70.0	77.71	7.6	0.2	210.0	2.149
100.0	75.88	7.3	0.2	220.0	0.200
120.0	78.90	6.3	0.3	230.0	2.419
150.0	72.73	3.5	0.2	240.0	1.348
180.0	63.50	1.6	0.2	250.0	2.233
200.0	54.98	1.6	0.2	260.0	1.280
210.0	51.12	1.3	0.2	270.0	2.213
220.0	47.63	0.9	0.2	280.0	2.206
240.0	40.73	0.7	0.1	290.0	2.559
260.0	34.00	0.8	0.1	300.0	3.078
270.0	30.73	0.8	0.1	310.0	3.391
280.0	27.40	0.8	0.1	320.0	3.789
290.0	24.12	0.8	0.1	330.0	4.586
300.0	20.78	0.8	0.2	340.0	5.452
320.0	14.12	0.8	0.5	350.0	6.519
340.0	7.64	0.6	1.5	355.0	6.761
350.0	4.84	0.5	2.8	360.0	6.909
355.0	3.67	0.4	3.8	375.0	6.432
360.0	2.71	0.4	5.1	385.0	5.626
375.0	1.05	0.2	11.5	390.0	5.195
390.0	0.59	0.1	19.8	395.0	4.808
395.0	0.54	0.1	20.9	1102.5	0.632
1202.5	0.26	0.1	20.2	1202.5	0.662
1302.5	0.30	0.1	17.4	1302.5	0.661
1400.0	0.33	0.1	15.9	1400.0	0.647
1500.0	0.38	0.1	14.7	1500.0	0.657
1600.0	0.41	0.1	14.1	1600.0	0.595

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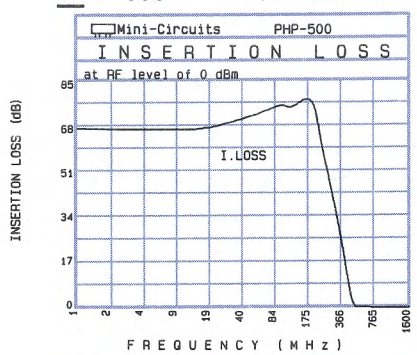
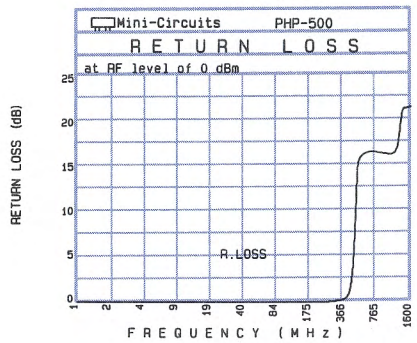
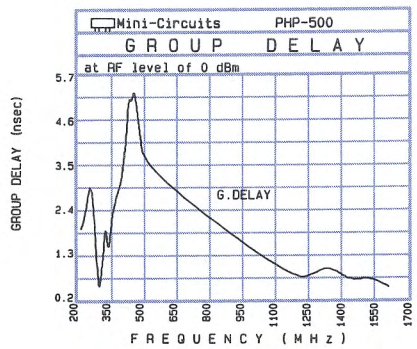
HP-500 500-1600 MHz

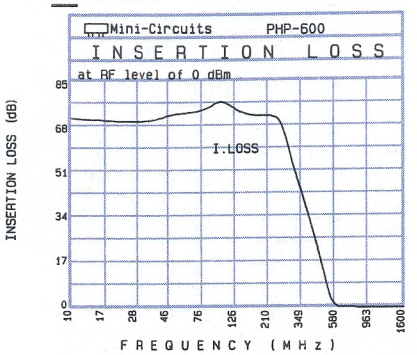


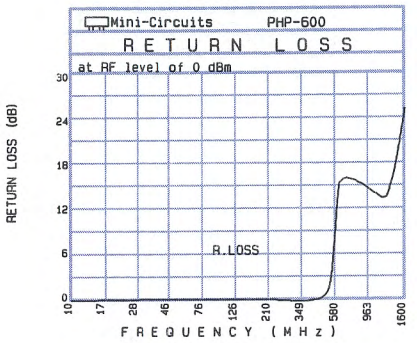


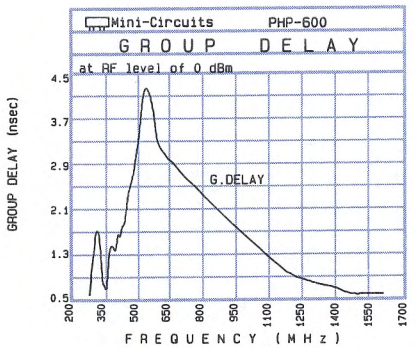


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
1.0	69.51	5.2	0.0	220.0	2.001
20.0	69.93	3.2	0.1	240.0	2.361
90.0	79.06	4.2	0.0	260.0	3.401
120.0	77.49	2.6	0.0	280.0	2.219
180.0	80.98	5.2	0.1	300.0	0.252
200.0	76.65	9.9	0.1	310.0	0.812
220.0	66.04	4.4	0.1	320.0	1.290
240.0	59.18	1.9	0.1	330.0	2.254
260.0	52.45	1.3	0.1	340.0	1.441
280.0	46.56	1.0	0.1	350.0	1.614
300.0	40.96	0.9	0.2	360.0	2.443
320.0	35.47	0.8	0.2	365.0	2.444
340.0	30.06	0.8	0.2	380.0	2.896
350.0	27.36	0.8	0.3	400.0	3.144
360.0	24.72	0.8	0.3	410.0	3.808
365.0	23.44	0.8	0.3	420.0	4.105
380.0	19.44	0.8	0.4	430.0	5.327
410.0	11.64	0.7	0.9	440.0	5.180
430.0	6.88	0.5	1.9	450.0	5.282
440.0	4.89	0.4	2.9	454.0	5.519
450.0	3.30	0.3	4.3	470.0	4.950
454.0	2.79	0.3	5.0	480.0	4.443
470.0	1.44	0.2	8.7	490.0	4.121
490.0	0.76	0.1	14.5	500.0	3.522
500.0	0.64	0.1	17.8	1156.0	0.787
1245.0	0.37	0.1	18.6	1245.0	0.779
1333.0	0.36	0.1	22.3	1333.0	1.168
1422.0	0.35	0.1	22.0	1422.0	0.677
1511.0	0.34	0.1	21.5	1511.0	0.840
1600.0	0.36	0.1	22.2	1600.0	0.578

HP-600 600-1600 MHz

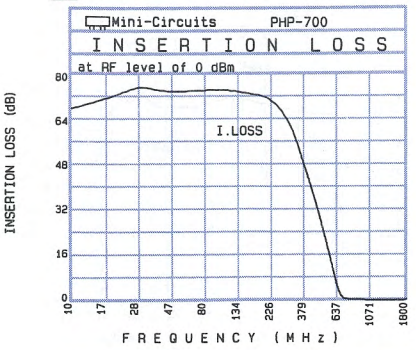


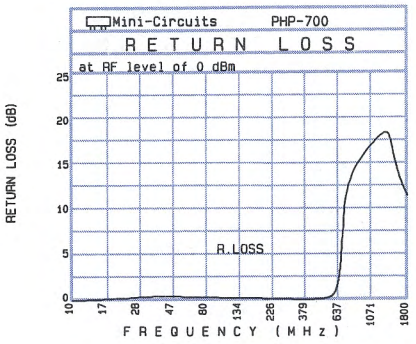


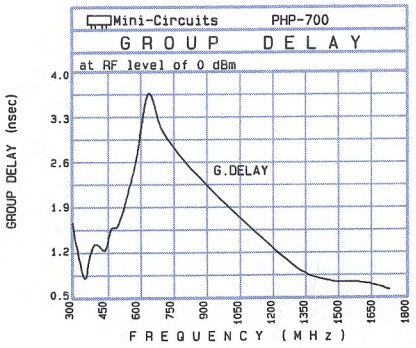


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	73.34	3.0	0.1	280.0	0.614
50.0	75.79	7.9	0.3	320.0	2.357
100.0	81.25	9.1	0.3	340.0	0.698
150.0	74.62	7.3	0.2	350.0	0.876
220.0	74.57	5.6	0.2	360.0	0.548
250.0	73.20	2.3	0.2	370.0	1.579
280.0	63.08	1.6	0.1	390.0	1.482
320.0	50.76	0.3	0.1	400.0	1.363
340.0	46.03	0.5	0.1	410.0	1.832
350.0	43.60	0.5	0.0	420.0	1.586
360.0	41.20	0.5	0.1	430.0	1.928
390.0	34.33	0.6	0.1	440.0	1.841
410.0	29.83	0.6	0.2	450.0	2.249
420.0	27.62	0.6	0.2	460.0	2.544
430.0	25.37	0.6	0.3	480.0	2.783
440.0	23.19	0.6	0.3	500.0	3.349
450.0	20.99	0.6	0.4	510.0	3.641
480.0	14.50	0.6	0.7	520.0	4.106
510.0	8.36	0.5	1.5	530.0	4.353
520.0	6.52	0.4	2.0	545.0	4.430
530.0	4.89	0.3	2.8	570.0	4.094
545.0	2.97	0.1	4.6	590.0	3.500
570.0	1.21	0.1	9.6	600.0	3.203
590.0	0.72	0.1	15.0	1167.5	0.979
600.0	0.61	0.1	18.0	1237.5	0.932
1237.5	0.47	0.1	14.5	1310.0	0.815
1382.5	0.40	0.1	18.1	1382.5	0.781
1455.0	0.38	0.1	20.9	1455.0	0.618
1527.5	0.37	0.1	26.2	1527.5	0.651
1600.0	0.36	0.1	26.2	1600.0	0.639

HP-700 700-1800 MHz





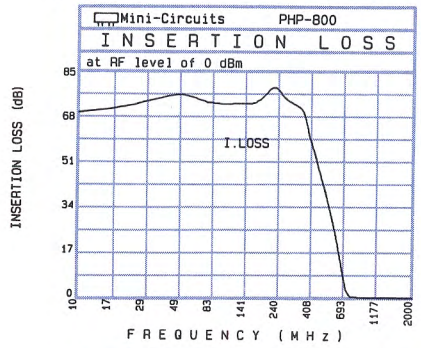


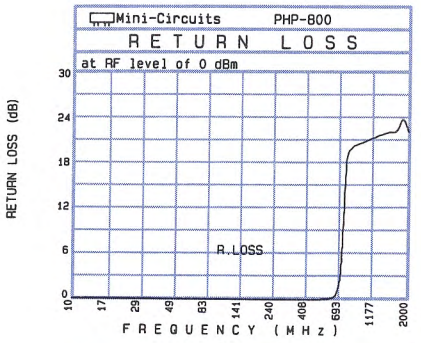
Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	69.97	2.7	0.1	300.0	1.702
30.0	79.30	6.2	0.5	360.0	0.576
70.0	76.67	6.3	0.5	370.0	1.107
120.0	76.75	5.9	0.4	390.0	1.287
220.0	74.46	5.8	0.3	400.0	1.387
300.0	64.87	2.8	0.3	420.0	1.353
360.0	51.59	0.9	0.2	450.0	1.203
370.0	49.50	1.2	0.2	460.0	1.450
390.0	45.90	0.8	0.2	470.0	1.580
400.0	43.94	0.9	0.2	480.0	1.649
420.0	40.15	0.7	0.3	500.0	1.606
460.0	32.96	0.6	0.3	510.0	1.717
480.0	29.32	0.6	0.3	520.0	1.801
500.0	25.76	0.6	0.3	540.0	2.053
510.0	24.00	0.5	0.4	570.0	2.460
520.0	22.24	0.5	0.4	590.0	2.751
540.0	18.71	0.5	0.5	600.0	3.012
590.0	10.13	0.3	1.0	610.0	3.254
610.0	7.01	0.3	1.7	620.0	3.521
620.0	5.60	0.2	2.3	630.0	3.693
630.0	4.36	0.2	3.0	640.0	3.784
640.0	3.29	0.1	3.9	650.0	3.751
650.0	2.44	0.1	5.1	670.0	3.551
670.0	1.30	0.1	8.7	700.0	2.942
700.0	0.65	0.1	15.2	1310.0	0.893
1395.0	0.36	0.1	17.9	1395.0	0.847
1555.0	0.45	0.1	14.7	1475.0	0.758
1635.0	0.50	0.1	13.5	1555.0	0.780
1720.0	0.54	0.1	12.7	1635.0	0.748
1800.0	0.57	0.1	12.0	1720.0	0.645

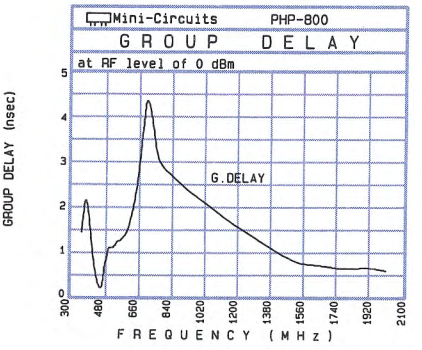
Filters, 50 ohm
high pass, rugged, high selectivity

MODEL SELECTION
(choose prefix)
P = plug in N = type N
B = BNC S = SMA

HP-800 780-2000 MHz

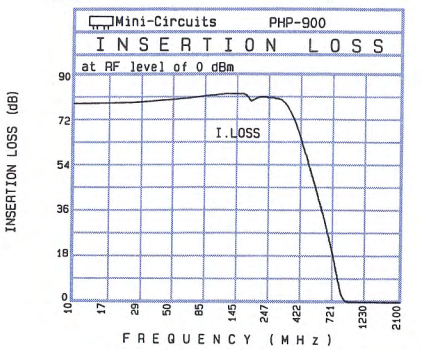


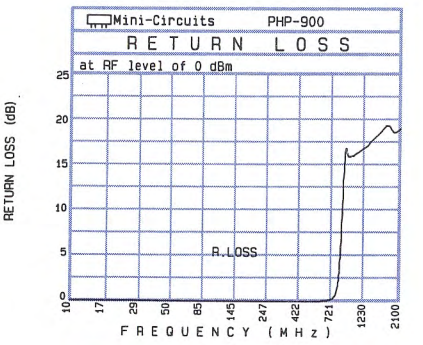


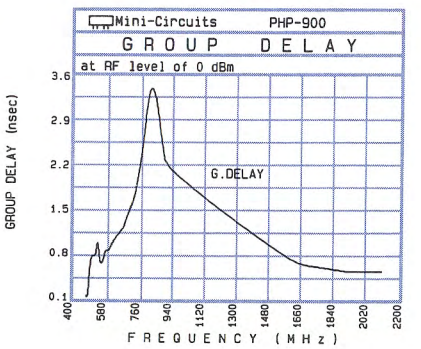


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	71.01	3.2	0.1	370.0	1.486
70.0	73.97	7.6	0.1	390.0	2.630
170.0	74.31	4.7	0.1	420.0	1.264
250.0	78.24	7.6	0.0	445.0	0.344
305.0	74.58	4.6	0.1	480.0	0.092
350.0	73.24	4.5	0.1	490.0	0.806
370.0	68.47	5.1	0.1	500.0	0.834
390.0	62.18	2.2	0.1	510.0	1.199
420.0	56.95	3.2	0.1	530.0	1.112
445.0	51.70	1.7	0.1	550.0	1.226
480.0	45.25	1.4	0.1	560.0	1.329
500.0	41.85	1.2	0.1	570.0	1.281
530.0	36.39	1.1	0.1	590.0	1.407
550.0	32.85	1.0	0.1	610.0	1.485
560.0	31.02	0.9	0.1	630.0	1.831
570.0	29.24	0.9	0.2	660.0	2.471
590.0	25.55	0.8	0.2	690.0	3.777
630.0	17.93	0.7	0.4	700.0	4.215
690.0	6.18	0.7	2.4	705.0	4.425
700.0	4.49	0.6	3.4	710.0	4.504
705.0	3.77	0.6	4.1	730.0	4.395
710.0	3.11	0.5	5.0	760.0	3.363
730.0	1.38	0.3	10.4	780.0	2.835
760.0	0.65	0.1	19.8	1480.0	0.833
780.0	0.59	0.1	20.9	1565.0	0.794
1565.0	0.34	0.1	22.7	1655.0	0.765
1740.0	0.36	0.1	23.6	1740.0	0.695
1825.0	0.33	0.1	25.2	1825.0	0.696
1915.0	0.34	0.1	24.1	1915.0	0.724
2000.0	0.34	0.1	22.9	2000.0	0.644

HP-900 910-2100 MHz

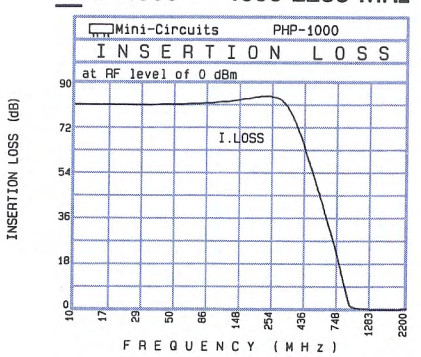


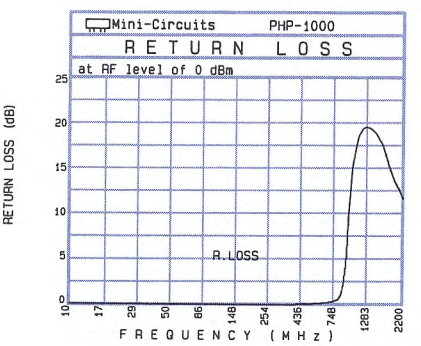


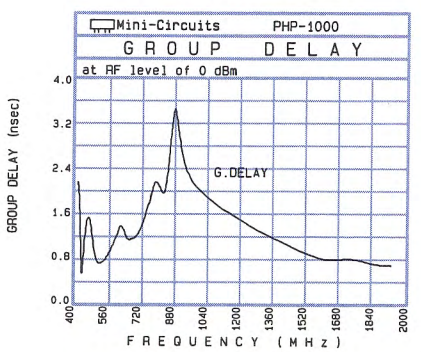


Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	80.42	2.0	0.1	480.0	0.195
150.0	85.02	5.3	0.1	490.0	0.104
180.0	80.96	3.8	0.1	500.0	0.834
250.0	83.18	5.7	0.1	520.0	0.818
350.0	78.61	3.6	0.1	530.0	0.817
470.0	56.26	1.2	0.1	540.0	1.169
480.0	54.59	0.9	0.1	550.0	0.655
490.0	52.88	0.8	0.1	570.0	0.721
500.0	51.14	0.9	0.1	580.0	0.932
520.0	48.03	0.9	0.1	600.0	0.876
530.0	46.30	0.8	0.1	620.0	1.069
550.0	43.21	0.7	0.1	660.0	1.193
580.0	38.53	0.8	0.1	680.0	1.294
600.0	35.53	0.7	0.1	700.0	1.495
620.0	32.52	0.7	0.1	720.0	1.653
660.0	26.48	0.7	0.2	740.0	1.900
680.0	23.41	0.7	0.2	760.0	2.256
720.0	17.21	0.7	0.4	780.0	2.699
760.0	10.84	0.6	0.9	800.0	3.209
780.0	7.78	0.5	1.5	820.0	3.565
800.0	4.95	0.3	2.7	850.0	3.356
820.0	2.78	0.1	5.1	870.0	2.884
850.0	1.06	0.1	11.9	900.0	2.376
900.0	0.61	0.1	16.7	910.0	2.204
910.0	0.60	0.1	15.9	1600.0	0.719
1700.0	0.34	0.1	20.1	1700.0	0.673
1800.0	0.35	0.1	19.9	1800.0	0.644
1900.0	0.38	0.1	18.9	1900.0	0.582
2000.0	0.39	0.1	18.6	2000.0	0.590
2100.0	0.39	0.1	19.6	2100.0	0.593

HP-1000 1000-2200 MHz







Freq. (MHz)	I.Loss x̄ (dB)	I.Loss σ (dB)	R.L. x̄ (dB)	Freq. (MHz)	G.Delay x̄ (nsec)
10.0	83.18	2.8	0.1	420.0	2.224
200.0	87.50	7.1	0.1	430.0	1.926
330.0	81.91	4.5	0.1	440.0	0.042
410.0	69.01	3.7	0.1	450.0	1.378
430.0	64.76	2.6	0.1	480.0	1.800
440.0	63.14	2.6	0.1	500.0	0.668
450.0	61.53	2.3	0.1	550.0	0.759
480.0	56.69	1.8	0.1	610.0	1.255
500.0	53.07	1.3	0.2	620.0	1.481
550.0	45.76	1.0	0.2	640.0	1.373
610.0	36.92	0.6	0.3	650.0	1.219
640.0	32.87	0.5	0.3	660.0	1.184
660.0	30.45	0.5	0.3	670.0	1.180
670.0	29.21	0.5	0.3	700.0	1.227
700.0	25.28	0.4	0.4	720.0	1.365
720.0	22.61	0.4	0.5	770.0	1.949
770.0	15.62	0.4	0.6	790.0	2.348
820.0	9.80	0.5	1.2	820.0	2.039
860.0	4.84	0.4	2.9	840.0	1.970
880.0	2.75	0.4	4.4	860.0	2.877
885.0	2.41	0.4	4.9	880.0	3.588
900.0	1.81	0.4	6.7	885.0	3.562
920.0	1.40	0.3	9.8	900.0	3.220
1000.0	0.57	0.1	22.5	920.0	2.580
1560.0	0.53	0.1	18.5	1000.0	1.904
1745.0	0.42	0.1	15.8	1560.0	0.826
1925.0	0.62	0.1	14.0	1650.0	0.823
2015.0	0.59	0.1	13.5	1745.0	0.869
2110.0	0.77	0.1	12.9	1835.0	0.747
2200.0	0.71	0.1	12.2	1925.0	0.731

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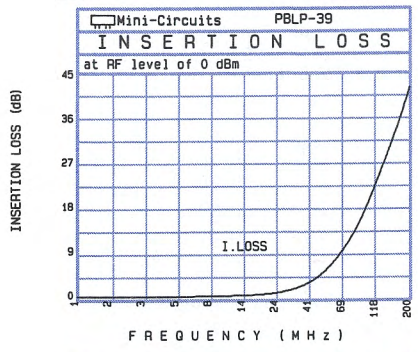
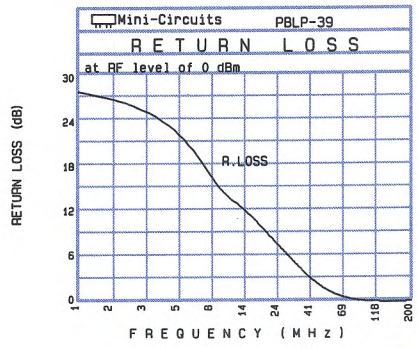
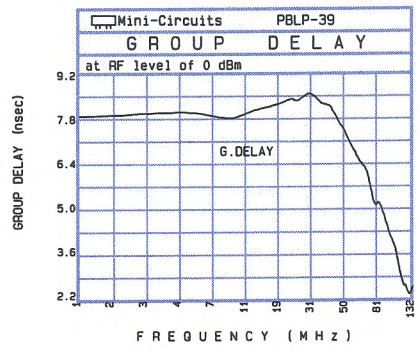
BLP-39 DC-23 MHz

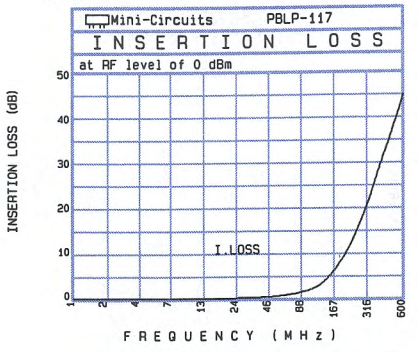


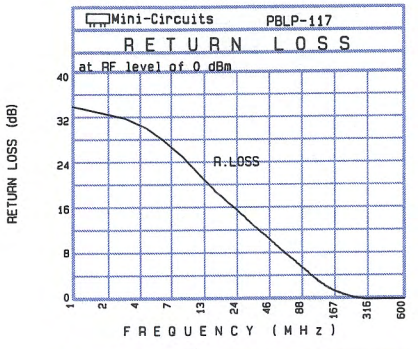


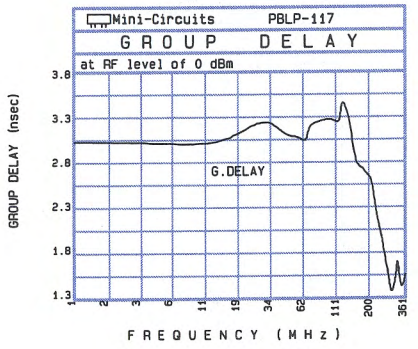


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	0.37	0.5	28.6	1.0	8.012
9.0	0.56	0.5	15.4	5.0	8.243
12.0	0.63	0.5	13.7	9.0	7.823
16.0	0.73	0.4	11.7	12.0	8.199
20.0	0.94	0.4	9.6	16.0	8.305
23.0	1.15	0.4	8.3	20.0	8.466
24.0	1.23	0.4	7.9	23.0	8.623
34.0	2.33	0.3	4.7	24.0	8.392
39.0	3.12	0.3	3.6	29.0	8.899
40.0	3.31	0.3	3.4	34.0	8.378
51.0	5.55	0.2	1.9	39.0	8.392
62.0	8.26	0.2	1.1	40.0	8.247
68.0	9.81	0.2	0.8	46.0	7.722
73.0	11.13	0.3	0.7	51.0	7.336
78.0	12.47	0.4	0.5	57.0	6.804
79.0	12.74	0.5	0.5	62.0	6.487
90.0	15.85	0.7	0.3	68.0	6.306
101.0	19.10	0.8	0.3	73.0	5.277
107.0	20.88	0.9	0.2	78.0	5.124
112.0	22.32	0.9	0.2	79.0	5.489
117.0	23.74	1.0	0.2	85.0	5.101
118.0	24.01	1.0	0.2	90.0	4.784
132.0	27.65	1.0	0.2	96.0	4.054
146.0	30.97	1.0	0.2	101.0	3.996
159.0	33.94	1.0	0.2	107.0	3.275
173.0	36.98	1.0	0.2	112.0	2.856
180.0	38.66	1.1	0.2	117.0	2.547
187.0	40.21	1.1	0.2	118.0	2.738
194.0	41.54	1.0	0.2	125.0	2.216
200.0	42.85	1.1	0.2	132.0	2.576

BLP-117 DC-65 MHz

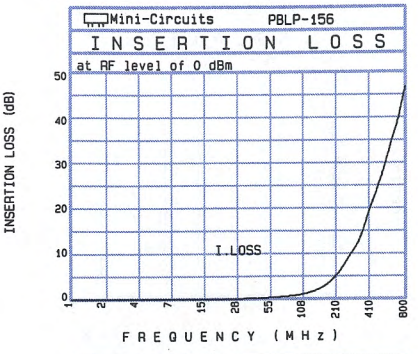


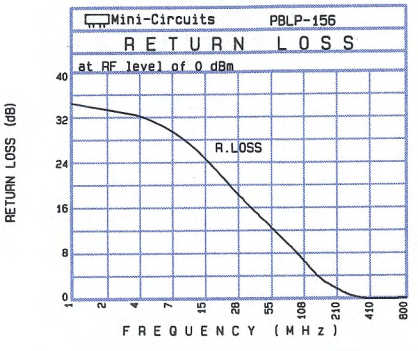


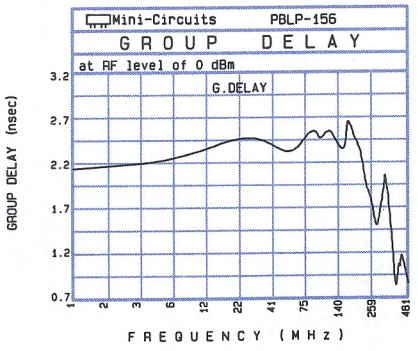


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	0.02	0.1	35.3	1.0	3.075
23.0	0.15	0.1	16.8	12.0	3.015
33.0	0.26	0.1	13.8	23.0	3.252
44.0	0.42	0.1	11.5	33.0	3.331
55.0	0.65	0.1	9.6	44.0	3.126
65.0	0.90	0.1	8.3	55.0	3.140
66.0	0.92	0.1	8.2	65.0	3.044
100.0	1.96	0.1	4.8	66.0	3.271
117.0	2.80	0.1	3.5	83.0	3.303
118.0	2.86	0.1	3.5	100.0	3.348
152.0	5.63	0.1	1.9	117.0	3.233
185.0	8.79	0.2	1.2	118.0	3.593
201.0	10.40	0.2	0.9	135.0	3.409
218.0	12.23	0.2	0.7	152.0	2.782
234.0	13.99	0.2	0.5	168.0	2.798
235.0	14.10	0.2	0.5	185.0	2.689
257.0	16.54	0.3	0.3	201.0	2.681
279.0	18.92	0.4	0.3	218.0	2.252
290.0	20.08	0.5	0.2	234.0	2.060
301.0	21.23	0.5	0.2	235.0	2.032
312.0	22.36	0.6	0.2	246.0	1.965
313.0	22.46	0.6	0.2	257.0	1.759
361.0	27.82	0.7	0.2	268.0	1.562
409.0	32.27	0.9	0.2	279.0	1.358
457.0	35.79	1.0	0.2	290.0	1.372
505.0	39.52	1.3	0.2	301.0	1.483
529.0	41.10	1.4	0.2	312.0	1.659
553.0	42.74	1.6	0.2	313.0	1.765
577.0	44.30	1.5	0.3	337.0	1.324
600.0	45.95	2.0	0.3	361.0	1.555

BLP-156 DC-94 MHz







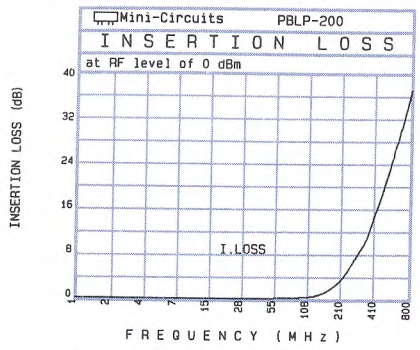
Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	0.05	0.1	35.6	1.0	2.185
32.0	0.17	0.1	17.6	17.0	2.540
48.0	0.30	0.1	14.2	32.0	2.534
63.0	0.46	0.1	11.9	48.0	2.358
79.0	0.68	0.1	10.0	63.0	2.382
94.0	0.92	0.1	8.3	79.0	2.619
95.0	0.93	0.1	8.2	94.0	2.595
136.0	1.98	0.1	4.6	95.0	2.467
156.0	2.79	0.2	3.6	116.0	2.682
157.0	2.85	0.2	3.5	136.0	2.392
202.0	5.33	0.2	2.2	156.0	2.383
246.0	8.75	0.3	1.2	157.0	2.835
268.0	10.25	0.3	0.9	180.0	2.501
290.0	11.57	0.3	0.7	202.0	2.433
312.0	12.97	0.3	0.6	224.0	1.923
313.0	13.03	0.3	0.6	246.0	1.878
343.0	15.67	0.3	0.5	268.0	1.392
372.0	18.60	0.3	0.4	290.0	1.756
387.0	20.01	0.3	0.3	312.0	2.001
402.0	21.23	0.3	0.3	313.0	2.235
416.0	22.25	0.3	0.3	328.0	1.944
417.0	22.32	0.3	0.3	343.0	1.740
481.0	27.17	0.5	0.3	358.0	1.360
545.0	31.67	0.7	0.3	372.0	0.911
609.0	36.32	1.0	0.4	387.0	0.786
673.0	39.65	1.2	0.4	402.0	1.170
705.0	41.78	1.2	0.4	416.0	0.978
737.0	44.07	1.6	0.5	417.0	1.269
769.0	46.28	1.6	0.5	449.0	1.042
800.0	47.95	1.8	0.5	481.0	0.864

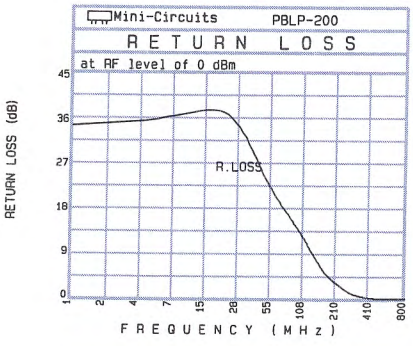
flat time delay, linear phase

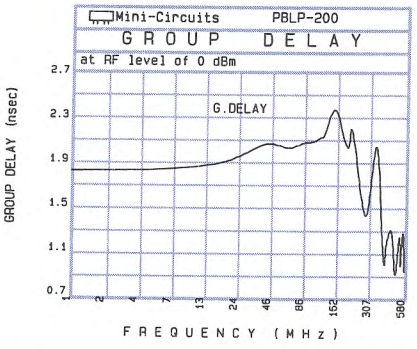
Low Pass Filters

MODEL SELECTION
(choose prefix)
P = plug in N = type N
B = BNC S = SMA

BLP-200 DC-120 MHz

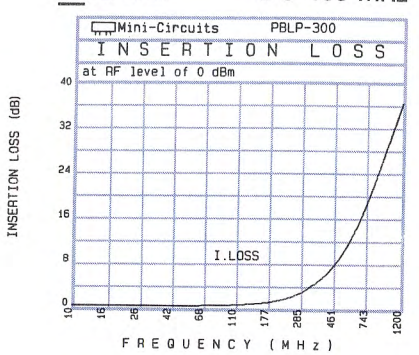


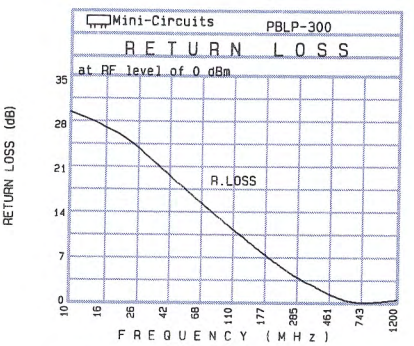


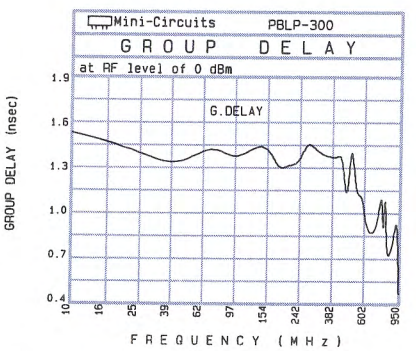


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
1.0	0.04	0.1	35.5	1.0	1.829
41.0	0.10	0.1	27.0	21.0	1.915
61.0	0.16	0.1	20.6	41.0	2.144
81.0	0.22	0.1	16.6	61.0	2.006
101.0	0.33	0.1	13.4	81.0	2.109
120.0	0.52	0.1	10.4	101.0	2.087
121.0	0.53	0.1	10.2	120.0	2.170
174.0	2.10	0.1	4.7	121.0	2.113
200.0	3.22	0.1	3.5	148.0	2.521
201.0	3.26	0.1	3.5	174.0	2.169
258.0	6.65	0.2	1.6	200.0	1.964
315.0	9.45	0.2	0.9	201.0	2.367
344.0	11.17	0.3	0.7	230.0	1.912
372.0	13.45	0.4	0.5	258.0	1.485
400.0	15.58	0.5	0.4	287.0	1.356
401.0	15.65	0.5	0.4	315.0	2.048
439.0	17.90	0.7	0.3	344.0	2.142
477.0	20.36	0.8	0.3	372.0	1.206
496.0	21.60	0.8	0.2	400.0	0.894
515.0	22.72	0.9	0.2	401.0	1.205
534.0	23.75	0.9	0.2	420.0	1.143
535.0	23.81	0.9	0.2	439.0	0.984
580.0	26.67	1.0	0.2	458.0	1.412
624.0	29.26	1.0	0.2	477.0	0.888
668.0	31.05	1.1	0.2	496.0	0.903
712.0	33.19	1.2	0.3	515.0	1.244
734.0	34.36	1.2	0.3	534.0	1.282
756.0	35.72	1.2	0.3	535.0	0.796
778.0	37.00	1.2	0.3	558.0	1.491
800.0	37.94	1.1	0.3	580.0	0.941

BLP-300 DC-180 MHz

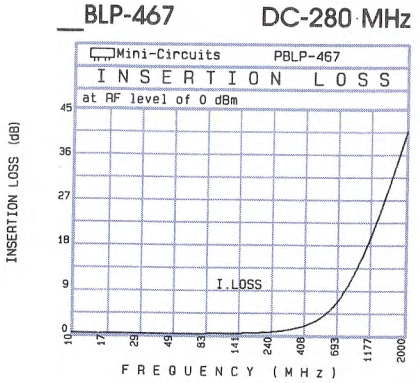


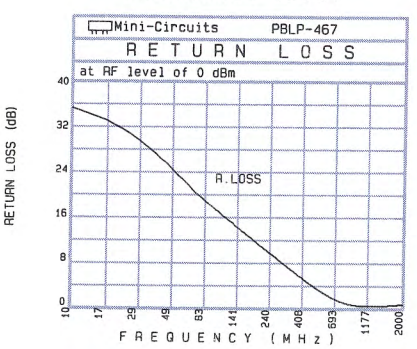


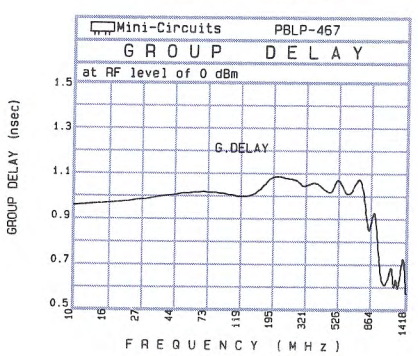


Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
10.0	0.16	0.2	30.7	10.0	1.563
67.0	0.27	0.2	16.4	39.0	1.282
95.0	0.37	0.1	13.4	67.0	1.509
124.0	0.53	0.1	11.1	95.0	1.368
152.0	0.73	0.1	9.4	124.0	1.468
180.0	0.99	0.1	7.9	152.0	1.487
200.0	1.24	0.1	7.1	180.0	1.297
267.0	2.35	0.2	4.9	200.0	1.351
300.0	3.06	0.2	4.1	234.0	1.343
400.0	5.85	0.2	2.5	267.0	1.534
458.0	7.82	0.2	1.8	300.0	1.427
515.0	9.91	0.3	1.3	400.0	1.383
543.0	11.02	0.4	1.1	429.0	1.448
572.0	12.18	0.4	0.9	458.0	0.984
600.0	13.35	0.5	0.8	486.0	1.599
700.0	17.70	0.5	0.5	515.0	1.173
729.0	18.96	0.6	0.5	543.0	1.140
758.0	20.25	0.6	0.5	572.0	1.134
773.0	20.92	0.6	0.5	600.0	0.869
787.0	21.51	0.6	0.5	700.0	0.878
801.0	22.10	0.6	0.5	715.0	0.983
900.0	26.28	0.7	0.6	729.0	0.767
950.0	28.25	0.7	0.7	744.0	1.244
1000.0	30.16	0.8	0.8	758.0	0.807
1050.0	32.02	0.9	0.8	773.0	1.089
1100.0	33.74	0.9	0.9	787.0	1.144
1125.0	34.62	1.1	0.9	801.0	0.587
1150.0	35.50	1.2	1.0	900.0	0.940
1175.0	36.29	1.2	1.0	925.0	0.980
1200.0	37.10	1.4	1.0	950.0	0.475

BLP-467 DC-280 MHz







Freq. (MHz)	I.Loss $\bar{x}$ (dB)	I.Loss σ (dB)	R.L. $\bar{x}$ (dB)	Freq. (MHz)	G.Delay $\bar{x}$ (nsec)
10.0	0.07	0.1	36.0	10.0	0.963
100.0	0.18	0.1	17.3	55.0	1.041
145.0	0.28	0.1	14.2	100.0	1.016
190.0	0.42	0.1	11.8	145.0	0.994
235.0	0.61	0.1	10.0	190.0	1.118
280.0	0.85	0.1	8.5	235.0	1.085
300.0	0.98	0.1	7.9	280.0	1.088
412.5	2.01	0.1	5.2	300.0	1.042
467.0	2.72	0.1	4.2	357.5	1.083
500.0	3.19	0.2	3.6	412.5	1.043
625.0	5.57	0.2	2.1	467.0	1.010
750.0	8.71	0.3	1.1	500.0	1.118
810.0	10.34	0.4	0.9	562.5	1.017
872.5	12.19	0.4	0.7	625.0	1.017
934.0	14.02	0.5	0.6	687.5	1.110
1000.0	15.94	0.5	0.5	750.0	1.055
1072.5	18.12	0.6	0.5	810.0	0.762
1142.5	20.11	0.7	0.5	872.5	1.030
1177.5	21.14	0.7	0.4	934.0	0.736
1212.5	22.15	0.7	0.4	1000.0	0.572
1246.0	23.12	0.8	0.4	1037.5	0.663
1300.0	24.56	0.8	0.5	1072.5	0.675
1417.5	27.75	0.9	0.5	1107.5	0.659
1535.0	30.82	1.0	0.5	1142.5	0.722
1650.0	33.70	1.1	0.6	1177.5	0.551
1767.5	36.46	1.2	0.7	1212.5	0.679
1825.0	37.83	1.5	0.7	1246.0	0.558
1885.0	39.23	1.6	0.7	1300.0	0.668
1942.5	40.45	1.6	0.7	1360.0	0.781
2000.0	41.59	1.8	0.8	1417.5	0.573

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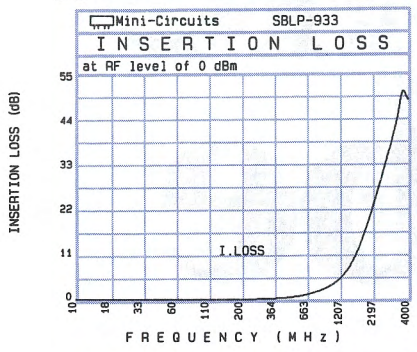
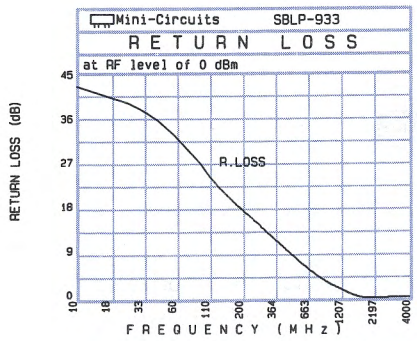
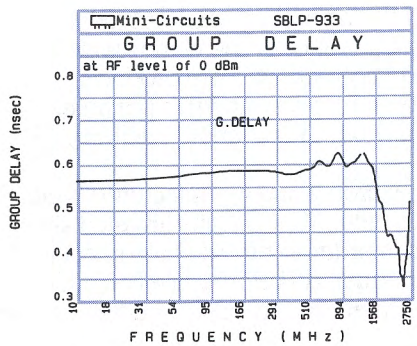
BLP-933 DC-560 MHz

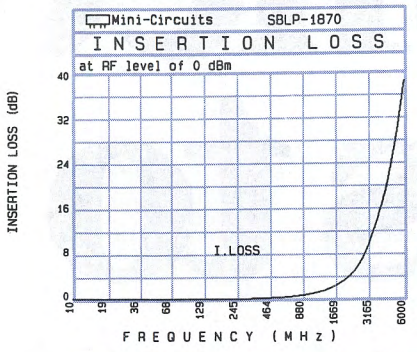


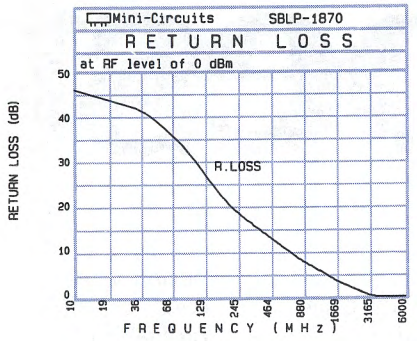


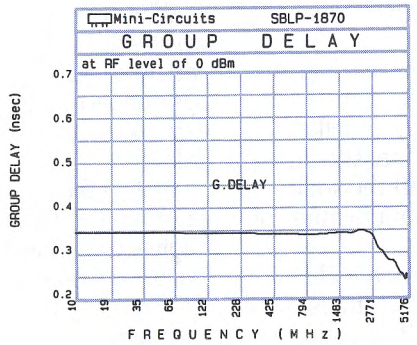


Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.01	0.1	43.3	10.0	0.568
195.0	0.11	0.1	18.1	105.0	0.594
285.0	0.21	0.1	14.5	195.0	0.591
380.0	0.38	0.1	11.6	285.0	0.593
470.0	0.59	0.1	9.4	380.0	0.577
560.0	0.88	0.1	7.6	470.0	0.596
600.0	1.05	0.1	7.0	560.0	0.594
825.0	2.24	0.1	4.2	600.0	0.626
933.0	3.00	0.1	3.3	715.0	0.584
1000.0	3.49	0.1	2.9	825.0	0.654
1250.0	5.97	0.1	1.7	933.0	0.591
1495.0	9.72	0.1	0.8	1000.0	0.609
1620.0	12.16	0.2	0.5	1125.0	0.610
1745.0	14.88	0.2	0.3	1250.0	0.645
1866.0	17.63	0.3	0.2	1375.0	0.601
2000.0	20.52	0.3	0.2	1495.0	0.606
2140.0	23.58	0.3	0.2	1620.0	0.510
2280.0	26.55	0.2	0.2	1745.0	0.528
2350.0	28.00	0.2	0.2	1866.0	0.423
2420.0	29.40	0.2	0.2	2000.0	0.462
2490.0	30.81	0.3	0.3	2070.0	0.422
2500.0	30.99	0.3	0.3	2140.0	0.338
2750.0	35.69	0.5	0.3	2210.0	0.404
3000.0	40.00	1.0	0.4	2280.0	0.430
3250.0	44.45	2.1	0.4	2350.0	0.336
3500.0	50.66	4.7	0.4	2420.0	0.364
3625.0	52.33	4.9	0.3	2490.0	0.310
3750.0	52.01	3.4	0.3	2500.0	0.366
3875.0	50.70	2.2	0.3	2625.0	0.392
4000.0	49.92	2.5	0.3	2750.0	0.519

BLP-1870 DC-850 MHz







Freq.	I.Loss $\bar{x}$	I.Loss σ	R.L. $\bar{x}$	Freq.	G.Delay $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(MHz)	(nsec)
10.0	0.01	0.1	47.2	10.0	0.347
152.3	0.05	0.1	22.6	152.3	0.346
433.0	0.22	0.1	14.1	290.8	0.345
571.6	0.36	0.1	11.6	433.0	0.344
710.1	0.53	0.1	9.8	571.6	0.344
850.0	0.73	0.1	8.3	710.1	0.343
1002.1	0.96	0.1	7.2	850.0	0.342
1582.4	2.28	0.1	4.0	1002.1	0.343
1870.0	3.21	0.1	3.1	1290.4	0.346
2001.7	3.65	0.1	2.8	1582.4	0.348
2499.6	5.91	0.3	1.6	1870.0	0.345
2997.5	9.36	0.7	0.7	2001.7	0.350
3244.6	11.63	1.0	0.5	2248.8	0.355
3491.7	13.38	1.1	0.3	2499.6	0.347
3740.0	15.60	1.2	0.3	2746.7	0.345
4000.8	17.72	1.2	0.3	2997.5	0.309
4289.1	20.35	1.2	0.3	3244.6	0.308
4573.6	23.49	1.3	0.3	3491.7	0.291
4715.9	25.12	1.3	0.3	3740.0	0.282
4858.2	26.62	1.4	0.2	4000.8	0.287
5000.0	28.10	1.4	0.3	4143.1	0.295
5011.7	28.25	1.4	0.3	4289.1	0.281
5176.4	30.15	1.5	0.2	4431.4	0.262
5341.1	32.09	1.8	0.2	4573.6	0.254
5505.8	34.13	2.6	0.2	4715.9	0.254
5670.6	36.22	4.0	0.2	4858.2	0.249
5752.9	37.22	5.2	0.2	5000.0	0.238
5835.3	38.40	6.7	0.2	5011.7	0.245
5917.6	39.23	8.2	0.2	5094.0	0.258
6000.0	39.53	8.0	0.2	5176.4	0.243

Someone has to be best.

It's always been that way.
In politics, in sports, in business. Someone who's more aggressive, more courageous, more dedicated.

Take Mini-Circuits, for example, supplying RF signal-processing components worldwide.

While other companies boasted about their product reliability, we worked at it...pioneering HTRB (high-temperature, reverse-bias) testing to screen potentially faulty mixer diodes; performing burn-in, thermal shock, and fine and gross leak testing on standard off-the-shelf units. And we were the first (and still only) manufacturer of Ultra-Rel™ mixers with a 5-year guarantee.

While others deliver products that may have a wide variance from one unit to the next but still meet specs, we deliver parts with "skinny" sigma, a small unit-to-unit variation. Applying the latest statistical process control techniques, we guarantee 4.5 sigma repeatability; this basically means production units shipped to you will very closely match the performance of the samples we supplied for your evaluation and prototypes. To our customers, such product uniformity translates to substantial reductions in cost by trimming manufacturing throughput time, re-work, specialized test equipment, troubleshooting, report paperwork, and inspection personnel. And more reliable performance of systems in the field under adverse conditions. Bottom line...a more competitive and profitable position.

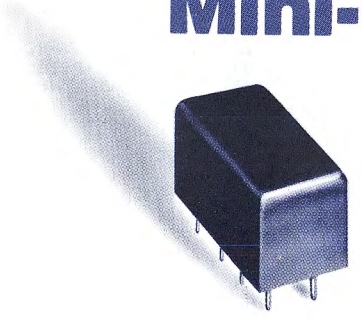
While others limited their standard catalog product line, we steadily added so today we offer the world's widest variety of off-the-shelf, immediate delivery products designed to perform to *your* specs. And this put an end to expensive, "custom" parts with their lengthy delivery delays.

While other RF signal-processing manufacturers were satisfied to offer limited data, Mini-Circuits invested six engineering man years in order to provide customers with exclusive Computer-Automated Performance Data (CAPD) ...the most detailed information ever published for standard catalog items.

While other firms were increasing prices and debating the wisdom of applying computer-aided systems for parts procurement, delivery scheduling, and automating manufacturing and test, we were busy putting such systems into operation. As a consequence, more than 95% of our product line has not been given more than one price increase during the past ten years.

World-class quality from Mini-Circuits...blending reliability, performance, repeatability, prompt delivery, and low-cost.

Mini-Circuits



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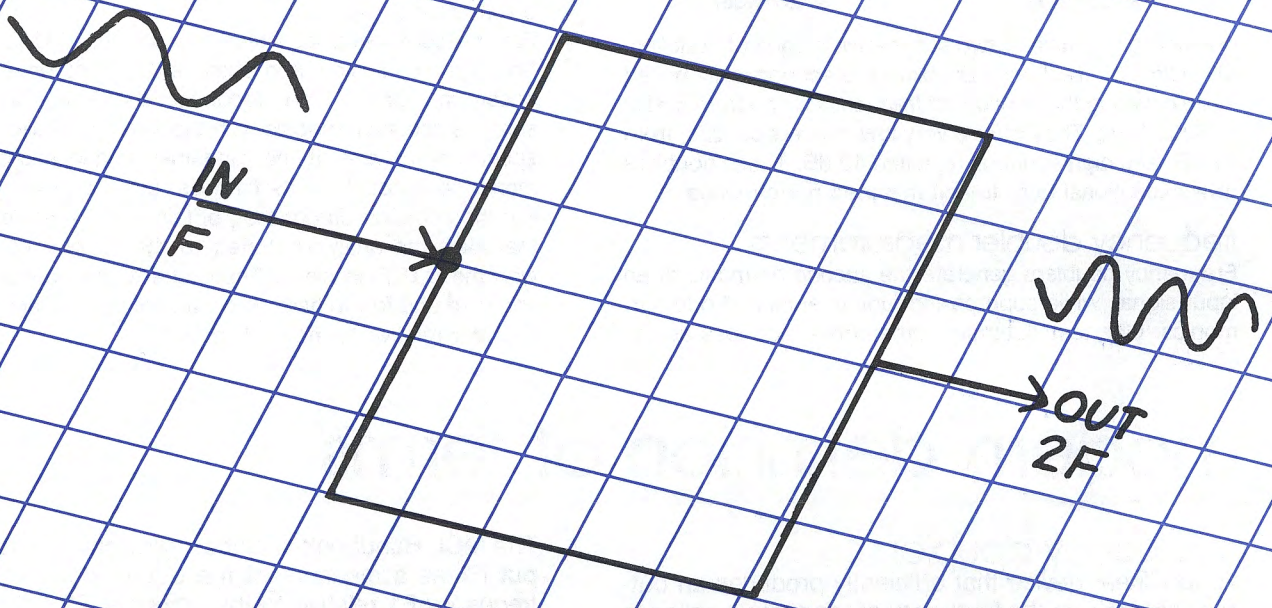
FREQUENCY DOUBLERS



contents of this section

technical

introduction definition of terms, questions 9-2, 9-3
specifications check list
a guide form for requirements 9-9

product specifications

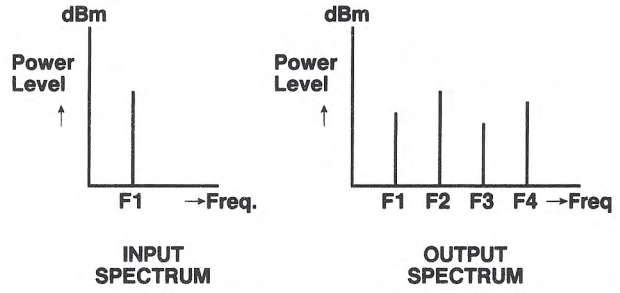
5 kHz to 3000 MHz models 9-4, 9-5

computer data and curves . . . . . 9-6 thru 9-8

Frequency Doublers

Mini-Circuits' frequency doublers offer a new degree of freedom in designing frequency multiplier chains. Their multi-octave band width and excellent rejection of fundamental and third harmonics enable a significant reduction in filter requirements. In addition, they operate with 50-ohm impedances at input and output ports and are not very sensitive to input power. They perform well from 0 dBm to +20 dBm input.

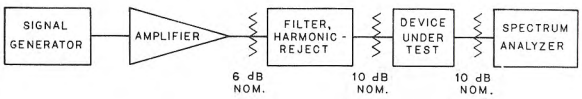
The frequency doubler may be operated as a quadrupler. Referring to the figure, the fourth harmonic will be approximately 12 dB less than the second. When filtering and power level considerations are made, there may be situations where operating the doubler as a quadrupler is a



practical alternative to two successive stages of doubling. Mini-Circuits' frequency doublers are economically priced while covering the very broad frequency range from 5 KHz to 3000 MHz. They offer a very low conversion loss, from 11 dB, and high spurious rejection 40 dB. These doublers give exceptional unit- to-unit matched performance.

frequency doubler measurements

Frequency doublers generate the second harmonic of an input signal, while suppressing fundamental and odd harmonics. One test determines the conversion loss as the dB-difference between the fundamental input power and the second harmonic output power. Another test measures the output power of the "spurious" spectral components: the fundamental, and the third and fourth harmonics, each relative to the desired second harmonic output. The Figure below shows the setup for both tests. The amplifier and attenuators ahead of the D.U.T. are chosen



to drive it at the specified fundamental input power, typically in the +5 to +15 dBm range, as well as to ensure a matched source impedance. Mini-Circuits amplifier model ZHL-2 is suitable for testing the lower-power D.U.T.'s, and ZHL-1000-3W or ZHL-5W-1 for the higher power ones. The filter can be lowpass or bandpass; its purpose is to present a harmonic-free input signal to the D.U.T. For wideband testing, different filter cut-off frequencies have to be used according to the frequency being applied.

For the conversion loss test, replace the D.U.T. with a "through" connection, and obtain a 0 dB reference on the spectrum analyzer. Then reconnect the D.U.T. and measure the second harmonic with the analyzer. Calibrate the spectrum analyzer at the fundamental and second harmonic, to account for its flatness, using a power meter. For the spurious output test, obtain a 0 dB reference on the spectrum analyzer, tuned to the second harmonic, with the D.U.T. in place. Then tune to the fundamental, and third and fourth harmonics, and measure each on the analyzer relative to the 0 dB reference.

modern definition of terms

frequency doubler

A non-linear device that efficiently produces an output that is twice the frequency of the signal applied to its input.

conversion loss

Conversion loss is a measure of the difference in power level between input signal [illegible] F1, and output signal F2 expressed in dB.

harmonic outputs:

F1 is input at frequency. F_1.
F2 is desired output frequency ($2 \times F_1$).
F3 is harmonic output ($3 \times F_1$).
F4 is harmonic output ($4 \times F_1$).

The MCL Handbook specifies **harmonic power output F1** as a measure of the output power level at frequency F1 relative to the power at F2. Similarly, **harmonic output F3** is a measure of the relative power level of frequency F3 to F2. And **harmonic output F4** is a measure of the relative power level at F4 to F2.

rf input power level

The required RF power that must be applied to the input of the frequency doubler in order that the "doubling action" will be performed and is the power range for which conversion loss is specified. At low RF input levels, the conversion loss will increase beyond its specified maximum level. At high RF input levels, the frequency doubler can burn out.

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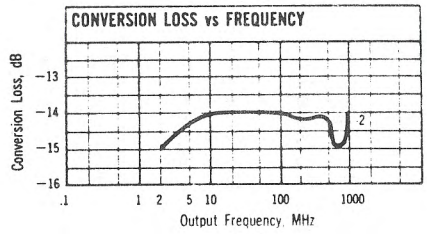
most often asked questions about frequency doublers

Q. *How does the return loss at the output of a frequency doubler vary as input power changes?*

A. Return loss is influenced by how hard the diodes are driven in their conducting state. As input power to the frequency doubler is reduced, the impedance will increase. It is possible, as it increases, to notice an improvement in VSWR or return loss; as input power is further reduced, return loss will degrade. Thus return loss is a function of the input signal level fed to the frequency doubler.

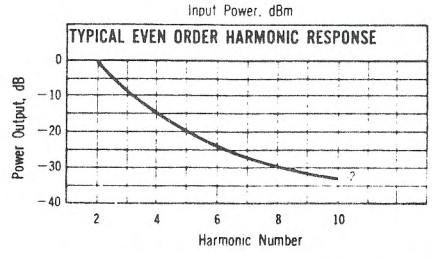
Q. *What is meant by the conversion loss of a frequency doubler?*

A. The conversion loss is the difference in power at the output of the frequency doubler (the second harmonic) compared to the power applied to the input (fundamental) in dB. The conversion loss will vary as a function of the power and frequency applied to the input of the doubler.



Q. *What is the spectrum at the output of a frequency doubler?*

A. Since the frequency doubler operates in a non-linear state, its output contains harmonics of the applied fundamental signal. The amount of odd-order harmonics is a function of the symmetry of the diodes when conducting at each half cycle of the input signal. Basically, all harmonics, including the fundamental, will appear at the output. Each even-order harmonic will appear approximately 12 dB lower than its previous even-order harmonic; for example, the 6th harmonic is about 12 dB lower than the 4th.



Q. *Can I use a frequency doubler as a quadrupler?*

A. Yes, by making use of the fourth harmonic rather than second at the output. There are two disadvantages to consider, however. First, the fourth harmonic output level is 12 dB lower than the second. Also, the harmonics closest to the fourth (the third and fifth) must be reduced, this could complicate filter requirements.

Q. *Suppose I need a tripler. Can I somehow use a frequency doubler?*

A. Use a different type of frequency multiplier, such as a comb generator or a Class-C amplifier.

Q. *Will there be a change in the amount of harmonics generated by the frequency doubler as input power is varied?*

A. No. The harmonics will remain the same but the power level associated with each harmonic will change as input level is varied.

Q. *What happens to the output of a frequency doubler when it is driven too hard?*

A. Think of a frequency doubler as a mixer with the same frequency signal applied to both the RF and IF ports; sum and difference frequency signals will appear at the output. When excessive signal level is applied, the frequency doubler will operate in heavy saturation, and higher-order harmonics will be greater in amplitude relative to the desired second-harmonic. In addition, the second harmonic output will not increase in linear proportion to the input so that effective conversion loss would be higher. Make sure the input power to the frequency doubler is within the power range specified for optimum performance.

Q. *Can the input waveform be other than a sine wave?*

A. Yes, a frequency doubler will operate with various input wave shapes. However, a square wave would probably provide higher efficiency since it would drive the device harder into its conducting and non-conducting state.

high rejection of 1st and 3rd harmonics

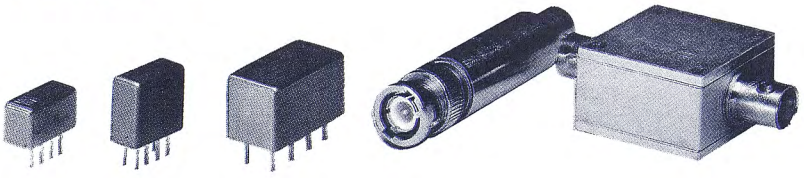
Frequency Doublers

input power 0 to +20dBm

5 KHz to 3000 MHz

case style selection

outline drawings see Table of Contents



SK AK RK FD FK

	MODEL NO.	FREQUENCY MHz Input	FREQUENCY MHz Output	RF INPUT PWR. dBm Min.	RF INPUT PWR. dBm Max.	CONVERSION LOSS dB Input freq.	CONVERSION LOSS dB Typ.	CONVERSION LOSS dB Max.	*HARMONIC OUTPUT, dB F1 Typ.	F1 Min.	F3 Typ.	F3 Min.	F4 Typ.	F4 Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
SK case B02	SK-2	1-500	2-1000	1	10	1-100	13.0	15.0	40	30	50	40	16	12	26.45	•	•
						100-300	13.5	15.5	25	20	40	30	16	12			
						300-500	14.0	17.5	20	15	30	25	16	12			
AK case A03	AK-2	1-500	2-1000	1	10	1-100	13.0	15.0	40	30	50	40	16	12	20.95	•	•
						100-300	13.5	15.5	25	20	40	30	16	12			
						300-500	14.0	17.5	20	15	30	25	16	12			
	AK-3000	70-1500	140-3000	12	15	70-1000	10.5	14.0	31	20	40	25	14	10	59.95	•	•
						1000-1500	11.5	16.0	22	15	30	20	30	14			
RK case A01	RK-2	1-500	2-1000	1	15	5-100	13.0	16.0	40	30	50	40	16	12	17.95	•	•
						100-300	13.5	15.5	25	20	40	30	16	12			
						300-500	14.0	16.5	20	15	30	25	16	12			
	RK-3	0.05-150	0.1-300	0	13	0.05-50	11.0	13.0	40	30	45	30	16	12	15.95	•	•
						50-150	11.5	15.0	35	20	40	20	16	12			
	RK-5	10-800	20-1600	10	20	10-100	13.0	15.0	20	12	25	20	15	12	49.95	•	•
						100-400	12.5	16.0	20	12	30	20	15	12			
						400-800	13.0	16.0	20	12	25	18	15	10			
	RK-6	0.005-25	0.01-50	0	10	0.005-1	11.0	13.0	40	30	45	30	16	12	25.95	•	•
						1-25	11.5	15.0	35	20	40	20	16	12			
	RK-3000	70-1500	140-3000	12	15	70-1000	11.0	14.0	31	20	40	25	15	10	54.95	•	•
						1000-1500	12.0	17.5	22	15	30	20	30	14			
FD case FF55	FD-2	1-500	2-1000	1	15	5-100	13.0	16.0	40	30	50	40	16	12	40.95	•	
						100-300	13.5	15.5	25	20	40	30	16	12			
						300-500	14.0	16.5	20	15	30	25	16	12			
FK case H16	FK-5	10-1000	20-2000	**10	20	10-600	13.0	15.0	20	10	16	20	15	10			
						600-1000	14.0	17.0	20	10	25	20	25	15	69.95	•	
	△FK-3000	70-1500	140-3000	12	15	70-1000		14.0	31	20	40	25	15	10	79.95	•	
						1000-1500	12.0	17.5	22	15	30	20	30	14			

NOTES:

△ Available with SMA connectors only.
*Hamonic output below power of F2.
**Above 700 MHz min. input power +13 dBm
1. Maximum RF input power, 200mW.
2. Refer to Table of Contents for quality control procedures; environmental specifications, absolute maximum ratings, and hi-rel testing.
3. For connector types and case mounting options, see case style outline drawings.
4. Prices and specifications subject to change without notice.

pin connections

see case style outline drawing

Series	SK	RK			AK	LK
Models	all models	−2 −5	−3	−6	all models	−3000
IN	*1,2	*1,3,4	*1,3,4	*1,3,4	*1,3,4	4
OUT	4	8	8	8	8	8
GND◆	3	2,5,6,7	2,5,6,7	2,5,6,7	2,5,6,7	—
CASE GND	3	2,5,6,7	2	—	2,5,6,7	1.2.3.5.6.7

*pins must be connected together externally
◆Ground externally. All measurements made with GND pin(s) grounded externally.

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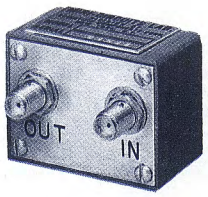
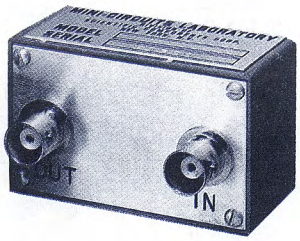
LK



MK



GK

	MODEL NO.	FREQUENCY MHz Input	Output	RF INPUT PWR. dBm Min.	Max.	CONVERSION LOSS dB Input freq.	Typ.	Max.	*HARMONIC OUTPUT, dB F1 Typ.	Min.	F3 Typ.	Min.	F4 Typ.	Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
LK case BB48	LK-3000	70-1500	140-3000	12	15	70-1000 1000-1500	10.5 11.5	14.0 16.0	31 22	20 15	40 35	25 20	15 20	10 14	64.95	•	•
MK case L19	MK-2	1-500	2-1000	1	15	5-100 100-300 300-500	13.0 13.5 14.0	16.0 15.5 16.5	40 25 20	30 20 15	50 40 30	40 30 25	16 16 16	12 12 12	52.95	•	
	MK-3	0.05-150	0.1-300	0	13	0.05-50 50-150	11.0 11.5	13.0 15.0	40 35	30 20	45 40	30 20	16 16	12 12	47.95	•	
	MK-5	10-1000	20-2000	**10	20	10-600 600-1000	13.0 14.0	15.0 17.0	20 20	10 10	26 25	20 20	15 25	10 15	76.95	•	
GK case L20	GK-2	1-500	2-1000	1	15	5-100 100-300 300-500	13.0 13.5 14.0	16.0 15.5 16.5	40 25 20	30 20 15	50 40 30	40 30 25	16 16 16	12 12 12	45.95	•	
	GK-3	0.05-150	0.1-300	0	13	0.05-50 50-150	11.0 11.5	13.0 15.0	40 35	30 20	45 40	30 20	16 16	12 12	43.95	•	
	GK-5	10-1000	20-2000	**10	20	10-600 600-1000	13.0 14.0	15.0 17.0	20 20	10 15	26 25	20 20	15 25	10 15	67.95	•	

applications

- Wideband frequency multiplier chains
- Low spurious frequency multiplier chains
- FM, PM modulation chains
- Double frequency range of signal generators

NSN GUIDE

MCL NO.	NSN
AK-2	5895-01-131-4569
FD-2	5895-00-087-7925
FK-5	5985-01-204-9746
MK-3BR	5895-01-332-8582
RK-2	5895-01-268-7337
RK-3	5895-01-143-3726
RK-3-TX	5895-01-160-8656
SK-2	6625-01-247-8425

In Stock...Immediate Delivery

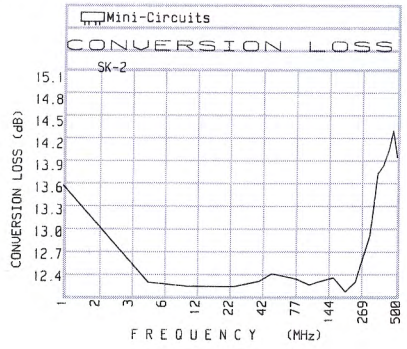
CAPO now available! computer-automated performance data see model index

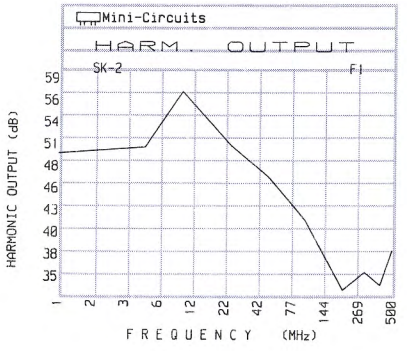
high rejection of 1st and 3rd harmonics

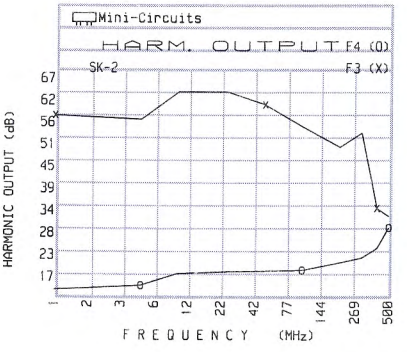
Frequency Doublers

AK-2
SK-2

1 to 500 MHz



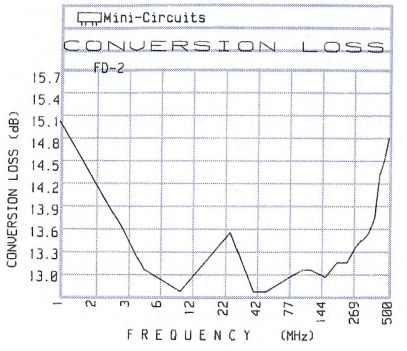


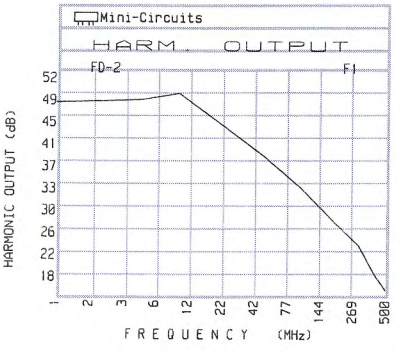


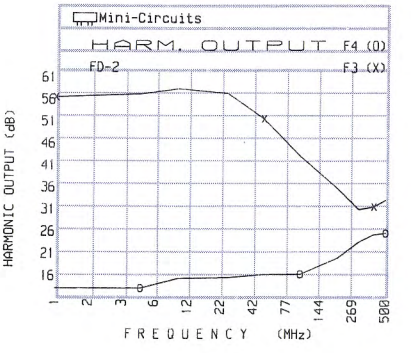
Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
1.00	13.72	.13	50.0	58.0	13.9
5.00	12.35	.06	50.8	57.0	15.0
10.00	12.29	.05	57.7	64.0	18.0
25.00	12.34	.05	51.0	64.0	18.5
50.00	12.47	.04	47.2	60.8	18.7
100.00	12.35	.05	41.8	55.2	18.9
200.00	12.26	.03	33.4	50.0	20.8
300.00	12.94	.04	35.6	53.6	22.0
400.00	13.94	.08	34.0	34.5	24.4
500.00	13.88	.14	38.2	32.5	29.6

MK-2
FD-2
GK-2
RK-2

1 to 500 MHz



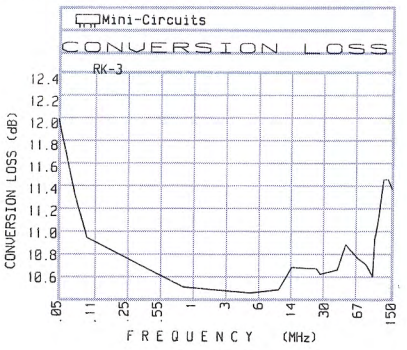


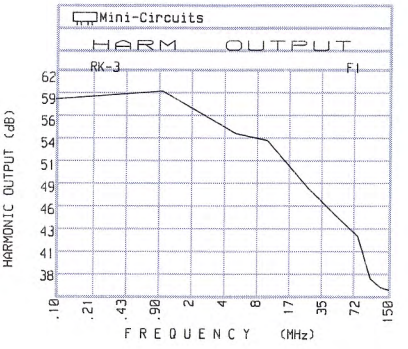


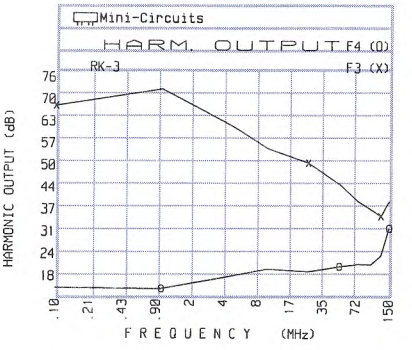
Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
1.00	15.26	.34	48.2	57.0	13.7
5.00	13.06	.23	48.7	57.8	13.8
10.00	12.72	.16	49.8	59.0	16.0
25.00	13.52	.16	43.6	58.0	16.2
50.00	12.74	.13	39.0	52.2	16.9
100.00	13.04	.13	33.6	43.6	17.0
200.00	13.06	.17	27.2	36.4	20.6
300.00	13.28	.27	23.7	31.6	24.2
400.00	14.00	.39	18.9	32.2	25.9
500.00	15.04	.58	16.0	33.7	26.2

GK-3
MK-3
RK-3

0.05 to 150 MHz







Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
.10	10.92	.15	59.0	68.0	14.4
1.00	10.44	.03	60.0	73.0	14.2
5.00	10.38	.03	55.0	61.6	18.2
10.00	10.47	.03	54.2	55.6	20.0
25.00	10.62	.03	48.6	51.3	19.3
50.00	10.78	.06	45.0	45.0	20.8
75.00	10.63	.05	43.0	40.0	21.5
100.00	10.93	.08	38.0	37.6	21.4
125.00	11.39	.09	37.0	35.6	24.0
150.00	11.43	.06	36.7	40.0	32.0

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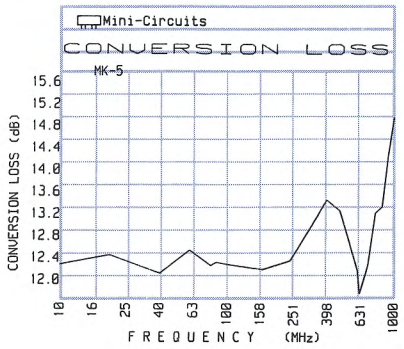
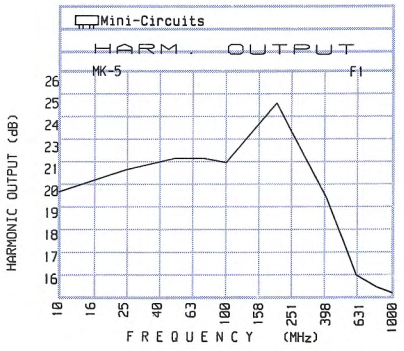
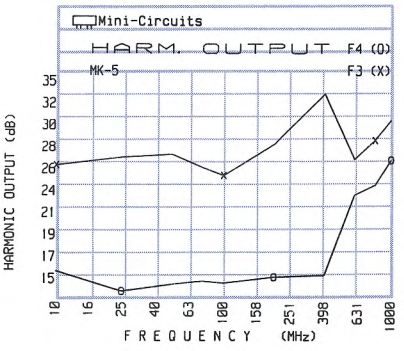
FK-5
GK-5
MK-5 10 to 1000 MHz

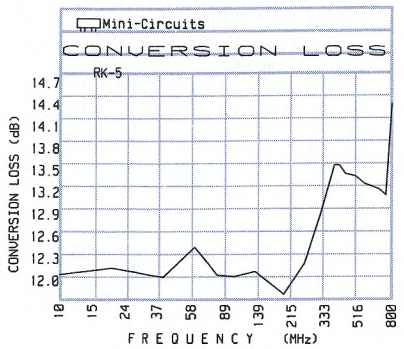


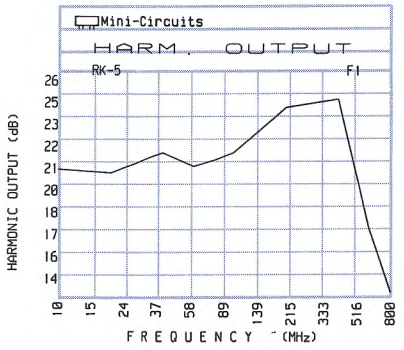


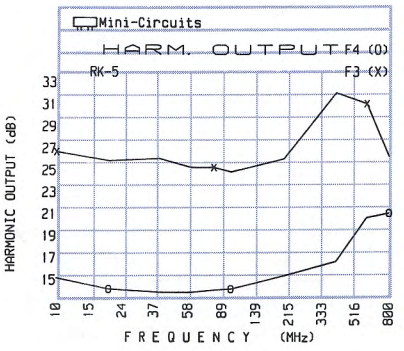


Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
10.00	12.28	.11	20.3	26.2	15.6
25.00	12.35	.04	21.4	27.0	13.6
50.00	12.31	.05	22.0	27.3	14.3
75.00	12.35	.08	22.0	26.0	14.6
100.00	12.27	.07	21.8	25.2	14.4
200.00	12.27	.05	24.8	28.3	15.0
400.00	13.42	.06	20.0	33.4	15.2
600.00	12.09	.11	16.2	26.8	23.2
800.00	12.92	.22	15.6	28.7	24.2
1000.00	14.71	.33	15.3	30.7	26.7

RK-5 10 to 800 MHz







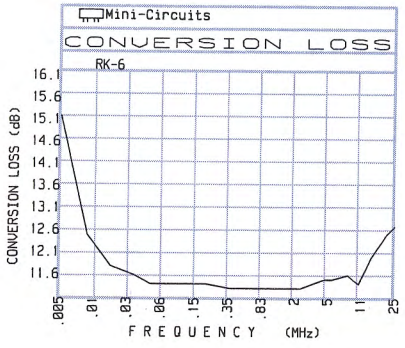
Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
10.00	12.09	.07	20.8	27.0	15.5
20.00	12.24	.09	20.6	26.2	14.5
40.00	12.08	.06	21.8	26.4	14.2
60.00	12.37	.07	21.0	25.6	14.2
80.00	12.08	.07	21.4	25.6	14.4
100.00	12.10	.10	21.8	25.2	14.5
200.00	11.88	.06	24.5	26.4	15.7
400.00	13.60	.12	25.0	32.4	17.0
600.00	13.25	.20	17.4	31.4	21.0
800.00	14.47	.38	13.6	26.6	21.4

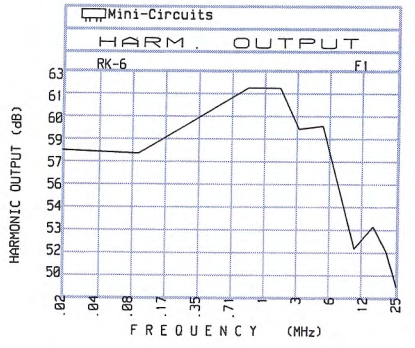
high rejection of 1st and 3rd harmonics

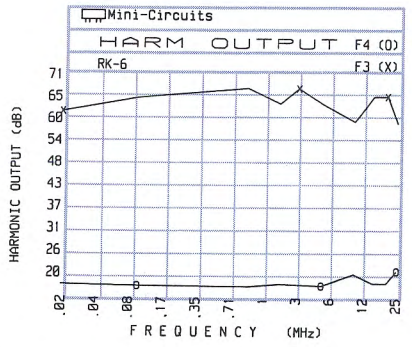
Frequency Doublers

50 ohms

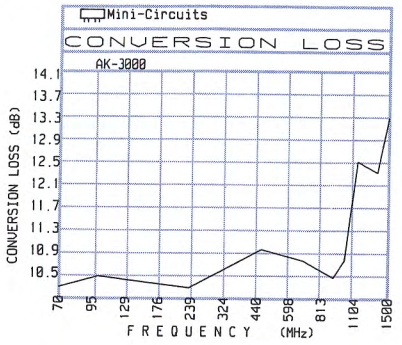
RK-6 0.005 to 25 MHz

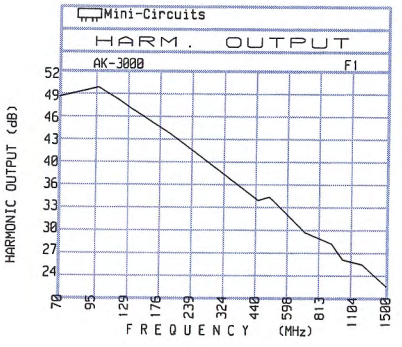


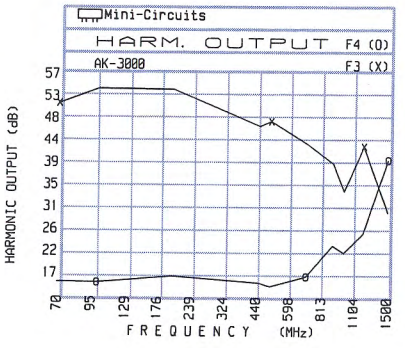




AK-3000 FK-3000 LK-3000 RK-3000 70 to 1500 MHz







Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
0.005	15.14	.13	----	----	----
0.100	11.47	.04	57.8	65.4	16.8
1.000	11.30	.00	62.0	68.0	16.7
2.000	11.30	.00	62.0	64.0	17.4
3.000	11.38	.00	59.4	68.0	17.2
5.000	11.50	.00	59.6	64.0	17.0
10.000	11.40	.00	51.8	59.4	20.0
15.000	12.11	.01	53.2	66.0	17.7
20.000	12.52	.04	51.6	66.0	17.7
25.000	12.76	.05	49.4	59.0	20.8

Freq. (MHz)	Conversion Loss (dB) $\bar{x}$	σ	Harmonic Output (dB) F1	F3	F4
70.00	10.32	.04	49.2	51.2	15.7
100.00	10.54	.05	50.6	54.2	15.6
200.00	10.39	.05	43.7	54.1	16.9
450.00	10.94	.05	34.3	46.8	15.6
500.00	10.91	.07	34.8	47.8	14.9
700.00	10.69	.16	29.7	43.4	16.9
900.00	10.56	.19	28.1	39.5	23.1
1000.00	10.82	.15	25.8	33.9	21.7
1200.00	12.43	.31	25.1	42.9	25.6
1500.00	13.30	.29	21.9	29.7	40.2

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SPECIFICATIONS CHECKLIST

Frequency Doublers

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

RF Input frequency range _____ MHz
RF input power max. ____ dBm, min. ____ dBm
Max. conversion loss _____ dB
Rejection of fundamental at output
_____ db min., relative to 2nd harmonic
Rejection of 3rd harmonic at output
_____ dB min., relative to 2nd harmonic
Rejection of 4th harmonic at output
_____ dB min., realtive to 2nd harmonic
VSWR or return loss (dB)
☐ 50 ohms ☐ 75 ohms ☐ Other
Input _____ Output _____
Max. input (without damage) _____ dBm
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC ☐ Other
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____

Company _____ Dept. _____

Company address _____

Phone _____ Fax _____

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Expose Mini-Circuits' TUF-mixers to 250°C for five minutes, or to the extreme shock and vibration stresses of MIL-STD-28837, or to 200 cycles of thermal shock from -55° to +100°C…they'll survive without any change in specs. They are mighty tough mixers!

Available with LO drive levels from +7 to +17dBm, performance features include very low conversion loss flat over the entire band, high isolation (L-R, L-I), and well-matched VSWR at all ports.

All-welded internal and external construction is used to assemble and package the TUF-unit in its tiny 0.5 by 0.2 by 0.25 in. metal case, for plug-in or surface-mount* assembly.

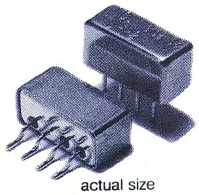
TUF-Ultra-Rel™ mixers are guaranteed for five years and boast unprecedented "skinny" sigma (δ) unit-to-unit repeatability as shown in the Table.

Tough, tiny, and with tight repeatability…Mini-Circuits' Ultra-Rel™ TUF-mixers with a five-year guarantee, priced from $3.95…available only from Mini-Circuits.

SPECIFICATIONS

Model	LO Power (dBm)	Freq. LO/RF (MHz)	■ Conv. Loss (dB) $\bar{X}$	δ	Isol. L-R (dB)	Price,$ Ea. 10 qty
TUF-3	7	0.15-400	4.98	0.34	46	5.95
TUF-3LH	10		4.8	0.37	51	7.95
TUF-3MH	13		5.0	0.33	46	8.95
TUF-3H	17		5.0	0.33	50	10.95
TUF-1	7	2-600	5.82	0.19	42	3.95
TUF-1LH	10		6.0	0.17	50	5.95
TUF-1MH	13		6.3	0.12	50	6.95
TUF-1H	17		5.9	0.18	50	8.95
TUF-2	7	50-1000	5.73	0.30	47	4.95
TUF-2LH	10		5.2	0.3	44	6.95
TUF-2MH	13		6.0	0.25	47	7.95
TUF-2H	17		6.2	0.22	47	9..95
TUF-5	7	20-1500	6.58	0.40	42	8.95
TUF-5LH	10		6.9	0.27	42	10.95
TUF-5MH	13		7.0	0.25	41	11.95
TUF-5H	17		7.5	0.17	50	13.95
TUF-860	7	860-1050	6.2	0.37	35	8.95
TUF-860LH	10		6.3	0.27	35	10.95
TUF-860MH	13		6.8	0.32	35	11.95
TUF-860H	17		6.8	0.31	38	13.95
TUF-11A	7	1400-1900	6.83	0.30	33	14.95
TUF-11ALH	10		7.0	0.20	36	16.95
TUF-11AMH	13		7.4	0.20	33	17.95
TUF-11AH	17		7.3	0.28	35	19.95

*To specify surface-mount models, add SM after P/N shown.
■ $\bar{X}$ = Average conversion loss at upper end of midband ($f_U/2$)
δ = Sigma or standard deviation


actual size

ULTRA-REL™ MIXERS
5-YR. GUARANTEE
with extra long life due to unique HP monolithic diode construction, 300°C high temp. storage, 1000 cycles thermal shock, vibration, acceleration, and mechanical shock exceeding MIL requirements.

finding new ways ...
setting higher standards

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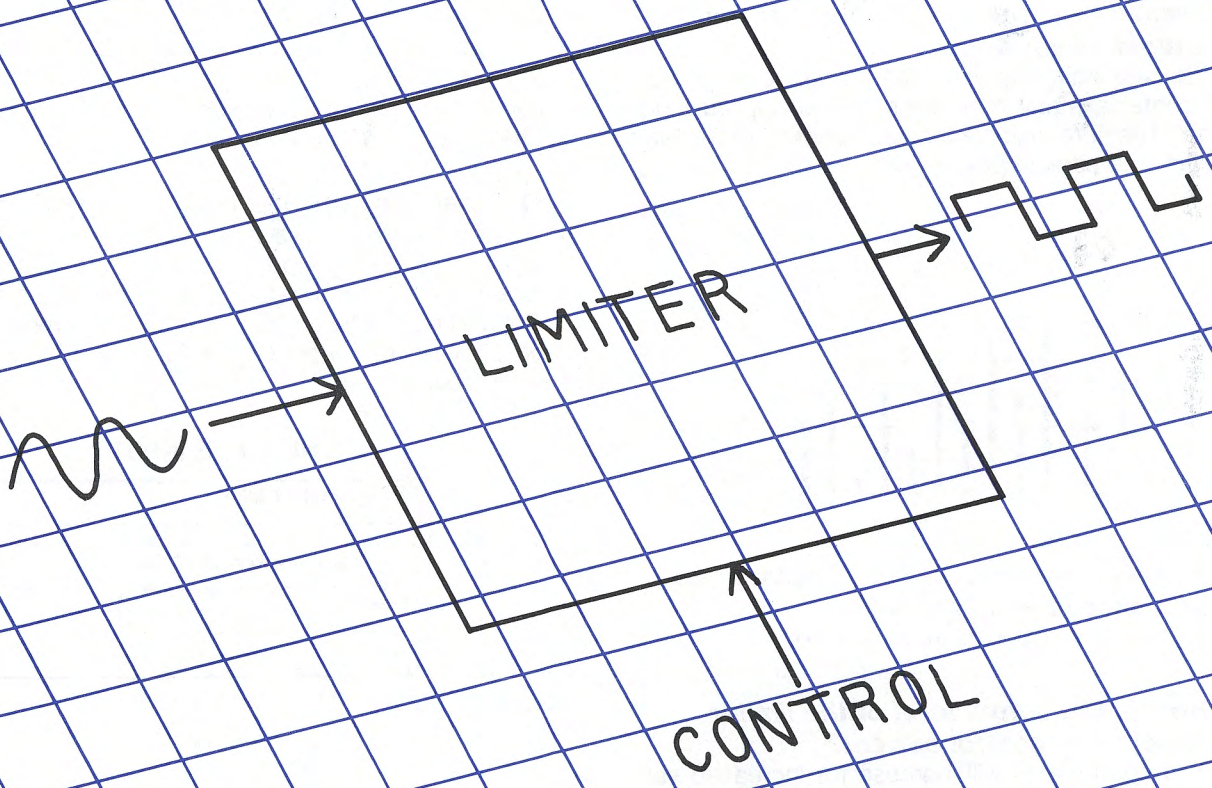
LIMITERS



contents of this section

technical

introduction, definition of terms, questions 10-2
specifications check list
a guide form for requirements 10-3

product specifications

+3 to +20 dBm input models 10-4

computer data and curves 10-5, 10-6

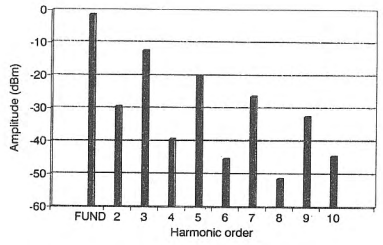
Limiters

Mini-Circuits' limiters cover a very broad frequency range from 3 KHz to 900 MHz, dynamic range from +3 to +20 dBM, and provide exceptionally hard limiting of 0.05 dB output change per dB input change.
All models have been designed to provide very small phase variations as the input level is changed. A bias current of only 3 mA from a 50 ohm source is required to excite a limiter.
When the RF signal level available is not within the dynamic range of the limiter then two options may be taken. One, if the level is too high, an attenuator may be utilized; if the level is too low, an amplifier may be utilized. Both components should be selected so that the input RF signal level range is centered within the range of the limiter.
Applications include stabilizing generator outputs, providing constant amplitude signals in phase-sensitive systems, and reducing amplitude variations in FM detection systems.

most often asked question about limiters

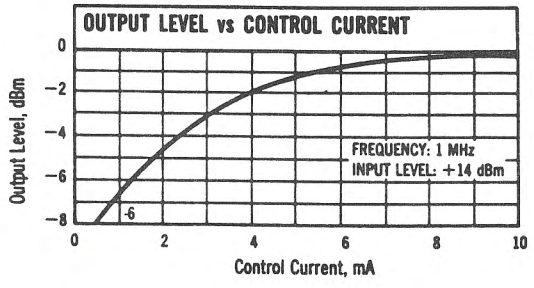
Q. *Please describe the spectrum at the output of a limiter.*
A. Since a limiter acts in a saturated mode, its output contains many harmonics of the applied input signal. The harmonic content is a function of the bias current and applied power level.

Harmonics Output Spectrum of PLS-1
@75MHz, +13dBm input, ctrl current 5mA



Q. *Will a dc component in the input signal influence limiting action?*
A. No. The input port is at dc ground.

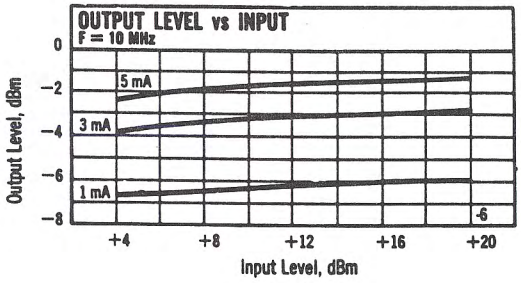
Q. *How is the output level of the limiter affected by control current?*
A. The output level will increase for increased values of control current, as shown.



Q. *What is the effect of using a 50-ohm limiter in a 75-ohm system?*
A. This approach is generally recommended because there will be a small change in limiting action. The efficiency of limiting would not be compromised.

Q. *What happens in a limiter if signals other than a sine wave are applied?*
A. As long as the input level is of sufficient amplitude the diodes will saturate and limiting will occur. The limiting efficiency of output/input will most likely be affected and would be a function of the input wave shape.

SINE WAVE INPUT



Q. *Is it possible to obtain Mini-Circuits' limiters in a surface-mount package?*
A. Yes. You may select anyone of our surface-mount packages in the handbook. Please refer to the mixer, Section 1, for various packages available.

Q. *What is meant by the dynamic range of a limiter?*
A. The dynamic range indicates the variation of RF input power over which a limiter will maintain a relatively constant output level.

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Limiters

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency _____ MHz
Input power, min. _____ dBm, max. _____ dBm
Power output _____ dBm, Tol. ± _____ dB
Control current _____ mA
Impedance ☐ 50 ohms ☐ 75 ohms
Limiting:
Input range _____ to _____ dBm
Output amplitude change _____ dB max.
Output phase change _____ deg. max.
Max. input power (without damage) _____ mW
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC ☐ Other
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____

Company _____ Dept. _____

Company address _____

Phone _____ Fax _____

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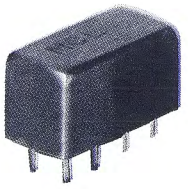
Limiters

50 ohms

3KHz to 900 MHz

broadband, minimal Δ phase +3 to +20 dBm input



PLS

	MODEL NO.	FREQUENCY MHz F_L F_U	INPUT dbm Min.	Max.	*OUTPUT dBm Typ.	CONTROL CURRENT (mA) Typ.	LIMITING Input range, Δ Output/Δ 1db Input dBm	amp, dB	phase, deg.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
PLS case A01	PLS-1	0.1-150	6	20	−4.0	3	6 to 10	0.1	0.8	22.95	•	•
							10 to 16	0.15	0.8			
							16 to 20	0.15	0.7			
	PLS-2	100-900	3	15	−5.0	5	3 to 8	0.2	2.0	22.95	•	•
							8 to 12	0.4	2.0			
							12 to 15	0.4	2.0			
	PLS-6	0.01-1	6	20	−0.5	5	6 to 10	0.2	1.0	35.95	•	•
							10 to 16	0.1	1.0			
							16 to 20	0.2	1.5			

*Typical output level at typical control current. Level may be changed by varying current.

pin connections

see case style outline drawing

Series	PLS		
Model	−1	−2	−6
INPUT	1	1	1
OUTPUT	8	8	8
CONTROL	*3,4	*3,4	*3,4
GND◆	2,5,6,7	2,5,6,7	2,5,6,7
CASE GND.	2	2,5,6,7	—

*Pins must be externally connected together.
◆Ground externally. All measurements made with GND pin(s) grounded externally.

NOTES:

1. Maximum RF input power, 100mW. Maximum control current, 10 mA.
2. Refer to Table of Contents for quality control procedures; environmental specifications, absolute maximum ratings, and hi-rel testing.
3. Prices and specifications subject to change without notice.

NSN GUIDE

MCL NO.	NSN
PLS-1	5895-01-105-7820
PLS-6	5820-01-249-8320

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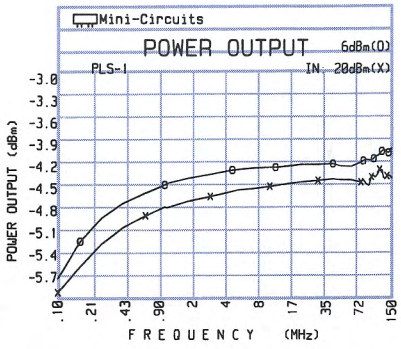
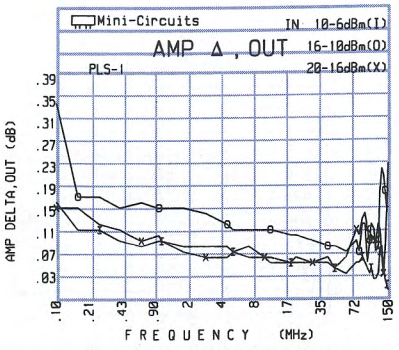
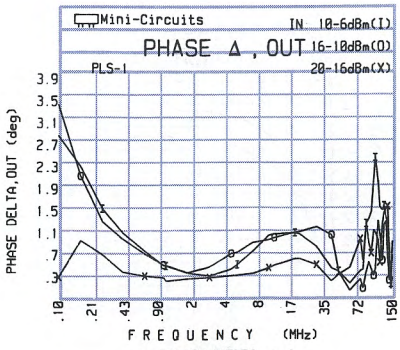
PLS-1

0.1 to 150 MHz





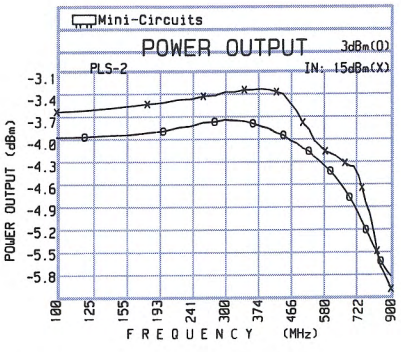


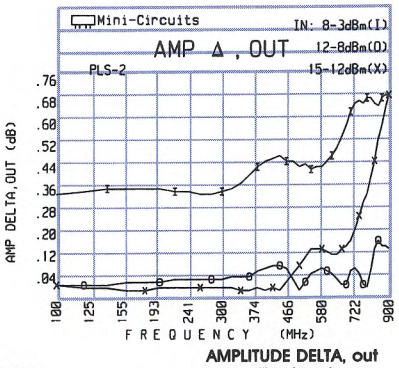
FREQ. (MHz)	POWER OUTPUT (20dBm IN) (dBm)	POWER OUTPUT (6dBm IN) (dBm)	DELTA (dB)	AMPLITUDE DELTA, out dBm Input 20-16 (dB)	AMPLITUDE DELTA, out dBm Input 16-10 (dB)	AMPLITUDE DELTA, out dBm Input 10-6 (dB)	PHASE DELTA, out dBm Input 20-16 (deg)	PHASE DELTA, out dBm Input 16-10 (deg)	PHASE DELTA, out dBm Input 10-6 (deg)
0.100	-5.87	-5.68	0.19	0.16	0.35	0.17	0.28	3.41	2.84
0.260	-5.21	-4.86	0.36	0.13	0.18	0.12	0.69	1.29	1.52
0.660	-4.83	-4.52	0.31	0.10	0.17	0.09	0.30	0.70	0.75
1.059	-4.72	-4.39	0.33	0.10	0.16	0.10	0.21	0.49	0.48
1.708	-4.63	-4.32	0.31	0.08	0.16	0.09	0.25	0.36	0.35
4.417	-4.50	-4.21	0.29	0.07	0.13	0.09	0.30	0.70	0.42
7.106	-4.46	-4.18	0.28	0.07	0.12	0.09	0.34	0.90	0.74
11.406	-4.42	-4.17	0.25	0.06	0.12	0.07	0.49	0.99	1.06
20.076	-4.37	-4.13	0.24	0.06	0.11	0.07	0.61	1.10	1.06
40.319	-4.33	-4.12	0.21	0.06	0.09	0.07	0.20	1.04	0.44
46.734	-4.34	-4.15	0.19	0.05	0.09	0.05	0.32	0.37	0.38
75.087	-4.37	-4.10	0.28	0.12	0.10	0.06	0.97	0.24	0.39
85.225	-4.40	-4.06	0.34	0.14	0.13	0.07	1.24	0.37	1.25
95.367	-4.30	-4.07	0.23	0.12	0.06	0.05	0.71	0.42	1.46
104.061	-4.31	-4.02	0.29	0.11	0.13	0.05	1.09	0.42	2.45
114.499	-4.20	-3.99	0.22	0.10	0.08	0.03	0.54	1.06	1.55
120.761	-4.21	-3.95	0.26	0.13	0.09	0.04	1.25	0.58	1.49
129.949	-4.33	-3.94	0.39	0.07	0.23	0.09	1.52	1.29	1.37
139.975	-4.28	-3.97	0.32	0.08	0.19	0.03	0.90	0.22	0.68
150.000	-4.32	-3.91	0.41	0.24	0.16	0.01	0.27	0.66	0.92

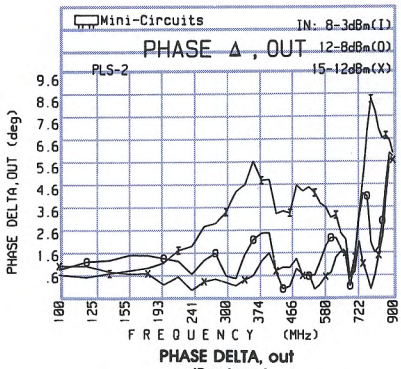
Data taken @ control current 3mA

PLS-2

100 to 900 MHz







FREQ. (MHz)	POWER OUTPUT (15dBm IN) (dBm)	POWER OUTPUT (3dBm IN) (dBm)	DELTA (dB)	AMPLITUDE DELTA, out dBm Input 15-12 (dB)	AMPLITUDE DELTA, out dBm Input 12-8 (dB)	AMPLITUDE DELTA, out dBm Input 8-3 (dB)	PHASE DELTA, out dBm Input 15-12 (deg)	PHASE DELTA, out dBm Input 12-8 (deg)	PHASE DELTA, out dBm Input 8-3 (deg)
100.000	-3.51	-3.86	0.35	0.02	0.02	0.35	1.10	0.94	0.70
140.000	-3.46	-3.83	0.37	0.01	0.02	0.37	0.83	1.36	0.76
180.000	-3.40	-3.79	0.38	0.00	0.03	0.37	0.76	1.59	1.01
220.000	-3.34	-3.72	0.38	0.01	0.04	0.36	0.61	1.32	1.81
260.000	-3.29	-3.65	0.36	0.01	0.04	0.35	0.39	1.36	2.90
320.000	-3.23	-3.62	0.39	0.01	0.05	0.37	0.21	0.54	4.48
360.000	-3.20	-3.66	0.46	0.00	0.05	0.42	0.67	2.30	5.85
400.000	-3.20	-3.73	0.53	0.00	0.08	0.47	1.70	2.61	5.03
440.000	-3.26	-3.82	0.56	0.00	0.09	0.49	1.05	0.08	3.60
480.000	-3.49	-3.93	0.44	0.06	0.04	0.47	1.44	0.99	4.78
520.000	-3.74	-4.04	0.30	0.12	0.03	0.46	0.75	0.66	4.68
560.000	-3.97	-4.18	0.21	0.15	0.07	0.45	0.28	1.32	3.94
600.000	-4.07	-4.31	0.25	0.14	0.07	0.47	0.80	2.38	3.30
640.000	-4.15	-4.48	0.33	0.13	0.04	0.52	1.75	1.89	2.59
680.000	-4.24	-4.67	0.43	0.16	0.02	0.60	0.59	0.20	0.60
740.000	-4.54	-5.00	0.46	0.27	0.06	0.69	1.21	4.40	5.11
780.000	-4.89	-5.22	0.33	0.35	0.01	0.70	0.06	2.16	8.70
820.000	-5.40	-5.44	0.04	0.47	0.15	0.68	1.59	1.94	7.33
860.000	-5.71	-5.62	0.09	0.60	0.16	0.70	4.24	4.91	7.02
900.000	-5.92	-5.75	0.17	0.71	0.15	0.71	5.90	6.07	6.23

Data taken @ control current 5mA

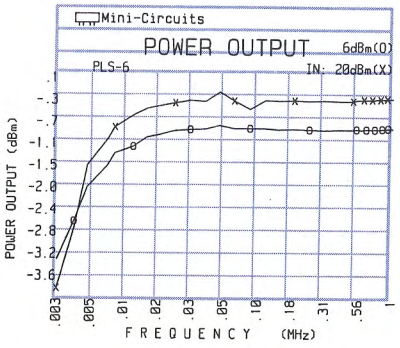
broadband, minimal Δ phase

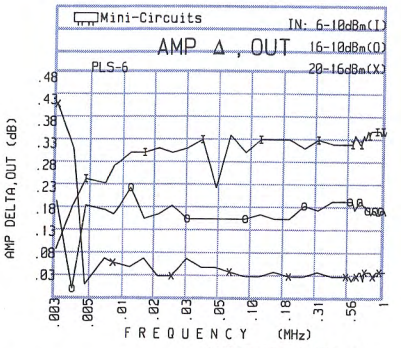
Limiters (+6 to +20dBm input)

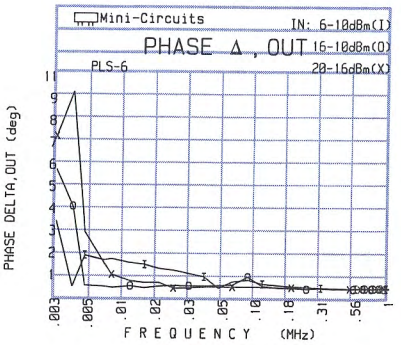
50 ohm

PLS-6

0.003 to 1 MHz







FREQ. (MHz)	POWER OUTPUT (20dBm IN) (dBm)	POWER OUTPUT (6dBm IN) (dBm)	DELTA (dB)	AMPLITUDE DELTA, out dBm Input 20-16 (dB)	AMPLITUDE DELTA, out dBm Input 16-10 (dB)	AMPLITUDE DELTA, out dBm Input 10-6 (dB)	PHASE DELTA, out dBm Input 20-16 (deg)	PHASE DELTA, out dBm Input 16-10 (deg)	PHASE DELTA, out dBm Input 10-6 (deg)
0.003	-3.87	-3.32	0.55	0.42	0.20	0.09	7.57	5.89	3.33
0.005	-1.52	-1.94	0.43	0.01	0.19	0.25	2.78	0.14	1.64
0.008	-0.79	-1.29	0.50	0.06	0.17	0.28	0.69	0.05	1.47
0.014	-0.43	-0.98	0.56	0.07	0.16	0.31	0.30	0.04	1.20
0.023	-0.32	-0.85	0.53	0.03	0.19	0.31	0.03	0.16	0.92
0.050	-0.11	-0.75	0.64	0.05	0.16	0.23	0.10	0.17	0.05
0.084	-0.44	-0.81	0.37	0.03	0.16	0.31	0.10	0.60	0.44
0.139	-0.28	-0.83	0.55	0.04	0.16	0.34	0.07	0.07	0.19
0.234	-0.28	-0.83	0.55	0.03	0.19	0.32	0.09	0.00	0.09
0.390	-0.28	-0.83	0.56	0.03	0.20	0.33	0.01	0.04	0.04
0.529	-0.26	-0.82	0.57	0.03	0.20	0.33	0.00	0.00	0.04
0.577	-0.26	-0.83	0.57	0.03	0.18	0.35	0.02	0.01	0.04
0.629	-0.25	-0.82	0.57	0.04	0.20	0.33	0.07	0.02	0.04
0.677	-0.25	-0.82	0.57	0.02	0.19	0.35	0.02	0.02	0.04
0.728	-0.25	-0.82	0.57	0.04	0.18	0.36	0.02	0.01	0.03
0.806	-0.24	-0.82	0.58	0.03	0.18	0.36	0.02	0.04	0.04
0.853	-0.24	-0.81	0.58	0.04	0.17	0.36	0.04	0.03	0.05
0.905	-0.23	-0.81	0.58	0.04	0.17	0.36	0.04	0.01	0.03
0.946	-0.23	-0.81	0.58	0.04	0.18	0.36	0.02	0.03	0.03
1.000	-0.23	-0.81	0.58	0.04	0.17	0.36	0.04	0.02	0.03

Data taken @ control current 5mA

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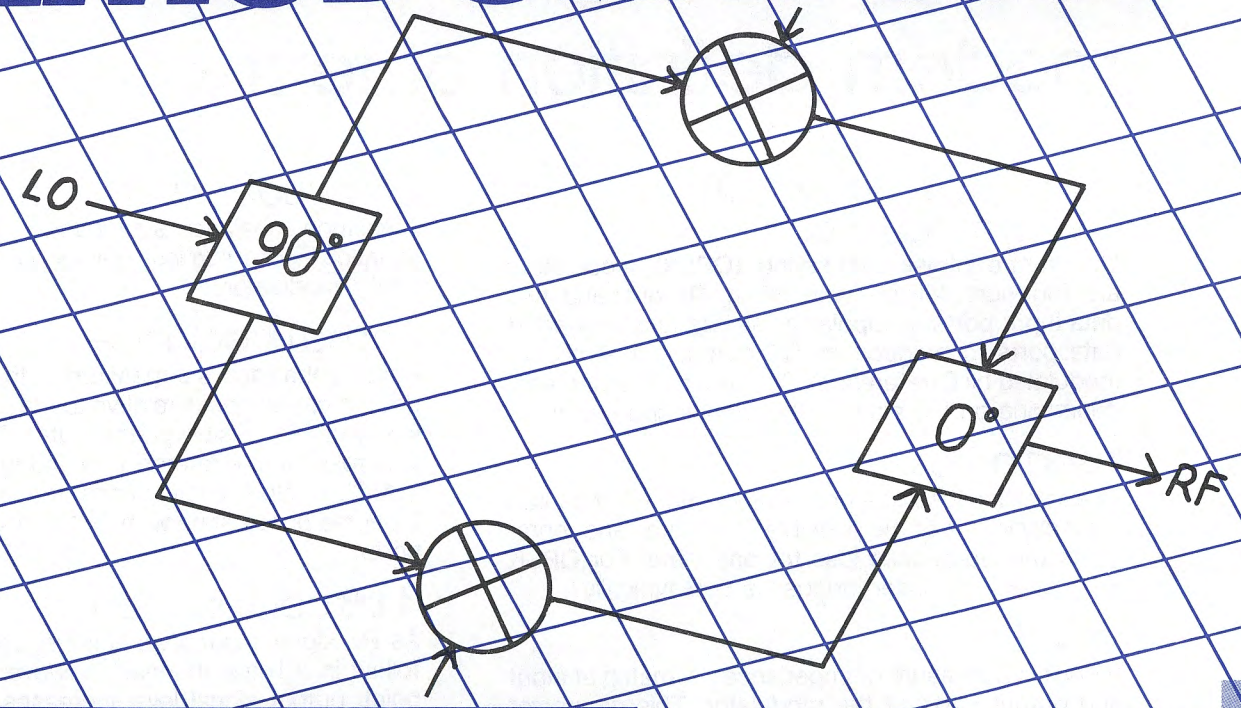
Mini-Circuits

SECTION 11

I&Q AND QPSK MODULATORS/ DEMODULATORS



contents of this section

technical

introduction, definition of terms, QPSK 11-2
definition of terms, I/Q 11-7
most often asked questions, QPSK & I/Q 11-8, 11-9
novel measurement schemes
serve I/Q applications . . . . . 11-3 thru 11-6
specifications check list
a guide form for requirements. 11-10

product specifications

QPSK modulators 11-11
I/Q modulators 11-12
I/Q demodulators 11-13

computer data and curves

CAPD information . . . . . 11-14 thru 11-26

Modulators

Mini-Circuits offers QPSK (quadrature phase-shift keying) and I&Q modulators from 10% bandwidth to as much as 5:1 octave span. So there's no longer any need to gather double-balanced mixers and 0° and 90° hybrids to assemble "in-house" QPSK or I&Q modulators.

QPSK moduators basically provide constant amplitude, 90° vectors: 0°, 90°, 180°, 270°. I&Q modulators provide variable amplitude 90° vectors and therefore must be specified for linear operation, namely 1 dB compression and harmonic suppression.

Using two recently-patented innovative designs, lengthy and tedious tuning steps associated with conventional manufacturing techniques are absent making thses models extremely competitive for low-cost, high volume requirements. Mini-Circuits' 90° phase modulators offer tight unit-to-unit repeatability and excellent performance stability over a −55° to +100°C temperature span.

Units are capable of meeting MIL-M-28837 and MIL-STD-202 electrical and environmental specifications. All I&Q modulators are statistically specified for conversion loss $\bar{x}$ and σ.

Applications include high-speed data systems, high-performance, low-budget communications systems, and simplified instrumentation to check a variety of narrowband QPSK modulators. Multi-octave and narrowband models are available, for imediate delivery, in hermetically-sealed cases with flat-pack or plug-in versions.

In addtion to the models shown in the handbook, Mini-Circuits offers designs for other frequencies, specifications, and package styles including surface-mount. Our experienced engineering group has developed a new technique to enable rapid turn around of new designs, many in less than two weeks.

For a detailed discussion of I&Q applications, see the article that follows "Novel Measurement Schemes Serve I/Q Applications."

modern definition of terms

quadrature phase shift keying modulator

Quadrature phase-shift-keying (QPSK) modulators are four-port devices with RF-in, RF-out, and two data input ports. A bipolar pulse signal is applied at data ports to produce an RF output signal phase-modulated by 0 (reference), 90, 180, or 270 degrees, depending on the state of the modulating signal.

insertion loss

The insertion loss of a phase modulator is measured statically in one of the possible four states and represents the worst-case loss for any state. For QPSK modulators, the insertion loss is 6dB typically.

VSWR

VSWR is a measure of impedance match at input and output ports of the modulator. This parameter represents imperfect input and output impedances. Mini-Circuits' modulators have a VSWR of 1.3:1 typically.

amplitude unbalance

Amplitude unbalance is a measure of the worst-case variation in insertion loss between the four states in a QPSK modulator.

phase unbalance

Phase unbalance is a measure of the offset from the desired carrier phase relative to the actual phase shift in any of the possible phase states. This is measured with respect to a reference or 0 degree phase state. In MCL catalog specifications, the reference is at the 0 degree phase state with + 20 mA for both control ports.

1 dB compression

As RF signal input level is increased, ouput should follow in a linear manner. However, after a certain point, output signal level increases at a lower rate until the modulator output level becomes fairly constant. The RF input level for which the output level deviates from linearity by 1 dB is termed the "1 dB compression point".

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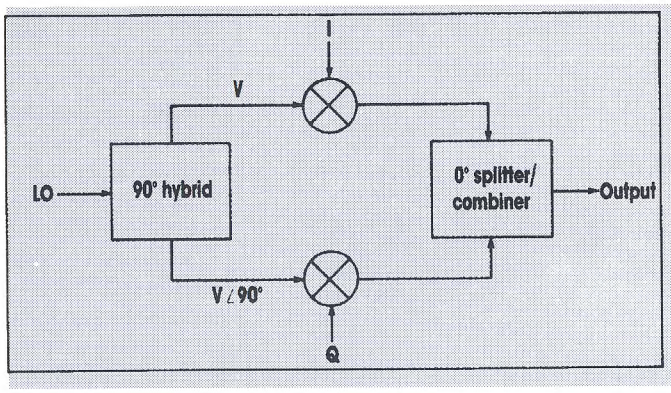
Novel Measurement Schemes Serve I/Q Applications

In-Phase/quadrature network characteristics can be measured using spectrum or network analyzers

Radhakrishnaiah P. N. Setty
Director of Engineering
Mini-Circuits Laboratory
Brooklyn, New York



1. The conventional I/Q modulator/demodulator includes a 90-deg. splitter, two double-balanced mixers, and a 0-deg. splitter/ combiner

In-phase/quadrature (I/Q) modulator/demodulator schemes are often used in digital communication systems. The popular form of an I/Q modulator/demodulator consists of a 90-deg. splitter, two double-balanced mixers, and a 0-deg. splitter/ combiner (Fig. 1). A variety of test methods unique to I/Q networks can be used to provide accurate network characterizations.

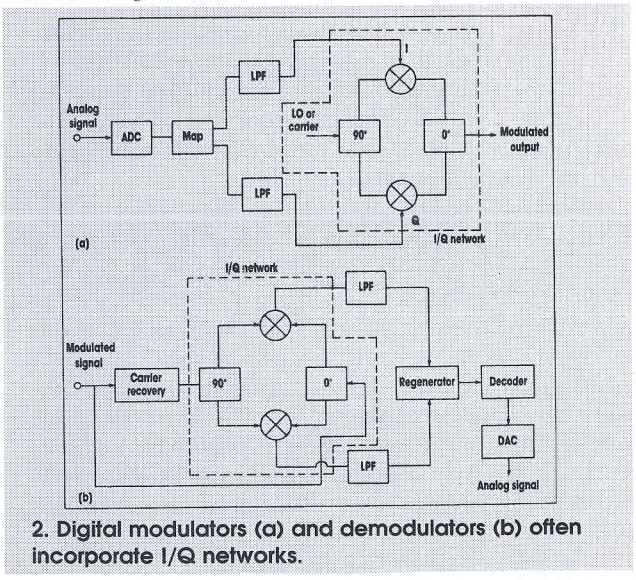
An RF signal can be represented in polar coordinates by magnitude and phase, or in x-y coordiantes as magnitudes of x and y vectors. In digital radio terminology, x is replaced by I and Y is replaced by Q, hence the name I/Q modulator/ demodulator. The quadrature signals are generated by the 90-deg. hybrid. The I/Q signal's magnitude and polarity determine the translated magnitude and phase of the I/Q vector (modulated RF carrier).

Among the various modulation methods is binary phase-shift keying (BPSK), where the carrier phase is shifted 180 deg. to transmit a change of state from 0 to 1, or vice-versa. In the I/Q plane used to describe the signal graphically, this can be represented by two dots on the I axis spaced equally apart from the origin. Assuming an arbitrary amplitude level of 1 for the RF signal, 1 is represented by a dot with a value of +1 on the I axis, while 0 is represented by a -1 on the I axis. The two states are separated by 180 deg. and the magnitude of the carrier is kept constant. Hence, the rate of change of the phase is the same as the rate of change of the digital bits (or bit rate).

In quadrature phase-shift keying (QPSK), the carrier is shifted in 90 deg. steps. There are four possible phase states, and the magnitude is constant. In I/Q networks, this is achieved by adding the appropriate values of the I and Q vectors. For example, the values of I and Q vectors are +1 and +1 for the state "00" and -1 and +1 for state "01," etc. In digital communication, the phase states are called "symbols."

In QPSK modulation, two successive bits are paired to form a symbol. The rate of change of the phase states (or symbol rate) is half of the bit rate. Theoretically, twice the information can be transmitted in a given bandwidth compared to BPSK.

In 8-PSK, there are eight possible phase states, 45 deg. apart, in the I/Q plane. Each phase state or symbol is composed of three bits. Hence, the symbol rate is one third of the bit rate. Note that in 8-PSK, the magnitudes of I and Q vectors are not equal, but the resultant carrier has a constant magnitude.



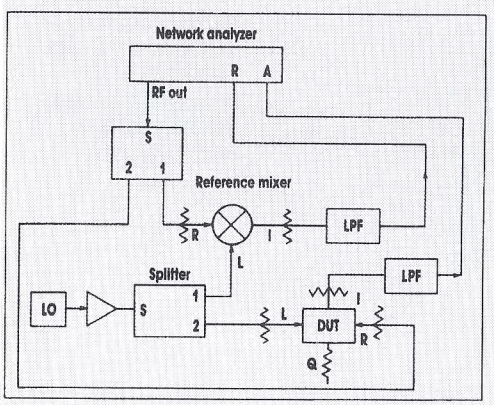
2. Digital modulators (a) and demodulators (b) often incorporate I/Q networks.

In 16-quadrature amplitude modulation (QAM), there are 16 phase states in the I/Q plane. Here the carrier magnitude differs for varying phase states; hence, the name QAM. Each symbol represents four bits, so the symbol rate is one fourth of the bit rate.

By extending this reasoning, it can be stated that the symbol rates for 64-QAM and 256-QAM are one-sixth and one-eighth of the bit rate, respectively. In practice, this is not the case. Realizable bit rates are lower than theoretical values due to various considerations. For higher-order QAM, the separation between phase states becomes smaller and susceptibility to noise becomes greater. In order to realize higher-order QAM, the signal-to-noise ratio (SNR) should be increased. Also, mixers should operate in the linear range to preserve symbol spacing.

Digital Modulator

The principle component of a digital modulator (Fig. 2a)



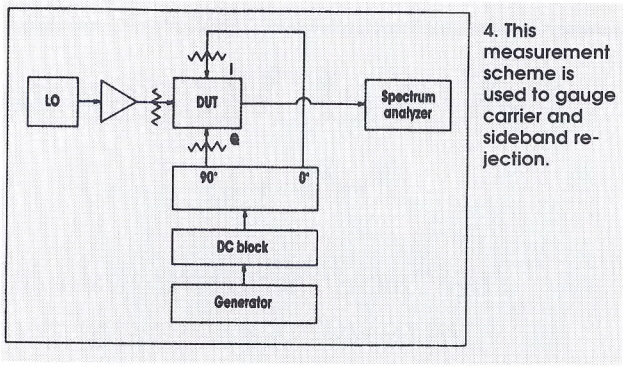
3. Amplitude and phase imbalances can be measured using this configuration with the analyzer in mixer mode.

is the 90-deg. splitter, which splits the carrier into two equal parts which are 90 deg. out of phase. An incoming analog signal is converted into digital form by an analog-to-digital converter (ADC) and is fed to a map/coder. The map takes the serial data, groups it into symbols, and produces I and Q ouputs of suitable amplitude and polarity for each symbol. The I and Q signals are then fed to the mixer I and Q ports, which generate double-sideband outputs that are in quadrature. These outputs are summed in a 0-deg. hybrid, and the resultant output is an I/Q-modulated signal.

In a demodulator (Fig. 2b), the carrier is recovered from the imcoming modulated signal and fed to 90° hybrid and modulated signal to the0° hybrids. The I and Q ports contain the downconverted intermediate-frequency (IF) signal. The I and Q outputs are then fed to a regenerator and decoder to obtain the demodulated signal.

Switched QPSK

A switched QPSK modulator is similar to an I/Q modulator. Its mixers are normally driven with bipolar ±20-mA signals at the I and Q ports. This results in a 0- or 180-deg. phase shift of the signal applied to each mixer, but with a constant output magnitude. The mixer outputs are combined in a 0-deg. hybrid. Radio-frequency (RF) input to this network should be below the 1-dB compression level. This



4. This measurement scheme is used to gauge carrier and sideband rejection.

network is excellent for QSPK applications at frequencies up to the gigahertz range, provided that amplitude, phase balance, and impedence match be maintained in the mixers and hybrids. However, the mixers are operated as switches and are not linear. Therefore, this mode of operation is not suitable for QAM.

Important I/Q network specifications include:

- amplitude and phase imbalance
- conversion loss
- carrier and single-sideband rejection
- port-to-port isolation
- third-and fifth-order products
- DC offset

In an ideal I/Q demodulator, the LO signal is split into two equal-amplitude signals which are 90 deg. apart, and the RF signal is split into two equal-amplitude, equal-phase signals which are applied to the two mixers. The downconverted signals from the two mixers are of equal amplitude but differ in phase by 90 deg. In practice, all four components of the I/Q network deviate from ideal operation. This results in I/Q-port signals that differ in amplitude and phase quadrature. For instance, if two quadrature signals Vi and Vq are given by:

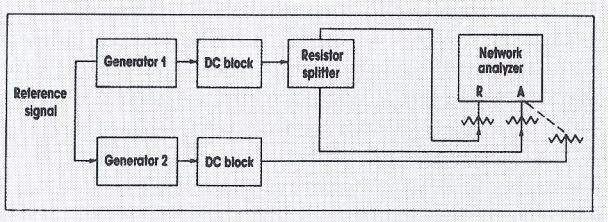
$$Vi = A1 \angle 0 \qquad (1a)$$

$$Vq = A2 \angle (90 + \Theta) \qquad (1b)$$

then amplitude imbalance (in dB) and phase imbalance (in deg.) are defined as:

$$\text{Amplitude imbalance} = 20 \log A1/A2 \qquad (2a)$$

$$\text{Phase imbalance} = \Theta \text{ deg.} \qquad (2b)$$



5. The use of two generators in this test setup eliminates the need for a highly-balanced 90-deg. hybrid.

Imbalance Testing

Amplitude and phase imbalances can be measured using a network analyzer in mixer mode (Fig.3). In mixer mode, the network analyzer needs an external IF signal to phase-

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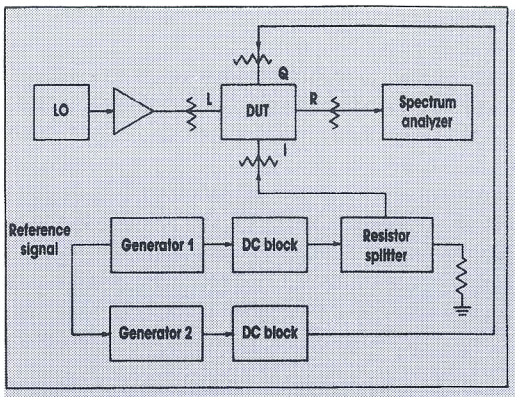
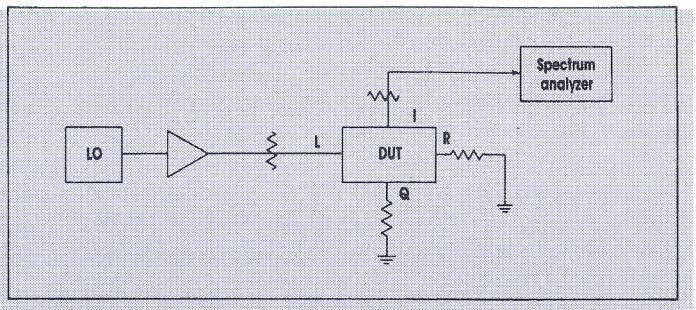
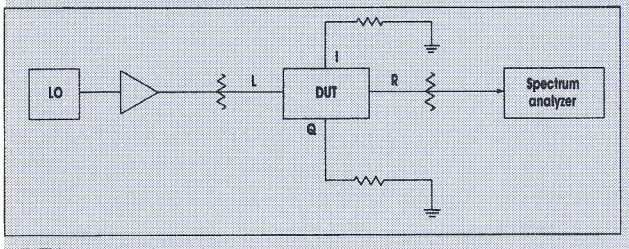


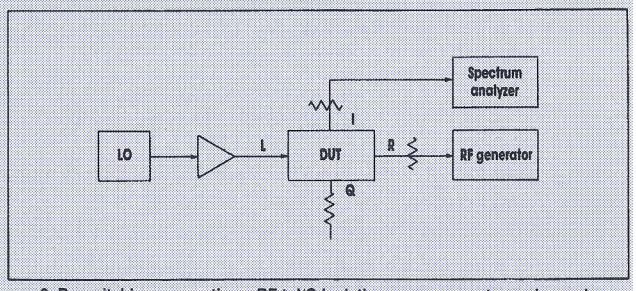
6. This measurement setup is used to gauge sideband and carrier rejection, suppression, and conversion loss, and does not require a network analyzer.



8. The LO-to-I/Q isolation measurement scheme utilizes a spectrum analyzer.



7. This test setup is used to determine the measurements of LO-to-RF isolation.



9. By switching connections, RF-tol/Q isolation measurements can be made.

lock its internal oscillators. This is accomplished by first dividing the LO and RF signals in the two splitters. The resultant signals are applied to the reference mixer and device under test (DUT). The IF output of the reference mixer is filtered to remove the upper sideband and is applied to the analyzer R channel to phase-lock the oscillator. Similar filtering is done to the I-port output of the DUT, which is applied to the analyzer A channel. The A channel then indicates the amplitude of the I-port signal with an arbitrary phase. The analyzer is normalized at this setting. The Q-port termination and the I-port attenuator-filter combination on the I port are then interchanged. The display on the A-channel then becomes the amplitude imbalance and phase difference. The deviation of this phase from 90 deg. is the phase imbalance. For example, if the display reads 89 deg., the phase imbalance is 1 deg.

The A-channel display before normalization indicates the absolute value of the I-port output. Knowing the loss of the attenuator and filter, the conversion loss can be computed. Network analyzers should be calibrated with a power meter to improve accuracy.

The DUT and reference mixer are padded on all ports to improve matching. Too much padding should be avoided or else the power output needed from the network analyzer to obtain a given DUT input would have to be increased. This results in an increased harmonic level from the network analyzer and greater inaccuracy. Padding of 6 to 10 dB is adequate for most measurements. The same precaution regarding allowable loss applies when choosing the two splitters.

In modulator applications, the amplitude and phase imbalance of the I and Q networks have a direct effect on sideband rejection. The output of each mixer is a double-sideband signal. The mixer outputs differ slightly in amplitude due to imbalance in the quadrature hybrid output and the unequal conversion loss and phase response of the two mixers. These outputs are combined in the 0-deg. hybrid and altered by the hybrid's amplitude and phase imbalance. Vectorial addition of the mixer output sidebands results in enhancement of one of the sidebands and suppression of the other.

Due to imbalance, sideband suppression is not perfect. For example, a 1-deg. phase and 0.1-dB amplitude imbalance results in 40-dB sideband suppression. For a 30-dB suppression requirement, a combination of 1-deg. phase and 0.5dB amplitude imbalance is allowable.

The carrier frequency lies midway between the sidebands. Carrier suppression depends on mixer balance. For good modulator operation, the carrier signal should be at or below the suppressed-sideband level.

Rejection Testing

In the setup for tesing carrier and sideband rejection/suppression (Fig.4), the low-frequency generator output is split into two signals at 0 and 90 deg. which are fed to the I and Q ports, respectively. The RF output is displayed on a spectrum analyzer. Carrier and sideband rdjections can be read directly on the analyzer. Precaution is exercised by using a DC block to prevent and DC output from the low-frequency generator from biasing the mixers and causing a false measurement.

This test method places excessive contraints on the 90-

deg. hybrid. Its amplitude and phase imbalance should be approximately 0.10 dB and 0.01 deg., respectively. An alternate technique is to use two generators to obtain equal-amplitude signals that are 90 deg. out of phase. The two signal levels and phases can be adjusted using a setup that incorporates a network analyzer (Fig. 5). The output from generator 1 is split into two parts. One part is applied to the R port of the network analyzer and the other part is applied to the A port. The analyzer is then set to continuous-wave (CW) mode at the generator frequency using the front panel keys. The amplitude is adjusted to the required level, which can be read directly on the analyzer, and the amplitude and phase displays are normalized.

The signal at the A port is then removed and splitter port 2 is terminated at 50Ω. The output of generator 2 is then applied to the analyzer A channel. The generator-2 output amplitude is adjusted to read 0 dB and the phase is adjusted to read 90 deg. Now the network analyzer is no longer needed. Port 1 of the resistive splitter is terminated at 50Ω. The port-2 output is applied to the I port of the DUT and the output of generator 2 is applied to the Q port (Fig. 6). This technique provides a wide selection of I- and Q-port signal frequency and is limited only by the generator.

This setup can also be used to measure converion loss. The absolute value of the amplitude of the higher sideband can be read from the spectrum analyzer. By knowing the attenuator loss on the RF port, converion loss can be computed. The spectrum analyzer should be calibrated with a power meter to improve accuracy.

Isolation Measurements

Isolation measurement are straightforward. The test set-ups for LO-to-RF (Fig. 7), LO-to-I or Q (Fig. 8), and RF-to-I or Q (Fig. 9) isolation incorporate a spectrum analyzer. High isolation is desirable in order to reduce filtering requirements. For LO-to-Q and RF-to-Q isolation measurements, the 50Ω term on the Q port is interchanged with the spectrum analyzer cable on the I port.

In a typical demodulator, the LO and RF frequencies are very close to each other. For example, if the difference is 100 kHz, the third- and fifth-order IF products will appear at 300 and 500 kHz, respectively. Double-balanced mixers have excellent even-order product suppression, therefore the second- and fourth-order IF products are not of concern. A spectrum analyzer can be used to measure the third- and fifth-order products. Achievable levels for these products are typically -40 to -50dBc. Third and fifth order products in modulator applications can be measured using the test setup of Fig. 6.

If I- and Q-port circuits external to the I/Q network are DC-coupled, they will have a finite DC offset. The combination of this DC offset and the mixer offset will bias the mixer diodes and reduce the balance. Measurement of the DC offset is straightforward and is similar to mixer-offset measurement.

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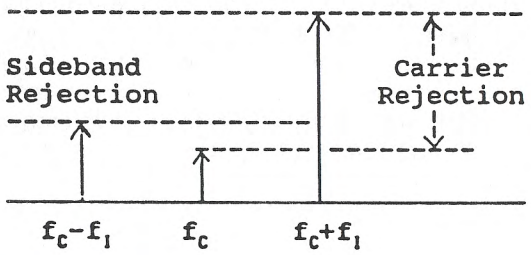
modern definition of terms

I & Q
In-phase and quadrature-phase

carrier rejection
the amount of carrier measured in dB below the desired output signal when a coherent signal of equal amplitude and 90° phase difference is applied to the I&Q ports. This is shown in fig. 1. fc & f_I are carrier and IF (I-Port/Q-Port) frequency.



sideband rejection
The amount of undesired sideband measured in dB below the desired sideband under the same conditions as the carrier rejection measurement.

harmonic suppression
In a modulator, besides the undesired sideband and carrier, harmonic products of the IF combine with the carrier to produce undesired signals at RF as below.

$$f_c \pm nf_i$$

The most important products are the third and fifth, $f_c \pm 3f_i$ and $f_c \pm 5f_i$ since they are very close to the desired sideband and almost impossible to filter.

For a demodulator, the harmonic products of interest are

$$nf_I$$

n = 3 and 5 are the products of most interest.

conversion loss
For a modulator, conversion loss (C.L.), in dB, is defined as below

C.L.(dB) = Input(I + Q) Power − Output RF Power of the dominant sideband

For a demodulator, it is defined as

C.L.(dB) = RF Input Power − (I + Q) Output Power

phase unbalance
The deviation from 90° of the phase angle difference of the I&Q port output signals.

amplitude unbalance
For a demodulator, amplitude unbalance is the difference of the I and Q power.

Amplitude Unbalance = P_I(dBm − P_Q(dBm)

most often asked questions about QPSK modulators

Q: *What is the difference between a biphase modulator and a quadrature (QPSK) modulator?*

A: The biphase modulator has two phase states, 0 degree and 180 degree, modulated by switching polarity of the dc voltage at the control ports.

The basic elements in a QPSK modulator are a pair, (each pair in quadrature to each other) matched biphase modulators, modulated by switching polarities of dc voltage controls in 4 different logics for 4 phase states.

Q: *How can I improve output phase accuracy in order to suit my application?*

A: The Mini-Circuits' modulators are wideband units. Tighter specs can be achieved in narrow band. If there is a choice on operating frequency, select the lowest frequency where better phase accuracies can more easily be achieved. Additionally, please contact our applications team about selecting for tighter specs from our standard units.

Q: *Is there a lower limit for RF input power level?*

A: QPSK modulators can be operated at low RF input power, typically 10 dB above the noise threshold when operated at nominal saturated control current.

Q: *My application requires a fast switching time. What should I look for in the phase modulator?*

A: MCL uses Schottky-barrier diodes in QPSK modulators, which have a bandwidth greater than 500 MHz to achieve very fast switching.

Q: *The MCL catalog specifies that all data are taken at a control current +20 mA. What changes can I expect in phase modulator performances if my control current is lower than +20 mA? higher than +20 mA?*

A: With too low current at the control ports, the insertion loss of the modulators will be increased due to insufficient operation. Too high current control does not help since the diodes are already turned on. High current can also damage the diodes; typically ±5% tolerance of control current is acceptable.

Q: *What changes should I expect in performance of a 50-ohm phase modulator being used in a 75-ohm system ?*

A: All phase modulators shown in the handbook are optimized for 50-ohm impedance. If your application requires QPSK modulators operating in a 75-ohm impedance system, request test data for the desired model from the Applications team. If you require tight tolerance specifications, we will design a unit to meet your requirements.

I&Q modulators and demodulators

Q. *What does I&Q mean?*

A. An RF signal can be represented in X-Y coordinates as magnitude of X & Y vectors. In digital radio, X is replaced by I (In-phase) and Y by Q (Quadrature phase).

Q. *Do I need filters at the demodulator I&Q output?*

A. Yes. Beside the desired IF signal, the sum of the LO and RF signals is also present and must be filtered out. It is important that the filters introduce minimal group delay. Flat time delay filters, such as Mini-Circuits PBLP series, are recommended.

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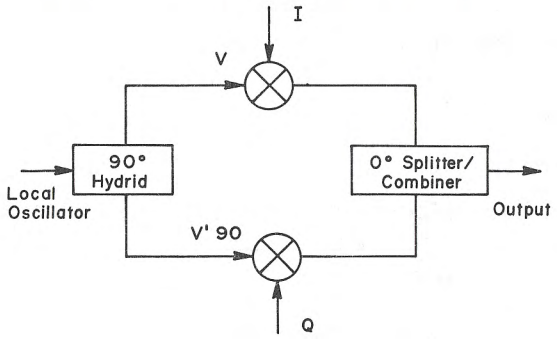
Q. *What is an I&Q modulator/demodulator?*

A. A popular form of an I&Q modulator/demodulator consists of a 90° splitter, two mixers and a 0° combiner/splitter, as shown below.



In a modulator, the incoming data stream is split into two independent bit streams to form I&Q signals. These are upconverted in mixers 1 & 2. Since the local oscillator signals to the mixers are 90° apart in phase, the outputs of mixers 1 & 2 are orthogonal. These signals are vectorially combined in a 0° hybrid. In essence, the quadrature nature of I&Q modulation is used for bandwidth reduction of modulated signals. By proper coding, of I&Q signals an I&Q modulator can be used for higher-order modulation. In a demodulator, the RF signal is applied to the 0° hybrid and the output I&Q signals are decoded.

Q. *What is the difference between an I&Q and QPSK modulator?*

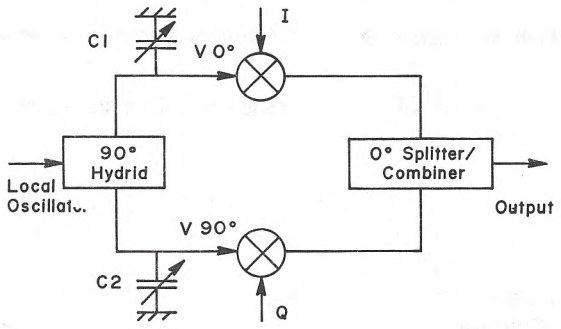
A. An I&Q modulator can be used as a QPSK modulator. As an I&Q modulator, mixers operate in the linear range. In a QPSK (360° in 90° steps) modulator (such as Mini-Circuits QMC-100), mixers behave as bi-phase modulators and operate in a saturated mode.

Q. *What are the most important specs of an I&Q modulator/demodulator and why?*

A. The most important specs of an I&Q modulator are the carrier and sideband rejection. Carrier rejection indicates the amount of the unwanted carrier present at the output. Sideband rejection signifies the orthogonality and amplitude balance of the modulator. The higher the rejection, the better the modulator. The carrier is an unwanted signal at the output; thus there should be as high a rejection as the system requirement demands. For a demodulator, the most important specs are amplitude and phase balance (deviation from 90°). These numbers indicate the degree of orthogonality present in the demodulator.

Q. *How can we improve sideband rejection?*

A. Additional sideband rejection can be achieved by adding trimmers at the output of the internal 90° hybrid, as shown below.



C1 and C2 are external components to the I&Q network and are connected across pins 9 & 12 of Mini-Circuits' MIQC-895M. Typically, 5 to 10 dB additional rejection can be achieved. All modulators do not have access to internal 90° hybrid. Consult factory with your specific requirement.

Q. *What limits the bandwidth of I&Q ports?*

A. Mini-Circuits' I&Q modulators use Schottky-barrier diodes and can perform well up to and beyond the specified frequency. Beyond the specified frequency, slight degradation in performance can be expected.

Q: *Is there a difference between a modulator and demodulator at the same frequency?*

A. Not much. Mini-Circuits' modulators and demodulators are tested for the specified function to confirm the specs. The higher the frequency, the greater the chance of a modulator not performing as well as a demodulator.

Q. *What is the advantage of buying an I&Q modulator instead of building one?*

A. Lower cost and smaller size. The I&Q modulator consists of two phase matched mixers, a 90° power splitter and a 0° power splitter. Interface matching between these elements are essential to maintain the phase relationships of each element. Mini-Circuits I&Q modulators are designed and manufactured to ensure excellent repeatability of each element of the modulator. Ferrite cores used are matched before they are wire wound as transformers. Mixers diodes are amplitude and phase-matched. The result, excellent unit to unit repeatability without tuning. The cost savings of this low cost manufacturing process is passed on to our customers.

Mini-Circuits

SPECIFICATIONS CHECKLIST

I & Q, QPSK modulators/demodulators

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application:

☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

☐ I & Q Modulator ☐ I&Q Demodulator
☐ Phase Modulator (QPSK, 360° in 90° steps)
Frequency range _____ MHz
Conversion loss/insertion loss _____ dB max.
LO level _____ dBm
1 dB compression at _____ dBm

For I&Q Modulator:
I/Q level _____ dBm
Carrier rejection _____ -dBc min.
Sideband rejection _____ -dBc min.
Harmonic suppression
LO ± 3 I/Q _____ - dBc min.
LO ± 5I/Q _____ - dBc min.

For I&Q Demodulator:
RF level _____ dBm
Amplitude unbalance _____ dB max.
Phase unbalance _____ deg. max.
Harmonic suppression 3 I/Q _____ - dBc min.
5 I/Q _____ - dBc min.

For Phase Modulator (QPSK, 360° in 90° steps)
Amplitude unbalance _____ dB max.
Phase unbalance _____ deg. max.

General:
RF/LO ☐ 50 ohms ☐ 75 ohms
I/Q ☐ 50 ohms ☐ 75 ohms ☐ 500 ohms

	VSWR — or —	return loss
RF	_____ max.	_____ dB min.
LO	_____ max.	_____ dB min.
I, Control #1	_____ max.	_____ dB min.
Q, Control #2	_____ max.	_____ dB min.

DC offset _____ mV max.
L-R isolation _____ dB min.
L-I/Q isolation _____ dB min.
Operating temperature _____ °C

Environmental requirements:

_____
_____
_____

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting

☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
(Specify connector for input & output separately)

☐ BNC ☐ TNC ☐ Isolated female BNC
☐ SMA ☐ Type N ☐ Other

Special Requirements: _____

_____

Name _____ Title _____

Company _____ Dept. _____

Company address _____

Phone _____ Fax _____

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Phase Modulators

Mini-Circuits

QPSK

case style selection

outline drawings see Table of Contents



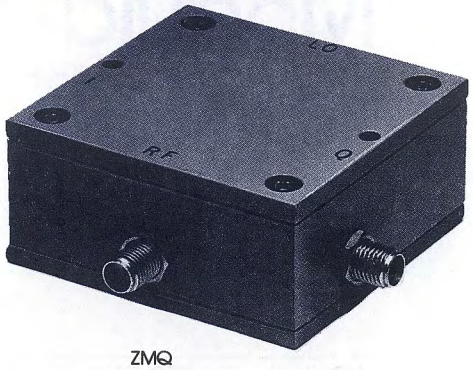
QMC



FPQ



PMQPW
PMQ



ZMQ

	MODEL NO.	FREQ. (MHz)	INSERTION LOSS dB TYP.	INSERTION LOSS dB MAX.	AMPLITUDE UNBAL., dB TYP.	AMPLITUDE UNBAL., dB MAX.	PHASE UNBAL., DEG (±) TYP.	PHASE UNBAL., DEG (±) MAX.	1 dB COMPRESSION dBm TYP	VSWR TYP. IN	VSWR TYP. OUT	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
QMC case C07	QMC-100	50-100	5.6	7.5	0.2	0.8	3	6	4	1.5:1	1.9:1	128.95	●	
	QMC-170	90-170	5.6	7.5	0.3	0.8	3	6	4	1.3:1	1.5:1	128.95	●	
	QMC-1050	800-1050	5.5	7.5	0.5	1.0	3	7	4	2.0:1	2.0:1	119.95	●	
PMQ case AAA118	PMQ-94	47-94	5.5	7.0	0.4	1.2	3	5	4	1.7:1	1.7:1	119.95	●	
	PMQ-330	200-330	5.8	8.0	0.4	1.5	3	6	4	1.5:1	1.5:1	119.95	●	
	PMQ-440	240-440	5.9	8.0	0.5	1.8	3	7	4	1.5:1	1.5:1	119.95	●	
FPQ case FFF122	FPQ-76	60-90	5.4	7.0	0.1	0.9	2	5	4	1.5:1	1.7:1	149.95	●	
	FPQ-331	205-331	6.0	8.0	0.6	1.5	3	6	4	1.4:1	1.7:1	149.95	●	
	FPQ-440	240-440	6.2	8.0	0.5	1.5	4	6	4	1.4:1	1.7:1	149.95	●	
	FPQ-475	421-475	6.8	8.0	0.8	1.5	3	6	4	1.7:1	1.7:1	149.95	●	
*PMQPW case AAA118	PMQPW-150	30-150	6	10.5	0.4	0.9	3	8	4	2:1	2:1	172.95	●	
	PMQPW-250	50-250	6.5	10.5	0.5	1.2	3	8	4	1.7:1	1.4:1	172.95	●	
†ZMQ case HHH141	ZMQ-1050	800-1050	5.5	7.5	0.5	1.0	3	7	4	2.0:1	2.0:1	169.95	●	

NOTES:

1. All data taken @ control current ±20 mA
2. Control ports drive with 50 ohms source.
3. Refer to Table of Contents for quality control procedures, environmental specifications and absolute maximum ratings.
4. Prices and specifications subject to change without notice.

* Protected under Patent No. 4,673,898

† Available only with SMA connectors

PHASE SHIFT VS. CONTROL CURRENT

CONT.-1 (mA)	CONT.-2 (mA)	PHASE SHIFT (Deg.)
+20	+20	0 (REF)
+20	−20	90
−20	−20	180
−20	+20	270

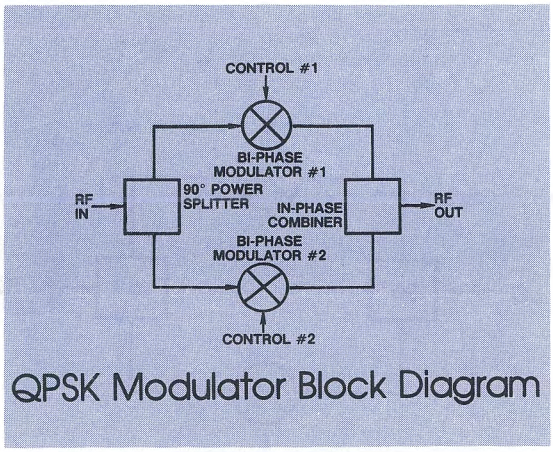
features

- octave & multi-octave bandwidth
- good phase & amplitude balance
- hermetically sealed metallic enclosure with bent leads or plug-in version.
- capable of meeting MIL-M-28837 requirements

pin configuration

Series	QMC ·100 ·170	QMC ·1050	PMQ & PMQPW	FPQ	ZMQ
RF IN	13	13	8	1	3
RF OUT	1	2	4	8	1
CONTROL-1	5	4	2	5	4
CONTROL-2	8	1	6	10	2
GND◆	9,12,16	—	—	—	
CASE GND	3,4,6,7,10 11,14,15	3,5,6,7,8 10,11,14,15	1,3,5,7	2,3,4,6,7,9 11,12,13,14	
NOT USED	2	9,12,16	—	—	

◆ Ground externally. All measurements made with GND pin(s) grounded externally.



QPSK Modulator Block Diagram

maximum ratings:

Input Power	100 mW
Control Current	+40 mA
Temperature	−55°C to 100°C

In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

I&Q Modulators

high rejection of carrier and sideband

9 MHz to 895 MHz

50 ohms



ZFMIQ

MIQC
MIQY



MIQA

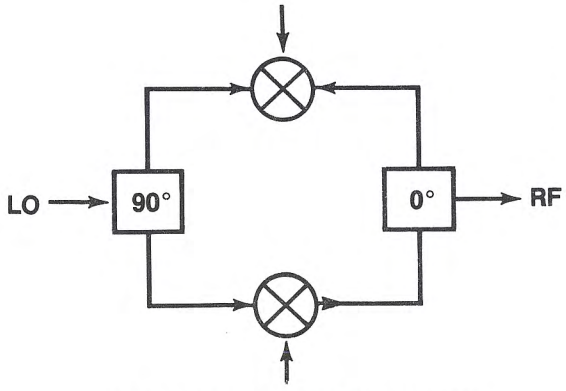
	MODEL NO.	FREQUENCY MHz RF(signal)/ LO(carrier) Fl	Fu	I & Q Min.	Max.	CONVERSION LOSS † (dB) $\bar{x}$	σ	Max.	CARRIER REJECTION* (-dBc) Typ.	Min.	SIDEBAND REJECTION* (-dBc) Typ.	Min.	HARMONIC SUPPRESSION (-dBc) 3×I/Q Typ.	Min.	5×I/Q Typ.	Min.	PRICE Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
MIQA	MIQA-10M	9	11	DC	2	5.8	0.2	7.0	41	30	40	30	58	48	68	58	49.95	•	•
case A06	MIQA-70M	66	73	DC	5	6.2	0.1	7.0	38	30	38	30	48	45	58	55	39.95	•	•
	MIQA-70ML	66	73	DC	5	5.7	0.1	6.5	38	30	38	30	48	45	58	55	49.95	•	•
	MIQA-91M	86	95	DC	5	5.5	0.1	6.5	38	30	38	30	48	45	58	55	49.95	•	•
	MIQA-100M	95	105	DC	5	5.5	0.1	6.5	38	30	38	30	48	45	58	55	49.95	•	•
	MIQA-108M	103	113	DC	5	5.5	0.1	6.5	38	30	38	30	48	43	58	55	49.95	•	•
	MIQA-195M	185	205	DC	5	5.6	0.1	6.5	38	30	38	30	48	45	58	55	49.95	•	•
MIQC	MIQC-88M	52	88	DC	5	5.7	0.1	7.5	41	35	34	30	52	40	66	50	49.95	•	•
case C07	MIQC-176M	104	176	DC	5	5.5	0.1	7.0	38	30	36	30	47	35	70	50	54.95	•	•
	MIQC-895M	868	895	DC	5	8.7	0.1	10.5	33	30	33	30	40	35	55	50	99.95	•	
△ZFMIQ	ZFMIQ-91M	86	95	DC	5	5.5	0.17	6.5	38	30	38	30	48	45	58	55	89.95	•	
case J17																	Qty. (1-49)		
□MIQY	MIQY-70M	67	73	DC	5	5.8	0.2	7.0	40	35	36	30	47	40	60	50	19.95	•	•
case C07	MIQY-140M	137	143	DC	5	5.8	0.2	7.0	34	30	36	30	45	35	60	50	19.95	•	•

NOTES:

□ NON-HERMETIC
△ Available only with SMA connectors
LO power: 10 ± 1 dBm
1 dB compression: 0 dBm, typ. (I&Q ports)
† C.L. = (I+Q) Power dBm RF Power
* Measured at −5 dBm I/Q power
Q = I − 90° for MIQA-70M
Q = I + 90° for all other models
** For lower sideband suppression

Max Ratings

LO power: 50 mW
I & Q current: 40 mA
Operating temperature: −55° to 100°C
Storage temperature: −55° to 100°C



I&Q Modulator Block Diagram

features

- cellular applications, radar and communication systems
- good carrier and sideband rejections
- excellent 3rd and 5th order harmonic suppression
- all MIQA and MIQC models, metal case and hermetically sealed

pin and coaxial configurations

see case style outline drawings

Function	MIQA	MIQC -895M -895D	MIQC -88M -176M	MIQY	ZFMIQ
LO (carrier)	1	13	13	13	1
RF (signal)	8	2	1	1	3
I (0°)(ref.)	7	4	8	8	S
Q (90°)**	4	1	5	5	2
Isolated^Δ	—	9,12,16	—	10,11	—
50 OHM external	2	—	—	—	—
GND	—	—	2,9,12,16	2,9,12,16	—
Case GND	3,5,6	3,5,6,7,8 10,11,14,15	3,4,6,7,10 11,14,15	3,4,6,7 14,15	—

^Δ For MIQY, external variable capacitors can be connected at pins 10 and 11 to ground for improvement of sideband rejection (modulator) or phase unbalance (demodulator).

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I&Q Demodulators

good amplitude and phase unbalance

9 MHz to 895 MHz

Mini-Circuits



MIQA



MIQC
MIQY

	MODEL NO.	FREQUENCY MHz				CONVERSION LOSS † (dB)			AMPLITUDE UNBALANCE (dB)		PHASE UNBALANCE (Deg.)		HARMONIC SUPPRESSION (-dBc)				PRICE	DISTRIBUTOR	
		RF(signal)/ LO(carrier)		I & Q									3×I/Q		5×I/Q			FACTORY	LOCAL
		F_l	Fu	Min.	Max.	$\bar{x}$	σ	Max.	Typ.	Max.	Typ.	Max.	Typ.	Min.	Typ.	Min.	Qty. (1-9)		
MIQA case A06	MIQA-10D	9	11	DC	2	5.8	0.10	7.0	0.15	0.3	1.0	3	50	35	65	55	49.95	•	
MIQC case C07	MIQC-895D	868	895	DC	5	8.7	0.05	10.5	0.15	0.3	1.5	4	40	35	55	50	99.95	•	
MIQY case C07	MIQY-70D	67	73	DC	5	5.5	0.25	7.0	0.1	0.6	0.5	3	52	40	66	50	Qty. (1-49) 19.95	•	•
	MIQY-140D	137	143	DC	5	5.5	0.25	7.0	0.1	0.6	0.5	3	47	35	70	50	19.95	•	•

NOTES:

□ NON-HERMETIC
LO power: 10±0.5 dBm
1 dB compression: 4 dBm, typ. at RF input
DC offset: 1 mV typ.
† C.L. = RF Power − (I + Q) Power
** Q = −90° for LO > RF
Q = +90° for LO < RF

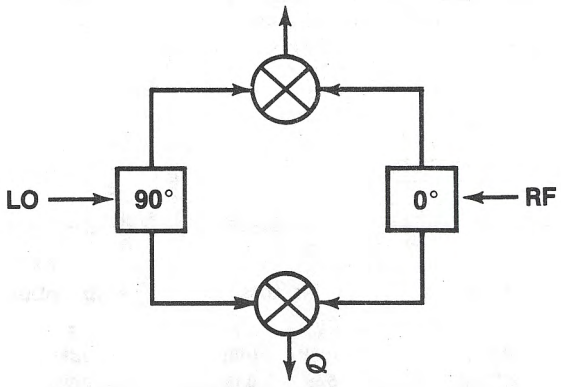
1. Refer to Table of Contents for quality control procedures, environmental specifications.
2. Prices and specifications subject to change without notice.

Max Ratings

RF/LO power: 50 mW
I & Q current: 40 mA
Operating temperature: −55° to 100°C
Storage temperature: −55° to 100°C

features

- cellular applications, radar and communication systems
- good amplitude and phase unbalance
- excellent 3rd and 5th order harmonic suppression



I&Q Demodulator Block Diagram

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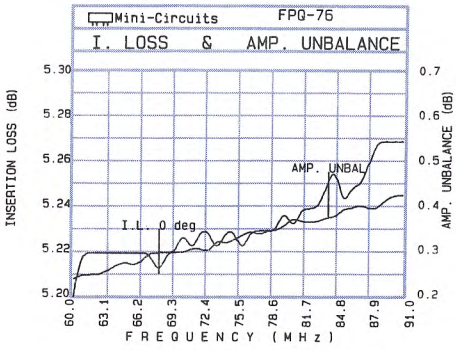
CAPO now available! computer-automated performance data see model index

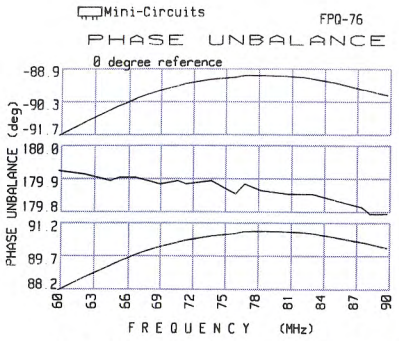
wideband, 360° in 90° steps

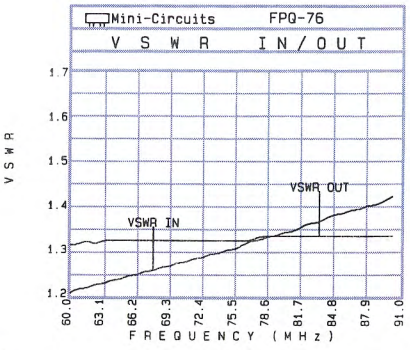
QPSK Modulators

FPQ-76

60 to 90 MHz



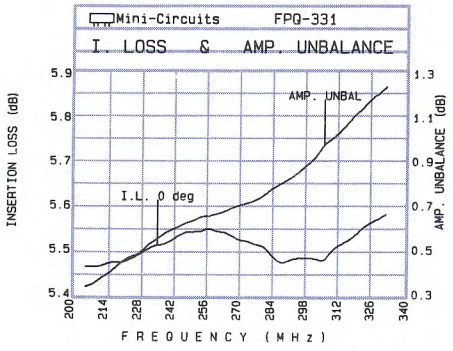


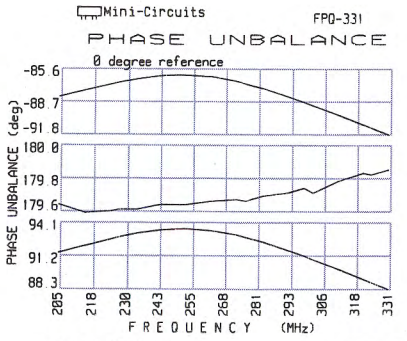


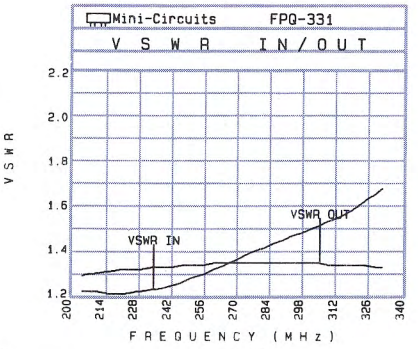
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
60.000	5.23	0.05	0.130	88.33	179.89	-91.60	1.22	1.36
62.325	5.24	0.05	0.130	88.92	179.88	-91.03	1.23	1.36
64.650	5.25	0.05	0.140	89.45	179.86	-90.51	1.25	1.37
65.400	5.24	0.05	0.150	89.63	179.87	-90.33	1.25	1.37
66.900	5.25	0.05	0.160	89.95	179.87	-90.03	1.26	1.37
69.225	5.26	0.05	0.160	90.31	179.85	-89.69	1.28	1.37
70.800	5.25	0.05	0.170	90.50	179.86	-89.50	1.29	1.37
71.550	5.26	0.05	0.170	90.60	179.85	-89.40	1.29	1.37
73.875	5.27	0.05	0.180	90.79	179.86	-89.22	1.31	1.37
76.125	5.27	0.05	0.200	90.90	179.82	-89.13	1.32	1.37
76.950	5.27	0.05	0.200	90.99	179.85	-89.06	1.33	1.37
78.450	5.27	0.05	0.210	91.00	179.83	-89.07	1.34	1.37
80.775	5.29	0.05	0.220	90.98	179.82	-89.10	1.36	1.37
82.275	5.28	0.06	0.220	90.95	179.82	-89.14	1.37	1.37
83.100	5.29	0.06	0.230	90.91	179.82	-89.20	1.38	1.37
85.350	5.29	0.06	0.240	90.73	179.80	-89.38	1.40	1.37
87.675	5.31	0.06	0.250	90.52	179.78	-89.65	1.41	1.37
88.425	5.31	0.06	0.260	90.44	179.76	-89.72	1.42	1.37
89.250	5.31	0.06	0.270	90.37	179.79	-89.78	1.43	1.37
90.000	5.32	0.06	0.270	90.25	179.76	-89.89	1.43	1.37

FPQ-331

205 to 331 MHz







Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
205.000	5.68	0.18	0.300	91.72	179.69	-87.90	1.27	1.35
214.765	5.66	0.17	0.310	92.33	179.64	-87.29	1.25	1.36
224.530	5.67	0.17	0.330	92.91	179.65	-86.72	1.24	1.37
227.680	5.67	0.16	0.330	93.10	179.66	-86.53	1.24	1.37
233.980	5.68	0.16	0.350	93.43	179.66	-86.23	1.25	1.38
243.745	5.71	0.17	0.380	93.72	179.69	-85.92	1.27	1.38
250.360	5.72	0.17	0.410	93.80	179.69	-85.86	1.28	1.38
253.510	5.72	0.16	0.410	93.82	179.69	-85.88	1.29	1.38
263.275	5.72	0.17	0.430	93.65	179.71	-86.02	1.32	1.39
272.725	5.69	0.16	0.460	93.30	179.72	-86.45	1.35	1.39
276.190	5.68	0.16	0.470	93.08	179.71	-86.71	1.36	1.39
282.490	5.66	0.16	0.490	92.70	179.74	-87.11	1.38	1.38
292.255	5.63	0.15	0.540	91.96	179.76	-87.89	1.41	1.38
298.555	5.63	0.15	0.580	91.46	179.79	-88.43	1.43	1.37
302.020	5.63	0.15	0.590	91.13	179.76	-88.75	1.44	1.37
311.470	5.65	0.15	0.650	90.34	179.83	-89.59	1.47	1.36
321.235	5.68	0.14	0.720	89.44	179.88	-90.53	1.53	1.35
324.385	5.69	0.15	0.740	89.13	179.87	-90.83	1.55	1.35
327.850	5.70	0.15	0.780	88.80	179.87	-91.16	1.57	1.34
331.000	5.71	0.15	0.800	88.53	179.90	-91.47	1.59	1.33

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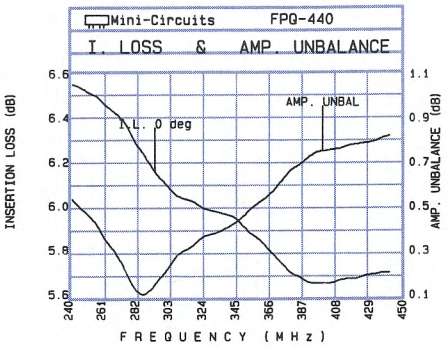
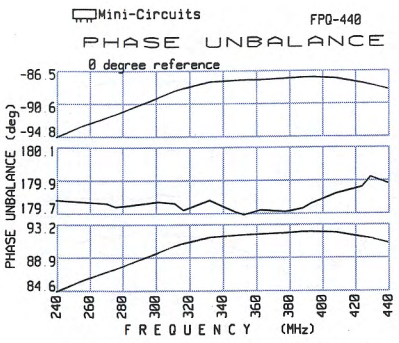
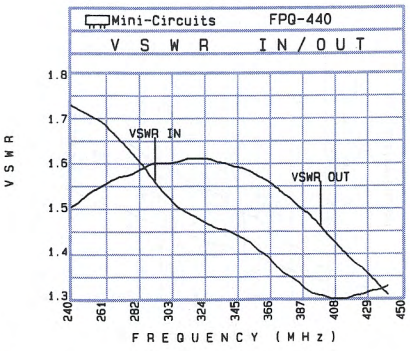
Mini-Circuits

FPQ-440

240 to 440 MHz



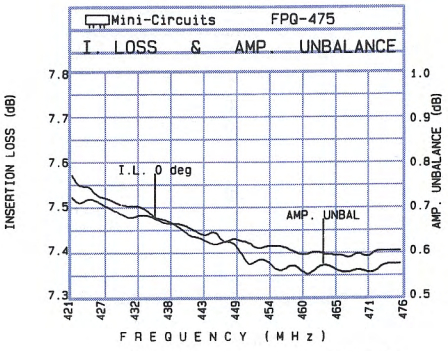


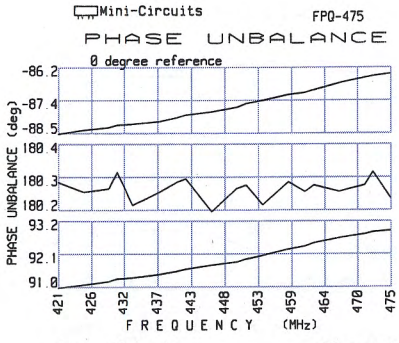


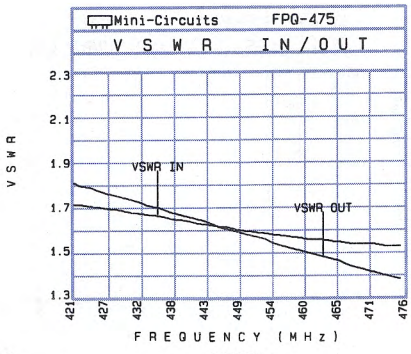
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
240.000	6.83	0.22	0.930	84.98	179.83	-94.38	1.79	1.52
255.500	6.77	0.22	0.820	86.39	179.82	-92.98	1.77	1.56
271.000	6.67	0.22	0.650	87.55	179.81	-91.87	1.72	1.60
276.000	6.63	0.22	0.590	87.88	179.79	-91.52	1.70	1.61
286.000	6.52	0.22	0.460	88.65	179.80	-90.75	1.66	1.63
301.500	6.38	0.21	0.370	89.96	179.82	-89.43	1.59	1.65
312.000	6.32	0.21	0.360	90.87	179.81	-88.55	1.56	1.66
317.000	6.31	0.20	0.340	91.23	179.77	-88.21	1.55	1.66
332.500	6.28	0.21	0.340	92.00	179.83	-87.40	1.52	1.66
347.500	6.22	0.21	0.330	92.22	179.76	-87.22	1.49	1.65
353.000	6.17	0.20	0.330	92.29	179.74	-87.17	1.47	1.64
363.000	6.10	0.19	0.350	92.40	179.77	-87.15	1.44	1.62
378.500	5.96	0.19	0.440	92.54	179.76	-86.99	1.38	1.58
388.500	5.92	0.19	0.480	92.69	179.78	-86.87	1.34	1.55
394.000	5.91	0.19	0.500	92.70	179.81	-86.84	1.32	1.53
409.000	5.91	0.18	0.530	92.60	179.87	-86.99	1.30	1.47
424.500	5.91	0.20	0.560	92.02	179.91	-87.57	1.29	1.41
429.500	5.91	0.20	0.580	91.83	179.97	-87.82	1.29	1.39
435.000	5.91	0.21	0.600	91.52	179.94	-88.09	1.29	1.37
440.000	5.90	0.20	0.610	91.24	179.93	-88.39	1.28	1.35

FPQ-475

421 to 475 MHz







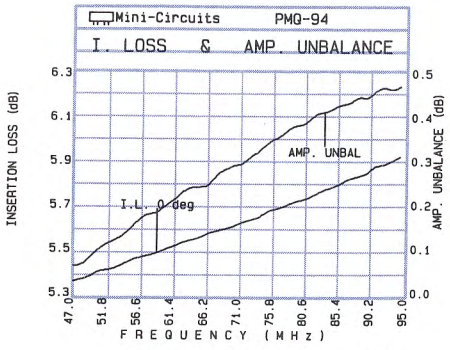
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
421.000	6.87	0.41	0.610	91.05	180.31	-88.43	1.69	1.81
425.185	6.85	0.42	0.620	91.15	180.28	-88.29	1.68	1.77
429.370	6.82	0.42	0.630	91.26	180.29	-88.20	1.66	1.74
430.720	6.81	0.42	0.630	91.35	180.34	-88.11	1.65	1.73
433.420	6.79	0.43	0.650	91.38	180.24	-88.08	1.64	1.71
437.605	6.76	0.43	0.650	91.50	180.28	-87.99	1.62	1.67
440.440	6.75	0.43	0.650	91.60	180.31	-87.85	1.61	1.65
441.790	6.73	0.44	0.660	91.67	180.32	-87.76	1.60	1.64
445.975	6.69	0.44	0.680	91.80	180.22	-87.65	1.59	1.61
450.025	6.67	0.46	0.680	91.90	180.29	-87.49	1.57	1.57
451.510	6.66	0.45	0.680	92.00	180.30	-87.36	1.57	1.56
454.210	6.65	0.46	0.690	92.12	180.24	-87.25	1.55	1.54
458.395	6.62	0.46	0.700	92.33	180.31	-87.04	1.54	1.51
461.095	6.61	0.47	0.710	92.43	180.28	-86.97	1.53	1.49
462.580	6.61	0.47	0.710	92.54	180.30	-86.88	1.52	1.48
466.630	6.59	0.47	0.710	92.70	180.28	-86.64	1.51	1.45
470.815	6.59	0.48	0.720	92.83	180.30	-86.45	1.50	1.41
472.165	6.59	0.48	0.730	92.90	180.34	-86.39	1.50	1.40
473.650	6.58	0.48	0.730	92.92	180.30	-86.37	1.50	1.39
475.000	6.58	0.49	0.710	92.95	180.26	-86.31	1.49	1.38

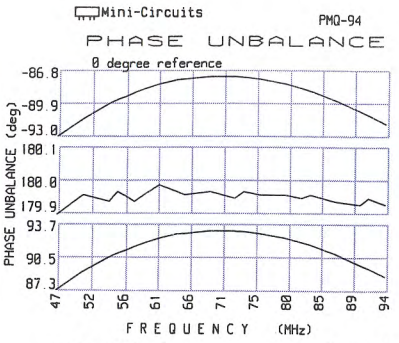
wideband, 360° in 90° steps

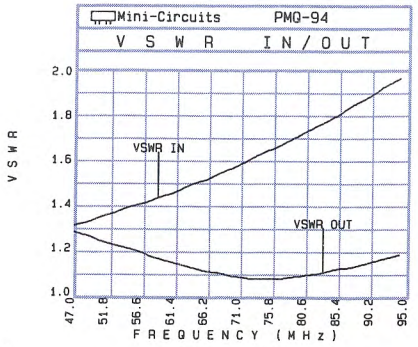
QPSK Modulators

PMQ-94

47 to 94 MHz



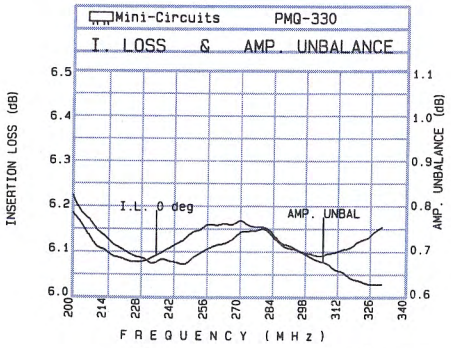


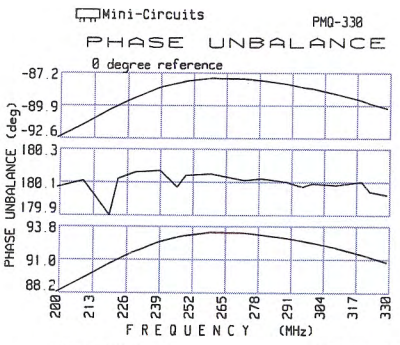


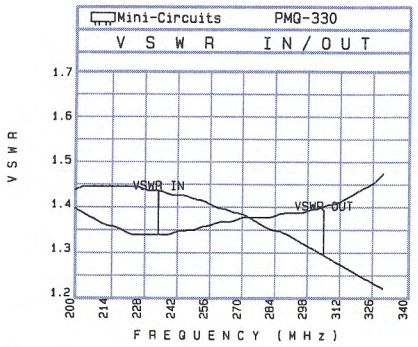
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
				@ 90°	@ 180°	@ -90°		
	$\bar{x}$	σ	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
47.000	5.31	0.09	0.120	87.57	179.95	-92.70	1.30	1.29
50.643	5.36	0.09	0.150	89.34	180.01	-91.02	1.34	1.25
54.285	5.39	0.09	0.160	90.73	179.99	-89.58	1.38	1.21
55.460	5.40	0.09	0.160	91.12	180.02	-89.20	1.39	1.20
57.810	5.42	0.09	0.180	91.78	179.99	-88.55	1.42	1.18
61.453	5.45	0.10	0.190	92.59	180.04	-87.76	1.46	1.15
63.920	5.48	0.10	0.210	93.01	180.02	-87.37	1.49	1.13
65.095	5.49	0.10	0.210	93.05	180.01	-87.31	1.51	1.12
68.738	5.52	0.10	0.230	93.33	180.02	-87.09	1.56	1.09
72.263	5.56	0.11	0.250	93.32	180.00	-87.09	1.61	1.07
73.555	5.57	0.11	0.250	93.27	180.02	-87.16	1.62	1.07
75.905	5.60	0.11	0.270	93.07	180.01	-87.34	1.66	1.07
79.548	5.64	0.11	0.280	92.65	180.01	-87.79	1.72	1.08
81.897	5.66	0.12	0.300	92.24	180.00	-88.21	1.76	1.08
83.190	5.68	0.12	0.290	91.99	180.01	-88.48	1.78	1.09
86.715	5.72	0.12	0.320	91.15	179.99	-89.34	1.84	1.11
90.358	5.77	0.13	0.340	90.06	179.98	-90.38	1.91	1.14
91.533	5.78	0.13	0.350	89.73	180.00	-90.73	1.93	1.15
92.825	5.80	0.13	0.350	89.30	179.99	-91.18	1.95	1.16
94.000	5.82	0.13	0.350	88.93	179.98	-91.56	1.97	1.17

PMQ-330

200 to 330 MHz







Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
				@ 90°	@ 180°	@ -90°		
	$\bar{x}$	σ	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
200.000	6.07	0.14	0.640	88.47	180.06	-92.35	1.47	1.47
210.075	5.98	0.14	0.550	89.63	180.10	-91.25	1.43	1.47
220.150	5.93	0.14	0.490	90.83	179.89	-90.05	1.41	1.47
223.400	5.92	0.15	0.480	91.18	180.11	-89.71	1.40	1.47
229.900	5.91	0.15	0.460	91.88	180.15	-89.04	1.40	1.46
239.975	5.93	0.15	0.440	92.70	180.16	-88.22	1.39	1.45
246.800	5.95	0.15	0.440	93.08	180.06	-87.89	1.40	1.45
250.050	5.96	0.16	0.450	93.22	180.13	-87.72	1.40	1.44
260.125	5.97	0.16	0.460	93.50	180.14	-87.47	1.40	1.42
269.875	5.96	0.16	0.460	93.46	180.11	-87.51	1.40	1.40
273.450	5.94	0.17	0.460	93.43	180.10	-87.53	1.40	1.39
279.950	5.93	0.18	0.460	93.26	180.11	-87.67	1.39	1.38
290.025	5.88	0.18	0.430	92.99	180.09	-87.97	1.38	1.35
296.525	5.86	0.19	0.420	92.76	180.06	-88.24	1.38	1.33
300.100	5.85	0.19	0.410	92.61	180.08	-88.33	1.38	1.32
309.850	5.85	0.20	0.410	92.17	180.07	-88.80	1.38	1.29
319.925	5.86	0.21	0.410	91.60	180.09	-89.33	1.40	1.26
323.175	5.86	0.21	0.410	91.38	180.03	-89.59	1.41	1.25
326.750	5.88	0.21	0.420	91.14	180.03	-89.78	1.41	1.24
330.000	5.88	0.22	0.430	90.93	180.01	-89.99	1.43	1.23

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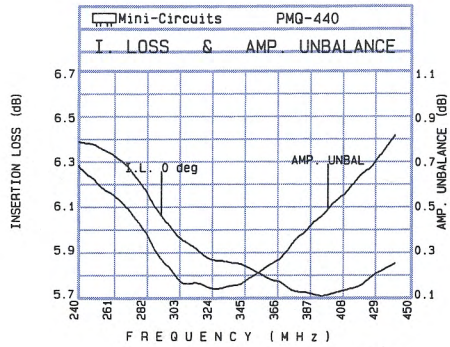
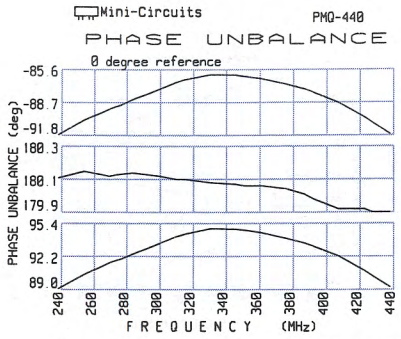
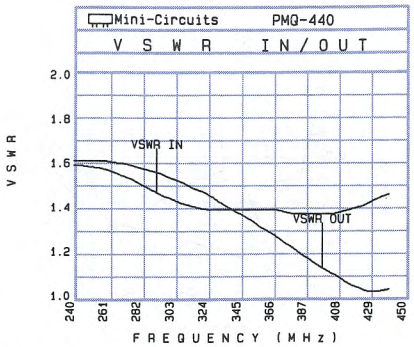
Mini-Circuits

PMQ-440

240 to 440 MHz



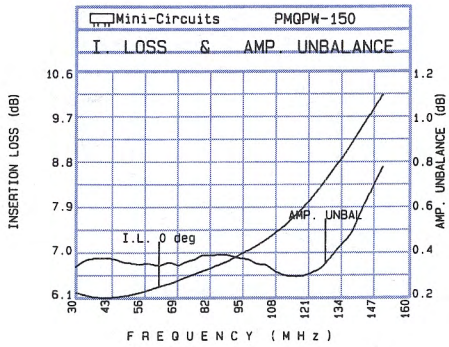


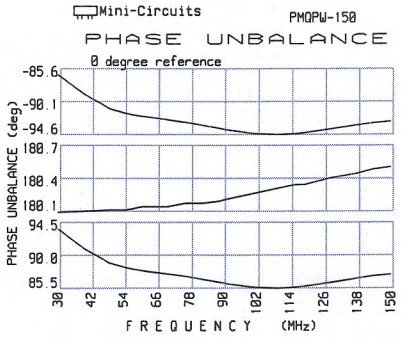


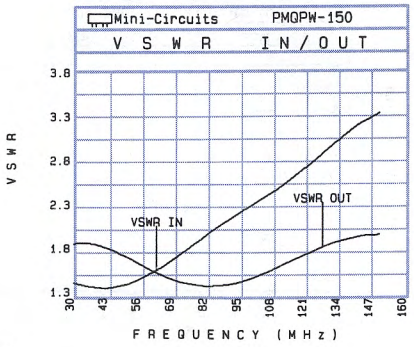
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
				@ 90°	@ 180°	@ -90°		
	$\bar{x}$	σ	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
240.000	6.40	0.10	0.600	89.33	180.13	-91.54	1.65	1.67
255.500	6.36	0.10	0.510	90.71	180.17	-90.15	1.63	1.67
271.000	6.27	0.11	0.390	91.83	180.14	-89.12	1.60	1.66
276.000	6.23	0.11	0.350	92.10	180.15	-88.83	1.58	1.65
286.000	6.11	0.11	0.290	92.70	180.16	-88.19	1.54	1.63
301.500	5.95	0.10	0.290	93.70	180.14	-87.24	1.48	1.58
312.000	5.89	0.10	0.310	94.37	180.12	-86.58	1.45	1.55
317.000	5.86	0.10	0.310	94.61	180.12	-86.34	1.44	1.53
332.500	5.82	0.10	0.340	95.13	180.10	-85.87	1.43	1.47
347.500	5.78	0.10	0.380	95.07	180.09	-85.90	1.43	1.40
353.000	5.76	0.10	0.410	94.98	180.08	-86.05	1.43	1.37
363.000	5.71	0.10	0.480	94.72	180.08	-86.27	1.42	1.33
378.500	5.64	0.10	0.600	94.15	180.06	-86.82	1.41	1.25
388.500	5.63	0.10	0.680	93.73	180.03	-87.24	1.40	1.20
394.000	5.62	0.11	0.710	93.42	180.00	-87.57	1.40	1.18
409.000	5.65	0.11	0.820	92.48	179.94	-88.52	1.41	1.12
424.500	5.69	0.13	0.920	91.06	179.94	-89.91	1.44	1.07
429.500	5.71	0.13	0.970	90.53	179.92	-90.45	1.46	1.07
435.000	5.73	0.14	1.020	89.99	179.93	-91.02	1.48	1.07
440.000	5.75	0.15	1.080	89.46	179.92	-91.52	1.50	1.08

PMQPW-150

30 to 150 MHz







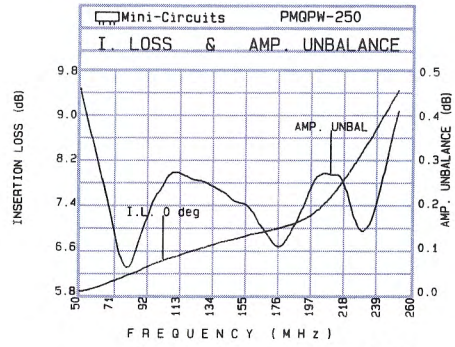
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
				@ 90°	@ 180°	@ -90°		
	$\bar{x}$	σ	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
30.000	6.22	0.07	0.310	93.98	180.09	-85.97	1.48	1.90
39.300	6.11	0.07	0.360	91.35	180.10	-88.60	1.41	1.90
48.600	6.15	0.07	0.330	89.38	180.11	-90.57	1.42	1.79
54.600	6.22	0.06	0.320	88.73	180.11	-91.24	1.48	1.70
57.600	6.26	0.07	0.310	88.53	180.12	-91.45	1.52	1.66
60.900	6.31	0.06	0.310	88.31	180.14	-91.64	1.57	1.61
69.900	6.45	0.06	0.290	87.85	180.14	-92.11	1.73	1.50
76.200	6.57	0.04	0.300	87.51	180.17	-92.47	1.86	1.46
82.200	6.67	0.05	0.290	87.12	180.17	-92.87	1.98	1.44
88.500	6.79	0.05	0.280	86.69	180.19	-93.31	2.10	1.45
91.500	6.87	0.05	0.250	86.48	180.21	-93.53	2.15	1.47
100.800	7.11	0.08	0.210	86.01	180.26	-94.03	2.30	1.54
110.100	7.43	0.11	0.170	85.86	180.31	-94.18	2.45	1.66
116.100	7.70	0.13	0.170	85.99	180.34	-94.06	2.57	1.75
119.100	7.86	0.15	0.160	86.12	180.34	-93.93	2.63	1.79
128.400	8.44	0.20	0.170	86.63	180.40	-93.43	2.83	1.92
137.700	9.12	0.26	0.230	87.20	180.44	-92.90	3.04	2.02
143.700	9.59	0.29	0.340	87.54	180.48	-92.60	3.14	2.06
147.000	9.86	0.32	0.410	87.66	180.48	-92.49	3.19	2.07
150.000	10.09	0.32	0.480	87.73	180.50	-92.40	3.23	2.08

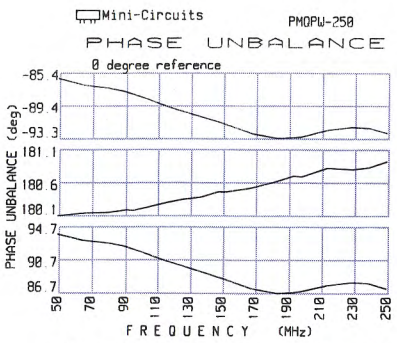
wideband, 360° in 90° steps

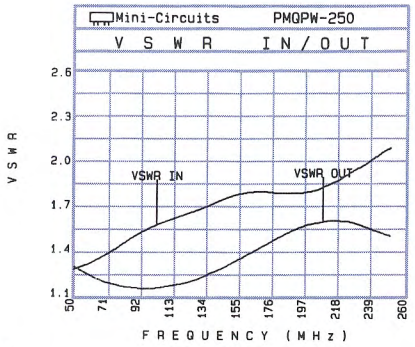
QPSK Modulators

PMQPW-250

50 to 250 MHz



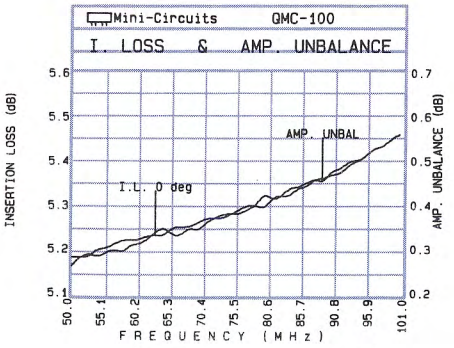


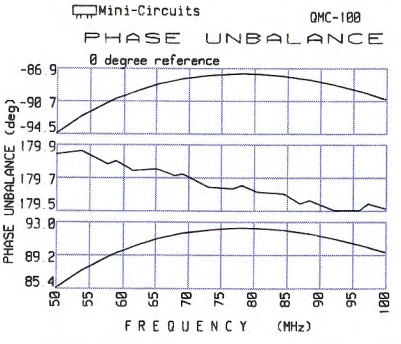


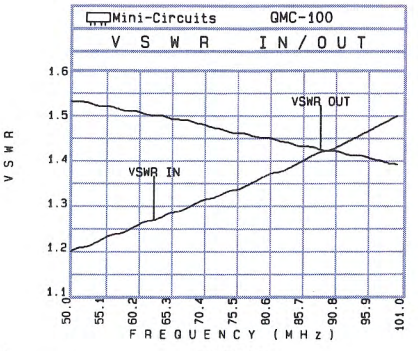
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
50.000	5.91	0.22	0.650	94.17	180.17	-85.82	1.28	1.30
65.500	5.98	0.12	0.410	93.39	180.21	-86.63	1.35	1.21
81.000	6.13	0.06	0.190	93.06	180.22	-87.00	1.45	1.16
91.000	6.23	0.08	0.170	92.64	180.26	-87.45	1.52	1.15
96.000	6.28	0.10	0.200	92.33	180.25	-87.74	1.54	1.15
101.500	6.33	0.11	0.220	91.97	180.28	-88.11	1.57	1.16
116.500	6.48	0.12	0.250	90.91	180.37	-89.17	1.61	1.18
127.000	6.56	0.11	0.220	90.28	180.42	-89.84	1.64	1.21
137.000	6.65	0.10	0.210	89.66	180.45	-90.44	1.67	1.26
147.500	6.72	0.10	0.210	89.00	180.53	-91.04	1.69	1.30
152.500	6.74	0.10	0.220	88.71	180.53	-91.37	1.70	1.33
168.000	6.84	0.10	0.280	87.63	180.59	-92.41	1.69	1.41
183.500	6.94	0.15	0.410	87.06	180.69	-92.97	1.65	1.49
193.500	7.07	0.21	0.520	87.14	180.77	-92.91	1.64	1.53
198.500	7.15	0.23	0.570	87.30	180.76	-92.80	1.64	1.55
214.000	7.55	0.30	0.620	87.99	180.89	-92.01	1.69	1.57
229.500	8.10	0.34	0.550	88.35	180.87	-91.64	1.78	1.55
239.500	8.49	0.38	0.510	88.24	180.90	-91.77	1.84	1.52
245.000	8.70	0.39	0.500	87.99	181.00	-91.99	1.88	1.50
250.000	8.91	0.41	0.480	87.59	180.99	-92.36	1.92	1.48

QMC-100

50 to 100 MHz







Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	@ 90° $\bar{x}$	@ 180° $\bar{x}$	@ -90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
50.000	5.20	0.06	0.200	85.71	179.87	-94.13	1.21	1.56
53.875	5.22	0.06	0.200	87.69	179.89	-92.10	1.23	1.56
57.750	5.24	0.06	0.210	89.23	179.81	-90.55	1.25	1.54
59.000	5.25	0.06	0.210	89.67	179.83	-90.09	1.25	1.54
61.500	5.26	0.06	0.220	90.39	179.77	-89.41	1.27	1.53
65.375	5.28	0.07	0.230	91.32	179.78	-88.44	1.28	1.52
68.000	5.29	0.08	0.240	91.77	179.74	-88.02	1.30	1.51
69.250	5.30	0.07	0.250	91.98	179.75	-87.82	1.30	1.51
73.125	5.32	0.08	0.260	92.32	179.67	-87.45	1.32	1.50
76.875	5.34	0.08	0.280	92.52	179.66	-87.30	1.34	1.48
78.250	5.34	0.08	0.280	92.55	179.68	-87.25	1.35	1.48
80.750	5.36	0.08	0.290	92.50	179.64	-87.30	1.36	1.47
84.625	5.39	0.09	0.320	92.32	179.63	-87.55	1.38	1.46
87.125	5.41	0.10	0.330	92.04	179.57	-87.83	1.40	1.45
88.500	5.42	0.10	0.330	91.90	179.59	-87.97	1.40	1.45
92.250	5.45	0.10	0.350	91.31	179.53	-88.56	1.43	1.43
96.125	5.49	0.11	0.390	90.61	179.53	-89.30	1.45	1.42
97.375	5.49	0.11	0.400	90.35	179.57	-89.57	1.46	1.42
98.750	5.51	0.11	0.400	90.00	179.52	-89.94	1.47	1.41
100.000	5.52	0.10	0.420	89.78	179.54	-90.23	1.48	1.41

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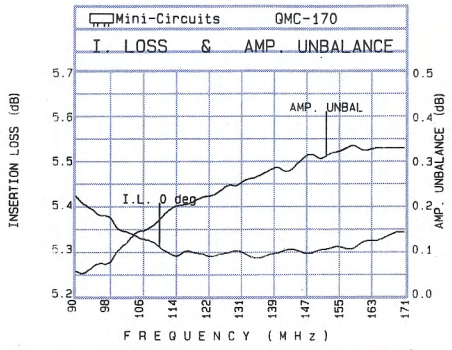
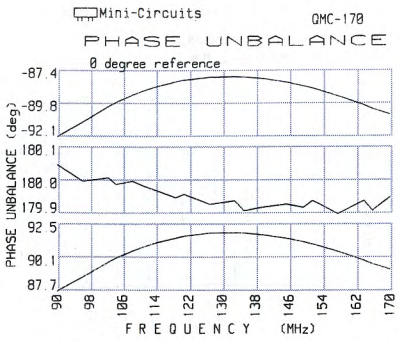
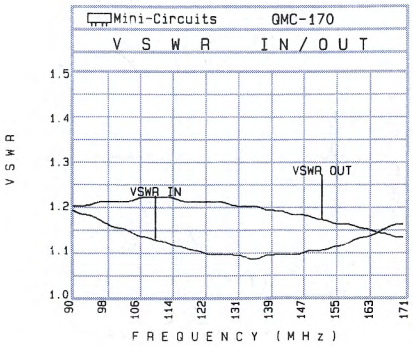
Mini-Circuits

QMC-170

90 to 170 MHz



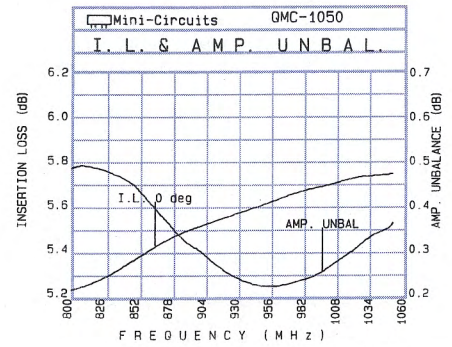


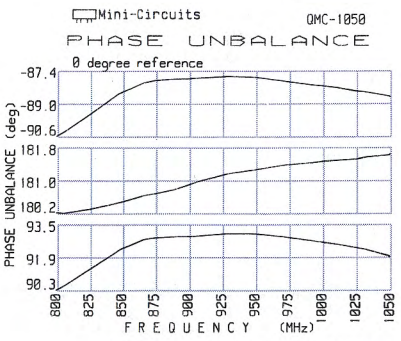


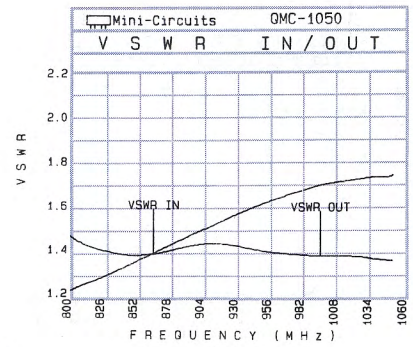
Freq.	Ins. Loss		Amp. Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	90° $\bar{x}$	180° $\bar{x}$	-90° $\bar{x}$	In $\bar{x}$	Out $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
90.000	5.49	0.09	0.130	87.93	180.02	-91.89	1.22	1.20
96.200	5.44	0.08	0.100	88.95	179.97	-90.86	1.20	1.21
102.400	5.40	0.07	0.100	90.01	179.98	-89.76	1.18	1.22
104.400	5.38	0.07	0.100	90.32	179.96	-89.47	1.17	1.22
108.400	5.36	0.06	0.120	90.85	179.97	-88.94	1.16	1.22
114.600	5.33	0.06	0.160	91.47	179.94	-88.32	1.14	1.22
118.800	5.32	0.05	0.180	91.77	179.92	-88.00	1.13	1.22
120.800	5.32	0.05	0.190	91.91	179.93	-87.88	1.13	1.22
127.000	5.31	0.04	0.230	92.13	179.90	-87.68	1.12	1.22
133.000	5.30	0.05	0.250	92.14	179.91	-87.65	1.12	1.22
135.200	5.29	0.04	0.270	92.13	179.88	-87.68	1.12	1.22
139.200	5.31	0.05	0.290	92.01	179.89	-87.77	1.12	1.21
145.400	5.31	0.04	0.310	91.74	179.90	-88.06	1.13	1.20
149.400	5.31	0.04	0.320	91.49	179.89	-88.34	1.14	1.20
151.600	5.32	0.04	0.330	91.32	179.91	-88.49	1.14	1.20
157.600	5.31	0.03	0.360	90.78	179.87	-89.06	1.16	1.19
163.800	5.32	0.04	0.370	90.14	179.91	-89.69	1.17	1.17
165.800	5.33	0.04	0.380	89.89	179.88	-89.95	1.18	1.17
168.000	5.33	0.05	0.380	89.67	179.88	-90.19	1.19	1.16
170.000	5.33	0.04	0.380	89.48	179.92	-90.37	1.20	1.16

QMC-1050, ZMQ-1050

800 to 1050 MHz







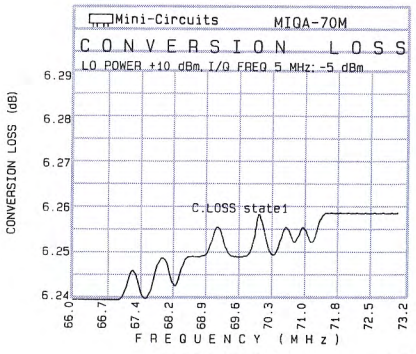
Freq.	Ins.Loss		Amp.Unbal	Phase Unbal			VSWR	
	$\bar{x}$	σ	$\bar{x}$	90° $\bar{x}$	180° $\bar{x}$	-90° $\bar{x}$	IN $\bar{x}$	OUT $\bar{x}$
(MHz)	(dB)	(dB)	(dB)	(Deg.)	(Deg.)	(Deg.)		
800.000	5.33	0.21	0.550	90.43	180.31	-90.46	1.20	1.45
806.500	5.34	0.20	0.550	90.65	180.30	-90.22	1.21	1.44
825.750	5.38	0.19	0.540	91.46	180.40	-89.37	1.25	1.41
846.750	5.44	0.17	0.510	92.33	180.55	-88.42	1.30	1.42
850.250	5.45	0.17	0.510	92.47	180.58	-88.31	1.30	1.43
867.750	5.51	0.16	0.490	92.89	180.73	-87.87	1.35	1.46
874.750	5.52	0.16	0.490	92.97	180.77	-87.76	1.37	1.48
888.750	5.56	0.15	0.480	93.03	180.87	-87.69	1.41	1.51
899.250	5.58	0.14	0.480	93.04	180.98	-87.67	1.43	1.53
908.000	5.60	0.14	0.470	93.07	181.08	-87.63	1.46	1.54
929.000	5.66	0.14	0.470	93.18	181.26	-87.56	1.51	1.55
950.000	5.70	0.14	0.460	93.17	181.36	-87.60	1.56	1.53
971.000	5.74	0.14	0.460	93.03	181.47	-87.78	1.61	1.53
992.000	5.79	0.14	0.480	92.84	181.53	-87.97	1.64	1.53
1000.750	5.81	0.14	0.490	92.76	181.57	-88.02	1.65	1.53
1011.250	5.84	0.14	0.510	92.66	181.59	-88.10	1.66	1.53
1025.250	5.87	0.14	0.550	92.50	181.62	-88.26	1.68	1.54
1032.250	5.88	0.15	0.570	92.42	181.67	-88.31	1.68	1.53
1049.750	5.91	0.15	0.610	92.10	181.72	-88.51	1.69	1.52
1050.000	5.92	0.14	0.620	92.04	181.75	-88.55	1.70	1.52

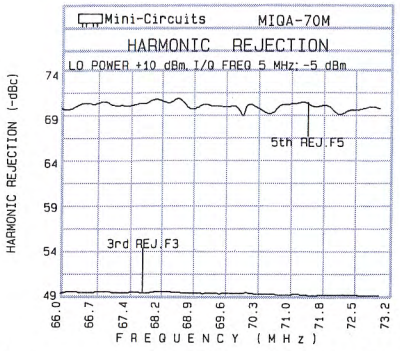
high rejection of carrier and sideband

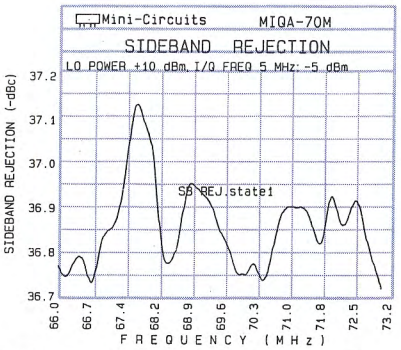
I&Q Modulator

MIQA-70M, MIQY-70M

66 to 73 MHz



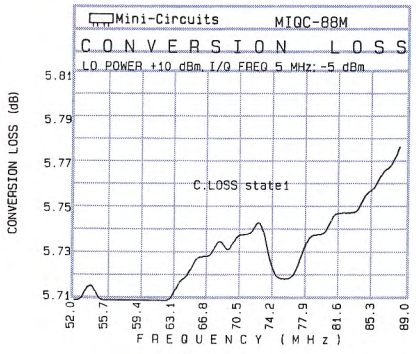


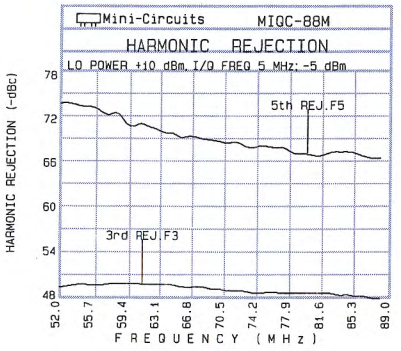


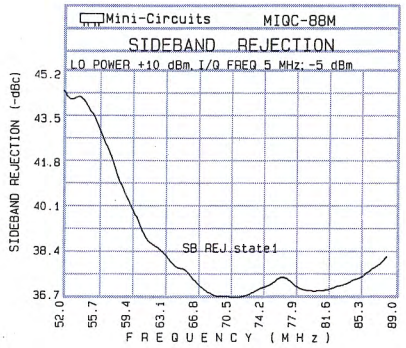
CARRIER Freq. (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ (mV)
66.0	6.17	0.05	35.29	37.71	52.10	52.12	49.98	58.32	70.26	63.44	0.16
66.6	6.17	0.05	35.42	37.86	52.24	52.25	49.94	58.19	70.66	63.23	0.17
67.1	6.18	0.05	35.54	37.94	52.08	52.10	49.92	58.28	70.10	63.32	0.16
67.3	6.18	0.05	35.60	38.01	52.04	52.18	49.96	58.56	70.22	63.16	0.16
67.7	6.18	0.04	35.75	38.10	51.90	52.23	50.00	58.39	70.26	63.53	0.16
68.2	6.18	0.04	35.77	38.34	52.02	52.06	50.04	58.58	69.94	63.42	0.17
68.6	6.19	0.05	35.84	38.47	51.96	51.92	49.98	58.56	70.08	63.30	0.17
68.8	6.19	0.04	35.90	38.56	51.94	51.98	49.94	58.40	69.94	63.38	0.16
69.3	6.19	0.04	36.01	38.78	51.86	51.92	50.02	58.34	69.74	63.20	0.17
69.9	6.19	0.05	36.08	38.87	51.70	51.83	50.00	58.31	69.98	63.15	0.17
70.0	6.19	0.05	36.11	38.94	51.84	52.10	49.86	58.20	69.30	63.12	0.17
70.2	6.19	0.04	36.15	38.88	51.74	51.75	49.96	58.31	70.10	63.29	0.17
70.8	6.19	0.04	36.23	38.93	51.83	51.91	49.83	58.19	69.89	63.33	0.17
71.2	6.19	0.05	36.27	39.08	51.72	51.81	49.92	58.05	69.58	63.05	0.17
71.3	6.19	0.05	36.35	39.13	51.61	51.85	49.71	58.23	70.09	63.13	0.17
71.9	6.20	0.04	36.45	39.21	51.62	51.79	49.72	57.95	70.46	63.29	0.17
72.5	6.20	0.04	36.51	39.21	51.59	51.58	49.75	57.72	70.21	62.82	0.17
72.6	6.20	0.04	36.49	39.35	51.45	51.67	49.71	57.71	69.69	62.77	0.17
72.8	6.20	0.04	36.48	39.38	51.33	51.56	49.75	57.66	69.45	62.84	0.17
73.0	6.20	0.04	36.53	39.39	51.37	51.38	49.67	57.66	69.55	62.98	0.17

MIQC-88M

52 to 88 MHz







CARRIER Freq. (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ (mV)
52.0	5.69	0.02	42.86	39.69	44.15	44.21	50.41	58.95	77.85	66.29	-0.10
54.7	5.69	0.03	41.30	38.12	43.80	43.74	50.66	59.53	76.40	65.83	-0.10
57.4	5.69	0.03	39.19	36.53	43.49	43.35	50.60	59.64	75.26	65.54	-0.09
59.2	5.69	0.03	37.98	35.67	43.26	43.28	50.57	59.53	74.57	65.23	-0.09
60.1	5.69	0.03	37.56	35.29	43.06	43.04	50.56	59.19	74.22	65.09	-0.09
62.8	5.69	0.03	36.43	34.51	42.85	42.71	50.32	59.20	73.56	64.62	-0.09
65.5	5.70	0.03	35.96	33.92	42.53	42.59	50.00	58.97	72.38	64.13	-0.09
67.3	5.71	0.03	35.66	33.67	42.39	42.38	49.89	58.76	72.39	64.00	-0.08
68.2	5.71	0.03	35.53	33.66	42.24	42.26	49.73	58.45	72.11	63.79	-0.08
70.9	5.72	0.03	35.54	33.66	41.98	42.01	49.49	57.70	71.65	63.68	-0.08
73.6	5.70	0.03	35.91	33.98	41.52	41.53	49.28	56.96	71.88	63.48	-0.07
75.4	5.69	0.03	36.14	34.00	41.37	41.34	49.27	56.68	71.35	63.24	-0.07
76.3	5.69	0.03	36.16	34.06	41.27	41.25	49.32	56.64	71.22	63.20	-0.07
79.0	5.71	0.03	35.95	34.02	41.12	41.10	49.29	56.42	70.83	62.88	-0.08
81.7	5.72	0.03	36.05	34.11	40.95	40.92	49.23	56.37	70.21	62.83	-0.08
83.5	5.72	0.03	36.14	34.25	40.81	40.82	49.00	56.26	70.28	62.68	-0.08
84.4	5.73	0.03	36.34	34.38	40.78	40.77	48.99	56.14	69.77	62.76	-0.08
86.2	5.74	0.03	36.84	34.71	40.75	40.69	48.73	55.97	69.85	62.71	-0.09
87.1	5.74	0.03	36.99	34.87	40.69	40.67	48.44	55.69	69.56	62.69	-0.09
88.0	5.75	0.03	37.34	35.01	40.64	40.65	48.44	55.49	69.84	62.83	-0.08

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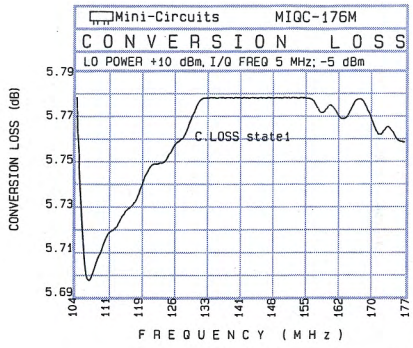
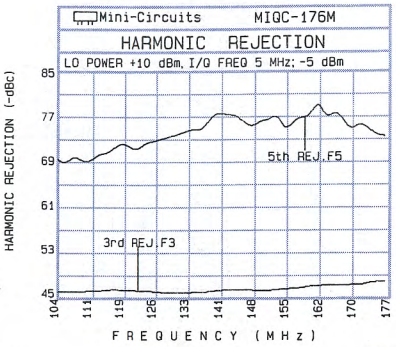
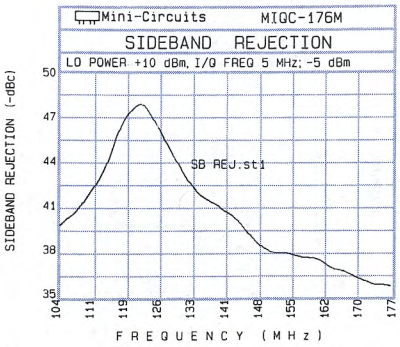
Mini-Circuits

MIQC-176M

104 to 176 MHz



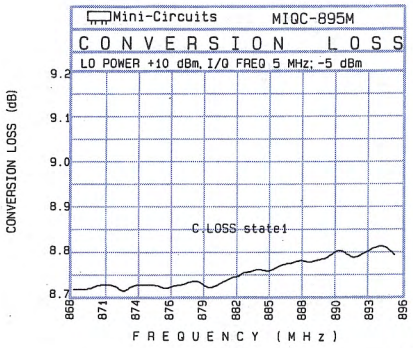


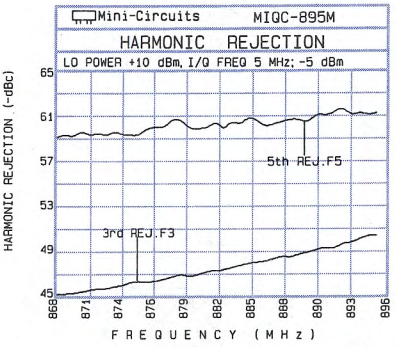


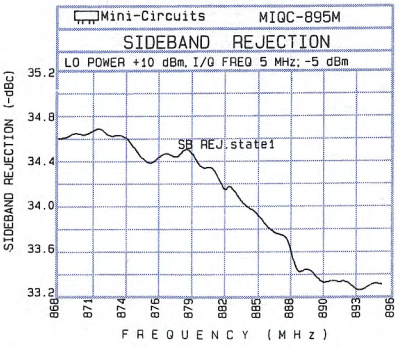
CARRIER Freq. (MHz)	CONVERSION LOSS $\bar{x}$ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION ($\bar{x}$) LSB (-dBc)	SIDEBAND REJECTION ($\bar{x}$) USB (-dBc)	CARRIER REJECTION ($\bar{x}$) LSB (-dBc)	CARRIER REJECTION ($\bar{x}$) USB (-dBc)	3rd. HARMONIC REJECTION ($\bar{x}$) LSB (-dBc)	3rd. HARMONIC REJECTION ($\bar{x}$) USB (-dBc)	5th. HARMONIC REJECTION ($\bar{x}$) LSB (-dBc)	5th. HARMONIC REJECTION ($\bar{x}$) USB (-dBc)	DC OFFSET $\bar{x}$ mV
104.0	5.75	0.02	44.00	40.36	39.60	39.63	46.08	50.09	71.54	64.27	-0.12
109.4	5.74	0.04	43.65	39.80	39.30	39.32	46.33	50.87	72.31	64.71	-0.11
114.8	5.72	0.04	46.03	39.54	38.98	38.99	46.63	51.30	73.65	64.68	-0.11
118.4	5.73	0.03	46.55	39.15	38.72	38.76	46.75	51.20	74.99	64.74	-0.11
120.2	5.73	0.03	46.21	38.88	38.66	38.68	46.88	51.14	75.24	64.26	-0.11
125.6	5.72	0.03	43.79	37.74	38.38	38.41	46.71	51.25	76.05	64.77	-0.11
131.0	5.74	0.03	41.41	36.65	38.11	38.16	46.80	51.78	76.42	65.40	-0.11
134.6	5.75	0.03	39.82	35.86	37.98	38.02	46.93	52.13	77.57	65.53	-0.10
136.4	5.75	0.03	39.31	35.61	37.90	37.97	47.01	52.05	76.99	65.63	-0.10
141.8	5.75	0.03	38.19	35.02	37.65	37.74	47.45	52.38	77.87	66.22	-0.12
147.2	5.75	0.03	36.87	34.30	37.46	37.58	47.53	52.93	77.43	65.79	-0.09
150.8	5.76	0.03	36.55	34.12	37.40	37.49	47.54	53.01	77.12	66.03	-0.08
152.6	5.75	0.03	36.56	34.13	37.37	37.47	47.87	53.14	76.91	65.90	-0.10
158.0	5.75	0.02	36.53	34.07	37.23	37.34	48.53	54.08	76.27	65.56	-0.08
163.4	5.75	0.02	36.15	34.03	37.17	37.29	49.21	56.24	75.31	65.88	-0.08
167.0	5.75	0.03	36.09	34.06	37.22	37.29	49.33	56.91	74.11	65.51	-0.09
168.8	5.75	0.02	36.03	34.16	37.16	37.30	49.47	56.85	73.67	65.43	-0.09
172.4	5.75	0.02	36.00	34.31	37.12	37.27	50.03	57.15	73.61	66.29	-0.09
174.2	5.74	0.02	36.25	34.46	37.14	37.27	50.26	57.25	73.42	65.85	-0.08
176.0	5.74	0.02	36.38	34.68	37.12	37.25	50.39	57.13	72.67	65.63	-0.08

MIQC-895M

868 to 895 MHz







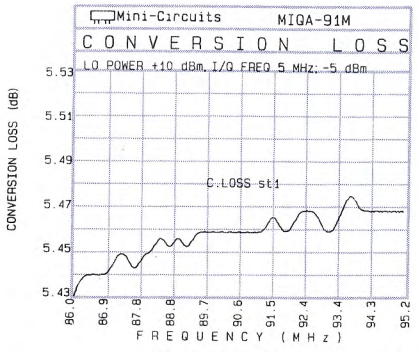
CARRIER Freq. (MHz)	CONVERSION LOSS $\bar{x}$ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION ($\bar{x}$) LSB (-dBc)	SIDEBAND REJECTION ($\bar{x}$) USB (-dBc)	CARRIER REJECTION ($\bar{x}$) LSB (-dBc)	CARRIER REJECTION ($\bar{x}$) USB (-dBc)	3rd. HARMONIC REJECTION ($\bar{x}$) LSB (-dBc)	3rd. HARMONIC REJECTION ($\bar{x}$) USB (-dBc)	5th. HARMONIC REJECTION ($\bar{x}$) LSB (-dBc)	5th. HARMONIC REJECTION ($\bar{x}$) USB (-dBc)	DC OFFSET $\bar{x}$ mV
868.0	8.64	0.06	40.37	39.42	40.28	40.16	46.63	44.24	59.35	62.87	-1.24
870.1	8.65	0.06	40.44	39.60	40.36	40.27	46.71	44.38	59.33	63.25	-1.23
872.3	8.66	0.04	40.41	39.49	40.37	40.45	46.95	44.52	59.48	62.84	-1.23
873.0	8.67	0.05	40.42	39.34	40.48	40.50	47.02	44.51	59.52	62.94	-1.23
874.4	8.67	0.05	40.80	39.30	40.45	40.46	47.21	44.68	59.44	62.90	-1.23
876.5	8.68	0.05	40.96	39.03	40.61	40.68	47.35	44.85	59.78	63.10	-1.22
877.9	8.69	0.04	40.97	38.86	40.65	40.77	47.56	45.02	59.79	62.97	-1.24
878.7	8.69	0.04	41.04	38.97	40.72	40.78	47.62	45.16	59.91	62.83	-1.24
880.8	8.69	0.04	41.23	38.95	40.96	41.03	47.85	45.23	60.03	63.19	-1.23
882.2	8.70	0.04	41.39	38.79	40.94	40.96	48.04	45.38	59.82	63.02	-1.22
882.9	8.71	0.04	41.46	38.73	40.98	41.04	48.15	45.51	60.04	63.04	-1.23
884.3	8.70	0.04	41.69	38.80	41.22	41.17	48.41	45.63	60.30	63.38	-1.22
886.5	8.73	0.04	41.24	38.56	41.27	41.07	48.52	45.76	59.96	62.74	-1.24
887.9	8.72	0.04	41.92	38.57	41.54	41.28	48.70	45.92	60.17	62.61	-1.23
888.6	8.73	0.04	41.48	38.50	41.55	41.22	48.75	46.03	60.16	62.54	-1.23
890.7	8.75	0.04	41.30	38.38	41.60	41.30	48.99	46.19	60.01	62.41	-1.24
892.9	8.75	0.04	41.13	38.40	41.87	41.39	49.19	46.47	59.93	62.57	-1.26
893.6	8.76	0.04	40.96	38.38	42.02	41.37	49.20	46.48	59.96	62.14	-1.26
894.3	8.77	0.04	40.78	38.18	42.08	41.39	49.24	46.54	59.88	61.92	-1.27
895.0	8.75	0.04	40.87	38.27	42.42	41.73	49.31	46.61	60.07	62.33	-1.26

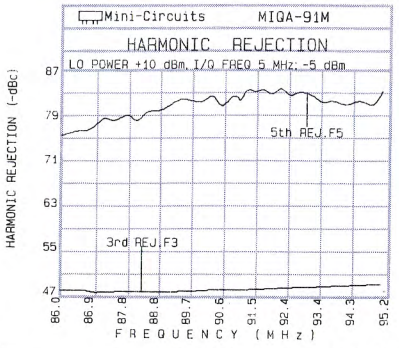
high rejection of carrier and sideband

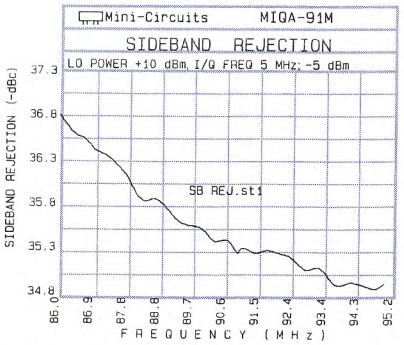
I&Q Modulator

MIQA-91M, ZFMIQ-91M

86 to 95 MHz



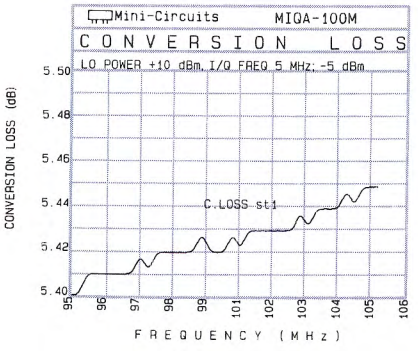


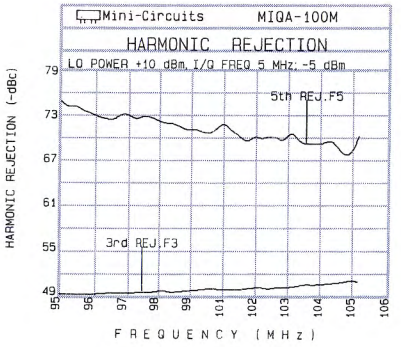


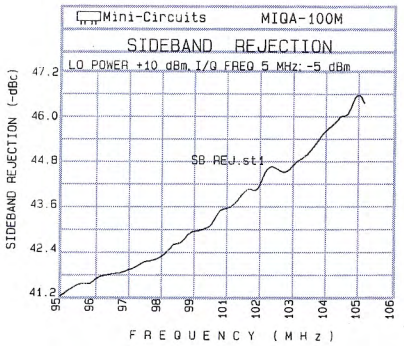
CARRIER Frequency (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ mV
86.0	5.43	0.01	38.25	38.49	47.39	47.41	47.59	53.41	75.27	77.69	0.37
86.7	5.44	0.02	38.88	38.76	47.31	47.24	47.45	53.41	76.83	78.37	0.36
87.4	5.44	0.02	39.63	39.13	47.26	46.98	47.43	53.21	78.67	79.85	0.36
87.7	5.44	0.01	39.92	39.24	47.12	47.06	47.47	53.28	78.61	80.58	0.36
88.1	5.44	0.02	40.07	39.46	47.09	47.03	47.47	53.36	79.35	80.87	0.36
88.8	5.45	0.01	40.65	40.03	47.07	47.04	47.61	53.31	81.11	82.87	0.37
89.3	5.45	0.02	40.92	40.31	46.95	46.77	47.57	53.45	82.03	82.83	0.37
89.6	5.45	0.02	41.33	40.49	46.93	46.95	47.69	53.41	82.17	83.19	0.36
90.3	5.45	0.02	41.81	40.74	46.86	46.89	47.83	53.73	82.93	83.93	0.36
91.0	5.45	0.02	41.90	41.32	46.84	46.76	47.93	53.87	81.69	82.39	0.36
91.0	5.45	0.02	42.04	41.44	46.86	46.74	47.95	53.85	81.69	83.45	0.36
91.4	5.46	0.02	42.53	41.58	46.81	46.63	47.98	54.05	81.60	81.45	0.37
92.2	5.45	0.02	42.75	42.00	46.56	46.52	48.17	54.33	82.23	81.55	0.37
92.6	5.46	0.02	42.71	42.24	46.64	46.45	48.33	54.37	80.81	80.47	0.37
92.9	5.45	0.02	42.83	42.24	46.53	46.54	48.29	54.49	81.21	80.15	0.36
93.6	5.46	0.02	43.10	43.00	46.43	46.24	48.58	54.97	79.58	78.29	0.36
94.3	5.46	0.02	42.97	43.22	46.26	46.25	48.76	55.09	78.26	78.29	0.37
94.5	5.46	0.02	42.97	43.37	46.21	46.15	48.77	55.14	78.45	77.70	0.37
94.8	5.46	0.02	42.93	43.40	46.27	46.13	48.91	55.36	78.95	77.40	0.37
95.0	5.46	0.02	42.82	43.50	46.23	46.17	48.89	55.30	78.71	76.78	0.38

MIQA-100M

95 to 105 MHz







CARRIER Frequency (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ mV
95.0	5.38	0.02	39.29	44.75	52.53	52.54	48.67	54.98	76.21	73.88	0.21
95.8	5.39	0.03	39.55	44.33	52.71	52.13	48.79	55.31	76.43	73.83	0.20
96.5	5.39	0.03	39.78	44.03	52.17	52.17	48.93	55.49	75.07	72.99	0.20
97.0	5.40	0.03	39.85	43.85	52.19	51.95	49.01	55.77	75.07	72.63	0.19
97.3	5.40	0.03	39.94	43.81	51.97	51.60	48.99	55.76	75.07	73.12	0.21
98.0	5.41	0.03	40.12	43.30	51.77	51.53	49.23	56.37	74.79	72.51	0.21
98.8	5.41	0.03	40.48	42.87	51.40	51.45	49.28	56.69	73.94	71.49	0.21
99.3	5.42	0.02	40.62	42.62	51.50	51.43	49.38	56.91	73.90	71.57	0.21
99.5	5.41	0.03	40.74	42.63	51.44	51.27	49.42	57.03	73.36	71.15	0.23
100.0	5.42	0.03	40.81	42.25	51.12	51.35	49.58	57.31	73.12	70.29	0.22
100.5	5.42	0.03	41.05	41.97	51.12	51.29	49.60	57.59	73.10	70.95	0.21
101.3	5.43	0.02	41.29	41.72	51.06	50.78	49.68	58.16	71.94	70.18	0.22
101.8	5.43	0.02	41.52	41.56	50.81	50.88	49.83	58.36	72.01	70.24	0.21
102.0	5.43	0.02	41.58	41.38	50.89	50.72	49.91	58.72	71.99	70.24	0.21
102.8	5.43	0.02	41.77	41.03	50.55	50.44	50.07	59.22	72.27	69.68	0.21
103.5	5.44	0.02	42.08	40.55	50.35	50.45	50.27	60.13	71.39	69.29	0.23
104.0	5.44	0.02	42.37	40.32	50.07	50.23	50.35	60.23	71.41	69.13	0.23
104.3	5.44	0.02	42.39	40.23	50.37	50.07	50.47	60.33	70.63	69.29	0.23
104.8	5.45	0.02	42.79	40.02	50.00	49.85	50.64	61.17	69.98	69.15	0.23
105.0	5.45	0.02	42.75	39.83	49.95	49.99	50.81	61.15	70.53	68.43	0.23

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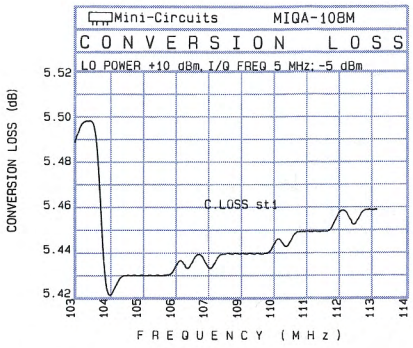
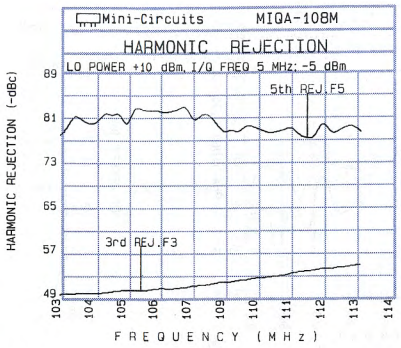
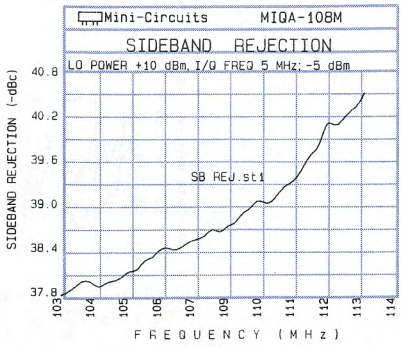
Mini-Circuits

MIQA-108M

103 to 113 MHz



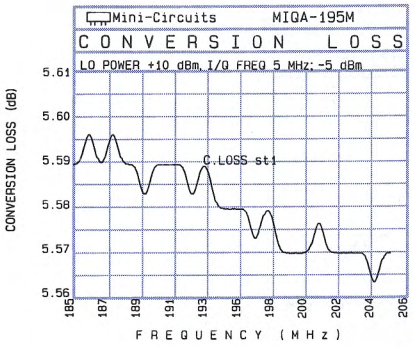


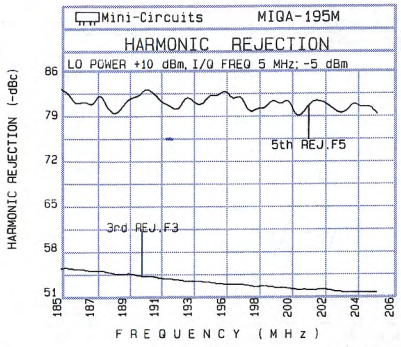


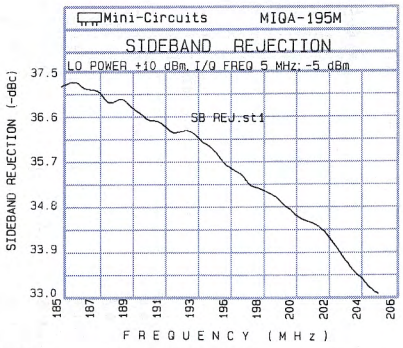
CARRIER Frequency (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ mV
103.0	5.48	0.01	39.66	40.66	49.00	48.98	49.84	58.54	75.90	76.16	0.41
103.8	5.47	0.03	39.74	40.65	49.04	48.98	49.94	58.94	77.26	77.20	0.42
104.5	5.45	0.03	39.71	40.52	48.90	48.90	50.00	59.40	78.42	78.34	0.44
105.0	5.45	0.03	39.86	40.54	48.90	48.67	50.18	59.71	78.86	79.15	0.43
105.3	5.45	0.03	39.82	40.62	48.74	48.71	50.22	59.79	78.98	79.51	0.44
106.0	5.45	0.03	39.97	40.42	48.60	48.71	50.34	60.23	80.80	80.27	0.44
106.8	5.46	0.03	40.05	40.63	48.46	48.45	50.62	60.99	81.40	79.85	0.43
107.3	5.46	0.03	40.19	40.77	48.52	48.50	50.82	62.04	81.02	81.16	0.42
107.5	5.46	0.03	40.28	40.90	48.41	48.36	51.03	62.12	80.57	79.04	0.44
108.3	5.44	0.02	40.39	41.02	48.32	48.34	51.50	64.32	79.92	80.04	0.44
109.0	5.45	0.02	40.72	41.53	48.14	48.32	51.96	66.84	80.34	79.10	0.43
109.5	5.45	0.02	41.02	41.78	48.13	48.10	52.29	68.46	80.47	78.26	0.42
109.8	5.45	0.02	41.10	41.85	48.13	48.18	52.29	69.38	79.43	78.30	0.44
110.5	5.45	0.02	41.51	42.03	48.04	47.93	52.83	68.81	79.75	77.15	0.43
111.3	5.46	0.02	42.01	42.68	47.92	47.96	53.53	68.35	79.83	77.01	0.44
111.8	5.46	0.02	42.53	42.99	47.85	47.67	53.85	67.83	79.65	77.59	0.45
112.0	5.46	0.02	42.69	43.30	47.79	47.72	53.80	67.29	79.54	76.87	0.45
112.5	5.47	0.02	43.13	43.52	47.70	47.80	54.24	67.03	79.10	76.93	0.46
112.8	5.47	0.02	43.20	43.67	47.79	47.66	54.46	67.39	80.36	77.35	0.45
113.0	5.46	0.02	43.22	43.73	47.72	47.71	54.48	67.40	79.70	76.20	0.44

MIQA-195M

185 to 205 MHz





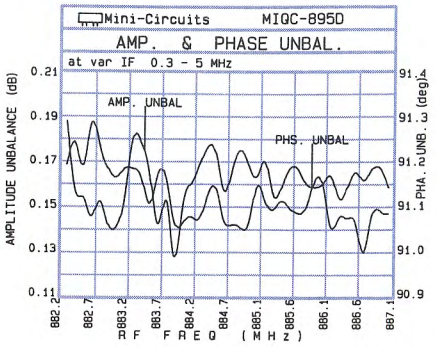


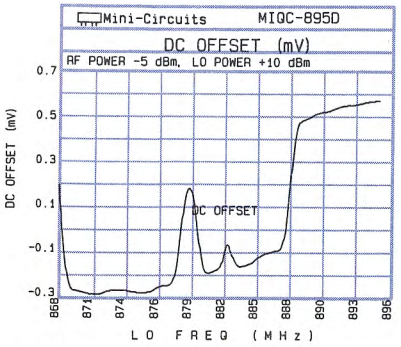
CARRIER Frequency (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ mV
185.0	5.60	0.03	39.87	42.64	41.48	41.50	55.49	49.15	79.33	77.29	0.47
186.5	5.60	0.03	39.95	42.51	41.31	41.31	55.07	48.98	80.07	77.46	0.47
188.0	5.60	0.03	39.88	42.29	41.14	41.17	54.59	48.72	79.11	77.26	0.47
189.0	5.60	0.03	39.91	42.13	41.01	41.01	54.45	48.70	79.29	77.02	0.48
189.5	5.59	0.03	39.88	41.95	40.97	41.00	54.40	48.68	79.50	77.74	0.48
191.0	5.59	0.02	39.76	41.88	40.85	40.88	54.02	48.54	79.84	77.26	0.47
192.5	5.59	0.03	39.64	41.32	40.77	40.76	53.58	48.33	79.22	77.41	0.47
193.5	5.59	0.02	40.04	41.09	40.67	40.66	53.38	48.28	79.56	77.42	0.49
194.0	5.58	0.03	39.57	40.99	40.65	40.66	53.20	48.16	79.68	76.94	0.49
195.5	5.58	0.03	39.15	40.43	40.52	40.50	52.75	48.00	80.31	76.48	0.49
197.0	5.58	0.03	38.64	39.99	40.41	40.45	52.61	47.96	78.35	77.12	0.50
198.0	5.58	0.03	38.43	39.68	40.36	40.35	52.53	47.72	79.79	77.68	0.51
198.5	5.57	0.03	38.27	39.38	40.31	40.31	52.41	47.74	80.05	76.06	0.50
200.0	5.58	0.03	37.95	39.04	40.17	40.21	51.99	47.60	78.17	76.04	0.51
200.5	5.58	0.02	37.80	38.83	40.11	40.10	51.99	47.56	78.51	76.18	0.52
202.0	5.58	0.03	37.23	38.09	40.01	39.99	51.96	47.45	79.84	76.57	0.53
203.0	5.57	0.02	36.87	37.64	39.91	39.93	51.76	47.38	77.80	75.84	0.54
203.5	5.57	0.03	36.64	37.44	39.82	39.79	51.73	47.36	78.95	75.34	0.54
204.5	5.57	0.03	36.20	36.98	39.74	39.76	51.53	47.32	78.55	75.42	0.54
205.0	5.57	0.02	35.96	36.44	39.69	39.74	51.64	47.20	77.88	75.46	0.55

good amplitude and phase unbalance
I&Q Demodulator

MIQC-895D

868 to 895 MHz



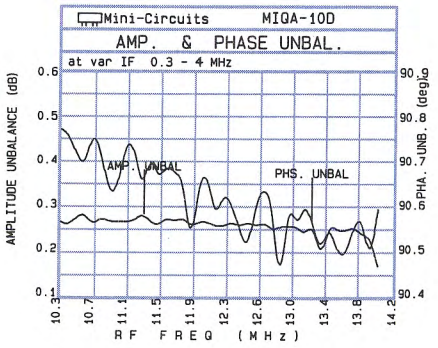


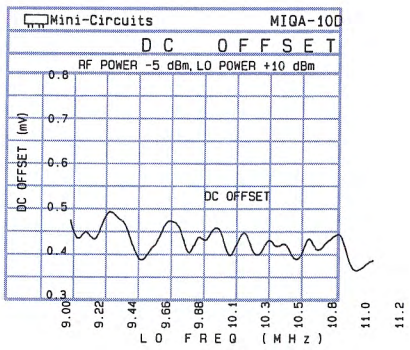
FREQUENCY RF (MHz)	FREQUENCY I&Q (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	AMP UNBAL. x̄ (dB)	PHASE (I-Q) x̄ (deg.)	FREQUENCY LO (MHz)	FREQUENCY RF (MHz)	DC OFFSET x̄ (mV)
* 882.300	0.30	8.79	0.11	0.13	90.93	868.000	868.10	0.88
882.660	0.65	8.78	0.11	0.12	90.92	870.130	870.23	0.69
883.020	1.03	8.77	0.10	0.12	90.92	872.260	872.36	0.70
883.140	1.15	8.77	0.11	0.13	90.87	872.970	873.07	0.70
883.380	1.38	8.76	0.11	0.13	90.76	874.390	874.50	0.70
883.750	1.76	8.75	0.10	0.14	90.89	876.530	876.63	0.73
883.990	1.99	8.74	0.10	0.13	90.78	877.950	878.05	0.74
884.110	2.11	8.73	0.11	0.13	90.80	878.660	878.76	0.91
884.470	2.46	8.71	0.10	0.13	90.86	880.790	880.89	0.79
884.830	2.84	8.70	0.10	0.13	90.69	882.210	882.31	0.86
884.950	2.96	8.69	0.11	0.14	90.76	882.920	883.02	0.81
885.190	3.19	8.68	0.10	0.13	90.77	884.340	884.44	0.83
885.550	3.54	8.65	0.11	0.14	90.79	886.470	886.57	0.87
885.790	3.80	8.63	0.11	0.13	90.71	887.890	888.00	1.08
885.920	3.92	8.62	0.10	0.12	90.84	888.610	888.71	1.08
886.280	4.27	8.60	0.10	0.11	90.79	890.740	890.84	1.09
886.640	4.65	8.59	0.11	0.13	90.68	892.870	892.97	0.87
886.760	4.76	8.60	0.11	0.14	90.83	893.580	893.68	0.88
886.880	4.88	8.60	0.11	0.13	90.79	894.290	894.39	0.87
887.000	5.00	8.59	0.10	0.13	90.68	895.000	895.10	0.87

* LO freq. at 882 MHz

MIQA-10D

9 to 11 MHz





FREQUENCY RF (MHz)	FREQUENCY I&Q (MHz)	CONVERSION LOSS (dB)	AMP UNBAL. (dB)	PHASE (I-Q) (deg.)	FREQUENCY LO (MHz)	FREQUENCY RF (MHz)	DC OFFSET (mV)
** 10.300	0.300	5.85	0.27	90.78	9.000	9.100	0.480
10.585	0.587	5.82	0.29	90.69	9.158	9.258	0.420
10.869	0.873	5.80	0.27	90.63	9.316	9.416	0.480
10.964	0.966	5.80	0.27	90.64	9.368	9.468	0.480
11.154	1.151	5.83	0.27	90.75	9.474	9.574	0.380
11.439	1.438	5.78	0.26	90.66	9.632	9.732	0.480
11.628	1.632	5.77	0.27	90.68	9.737	9.837	0.460
11.723	1.724	5.77	0.28	90.67	9.790	9.889	0.380
12.008	2.011	5.75	0.27	90.68	9.947	10.047	0.470
12.292	2.289	5.73	0.27	90.61	10.000	10.100	0.460
12.387	2.390	5.73	0.26	90.55	10.158	10.258	0.470
12.577	2.576	5.72	0.26	90.62	10.211	10.311	0.400
12.862	2.862	5.71	0.26	90.40	10.316	10.416	0.450
13.051	3.047	5.70	0.26	90.55	10.474	10.574	0.390
13.146	3.149	5.69	0.24	90.62	10.579	10.679	0.460
13.431	3.426	5.67	0.27	90.57	10.632	10.732	0.400
13.715	3.713	5.63	0.26	90.56	10.790	10.890	0.460
13.810	3.806	5.62	0.24	90.59	10.895	10.995	0.360
13.905	3.907	5.61	0.24	90.47	10.947	11.047	0.380
14.000	4.000	5.61	0.17	90.60	11.000	11.100	0.390

** LO freq. at 10 MHz

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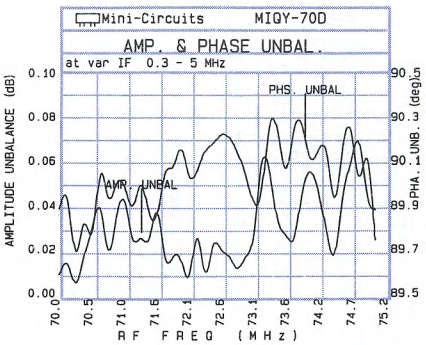
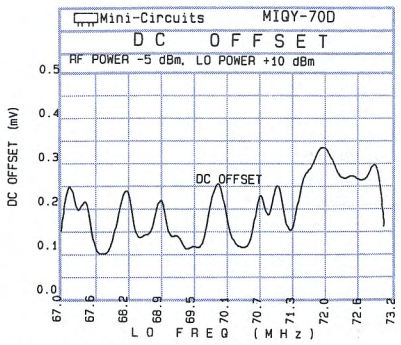
Mini-Circuits

MIQY-70D

67 to 73 MHz



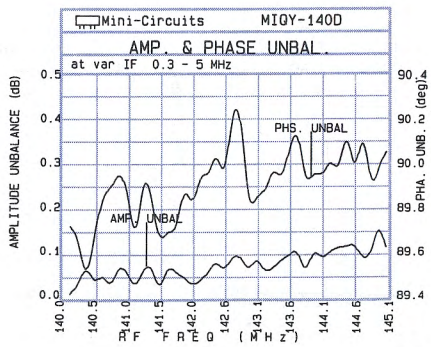


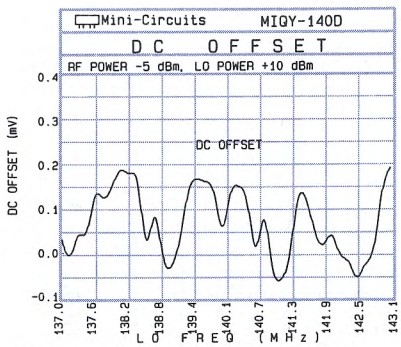
FREQUENCY		CONVERSION LOSS		AMP UNBAL	PHASE (I-Q)	FREQUENCY		DC OFFSET
RF	I&Q	x̄	σ	x̄	x̄	LO	RF	x̄
(MHz)	(MHz)	(dB)	(dB)	(dB)	(deg.)	(MHz)	(MHz)	mV
70.010	0.30	5.60	0.03	0.00	89.78	67.000	67.10	0.20
70.394	0.66	5.59	0.03	0.02	89.86	67.462	67.56	0.22
70.778	1.03	5.59	0.03	0.01	89.77	67.923	68.02	0.20
70.906	1.15	5.58	0.03	0.01	89.94	68.077	68.18	0.22
71.161	1.38	5.58	0.03	0.01	89.65	68.385	68.49	0.22
71.545	1.75	5.58	0.03	0.05	89.85	68.846	68.95	0.26
71.801	1.99	5.59	0.03	0.02	89.92	69.154	69.25	0.21
71.929	2.11	5.59	0.03	0.01	89.99	69.308	69.41	0.18
72.313	2.47	5.59	0.03	0.00	90.08	69.769	69.87	0.25
72.697	2.83	5.59	0.03	0.01	90.15	70.231	70.33	0.25
72.825	2.96	5.59	0.03	0.02	90.14	70.385	70.49	0.27
73.081	3.19	5.59	0.03	0.00	89.99	70.692	70.79	0.26
73.465	3.56	5.60	0.03	0.00	90.15	71.154	71.25	0.25
73.720	3.79	5.58	0.03	0.01	90.05	71.462	71.56	0.29
73.849	3.92	5.60	0.03	0.04	90.23	71.615	71.72	0.26
74.232	4.27	5.59	0.03	0.02	89.95	72.077	72.18	0.24
74.616	4.64	5.59	0.03	0.06	90.23	72.539	72.64	0.28
74.744	4.75	5.59	0.03	0.08	89.86	72.692	72.79	0.27
74.872	4.88	5.59	0.03	0.04	90.06	72.846	72.95	0.26
*75.000	5.00	5.59	0.03	0.06	89.78	73.000	73.10	0.29

* Lo freq. at 70 MHz

MIQY-140D

137 to 143 MHz





FREQUENCY		CONVERSION LOSS		AMP UNBAL	PHASE (I-Q)	FREQUENCY		DC OFFSET
RF	I&Q	x̄	σ	x̄	x̄	LO	RF	x̄
(MHz)	(MHz)	(dB)	(dB)	(dB)	(deg.)	(MHz)	(MHz)	mV
140.100	0.30	5.52	0.05	0.05	89.79	137.000	137.10	-0.08
140.477	0.66	5.50	0.05	0.05	89.81	137.462	137.56	-0.16
140.854	1.03	5.49	0.05	0.06	89.93	137.923	138.02	-0.06
140.980	1.15	5.49	0.05	0.10	89.99	138.077	138.18	-0.13
141.231	1.38	5.49	0.05	0.08	90.09	138.385	138.49	-0.13
141.608	1.75	5.50	0.05	0.06	89.96	138.846	138.95	-0.19
141.859	1.99	5.50	0.06	0.04	89.97	139.154	139.25	-0.14
141.985	2.11	5.50	0.06	0.06	90.00	139.308	139.41	-0.08
142.362	2.47	5.50	0.06	0.10	90.17	139.769	139.87	-0.07
142.739	2.83	5.50	0.06	0.11	90.19	140.231	140.33	-0.07
142.864	2.96	5.51	0.05	0.07	90.04	140.385	140.49	-0.11
143.115	3.19	5.51	0.06	0.08	90.14	140.692	140.79	-0.18
143.492	3.56	5.51	0.06	0.12	90.22	141.154	141.25	-0.17
143.744	3.79	5.51	0.06	0.08	89.94	141.461	141.56	-0.14
143.869	3.92	5.51	0.06	0.13	90.00	141.615	141.72	-0.19
144.246	4.27	5.51	0.05	0.13	90.07	142.077	142.18	-0.17
144.623	4.64	5.51	0.05	0.11	90.12	142.539	142.64	-0.11
144.749	4.75	5.52	0.05	0.12	90.07	142.692	142.79	-0.15
144.874	4.88	5.52	0.05	0.16	90.04	142.846	142.95	-0.12
**145.000	5.00	5.52	0.05	0.13	90.11	143.000	143.10	-0.10

** Lo freq. at 140 MHz

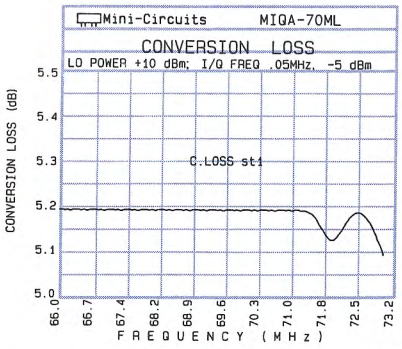
high rejection of carrier and sideband

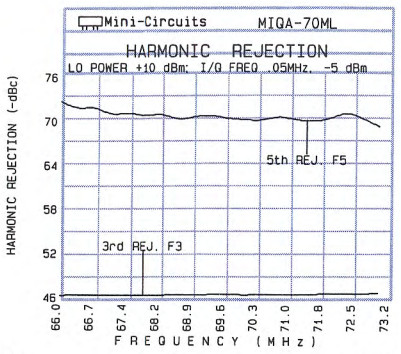
I&Q Modulator

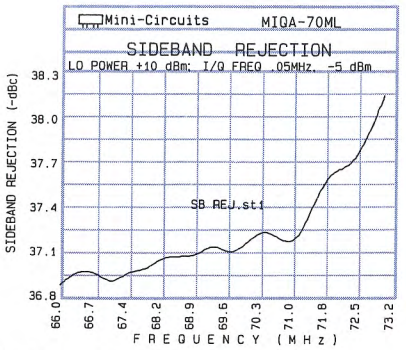
50 ohms

MIQA-70ML

66 to 73 MHz



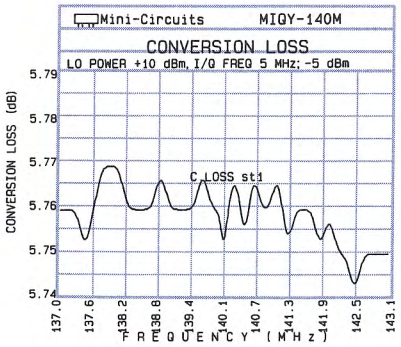


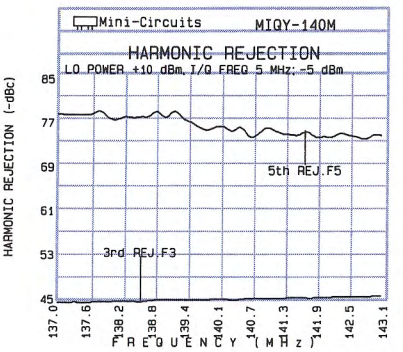


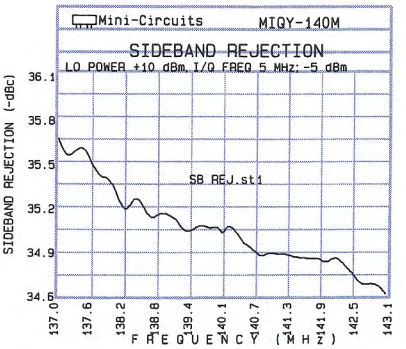
CARRIER Freq. (MHz)	CONVERSION LOSS x̄ (dB)	CONVERSION LOSS σ (dB)	SIDEBAND REJECTION (x̄) LSB (-dBc)	SIDEBAND REJECTION (x̄) USB (-dBc)	CARRIER REJECTION (x̄) LSB (-dBc)	CARRIER REJECTION (x̄) USB (-dBc)	3rd. HARMONIC REJECTION (x̄) LSB (-dBc)	3rd. HARMONIC REJECTION (x̄) USB (-dBc)	5th. HARMONIC REJECTION (x̄) LSB (-dBc)	5th. HARMONIC REJECTION (x̄) USB (-dBc)	DC OFFSET x̄ (mV)
66.0	5.20	0.00	38.26	37.56	54.72	55.04	47.30	47.58	74.90	73.48	0.09
66.4	5.20	0.00	38.36	37.72	54.40	54.88	47.32	47.66	75.06	73.86	0.09
66.7	5.20	0.00	38.50	37.76	54.58	54.66	47.34	47.68	75.52	74.60	0.09
67.1	5.20	0.00	38.54	37.92	54.10	54.64	47.34	47.68	74.94	75.12	0.09
67.5	5.20	0.00	38.60	38.08	54.36	54.30	47.42	47.72	74.76	75.22	0.09
67.8	5.20	0.00	38.72	38.22	53.88	53.98	47.44	47.74	74.84	74.94	0.08
68.2	5.20	0.00	38.74	38.40	53.96	53.92	47.48	47.72	75.42	74.58	0.08
68.6	5.20	0.00	38.78	38.58	53.56	53.70	47.44	47.74	74.38	74.54	0.08
69.0	5.18	0.04	38.88	38.76	53.64	54.10	47.52	47.80	75.04	75.38	0.08
69.3	5.20	0.00	38.94	38.94	53.36	54.12	47.56	47.80	74.86	75.12	0.08
69.7	5.20	0.00	38.98	39.06	53.16	53.78	47.50	47.76	75.14	74.96	0.08
70.1	5.20	0.00	39.12	39.30	53.02	53.70	47.54	47.78	73.92	75.16	0.08
70.4	5.18	0.04	39.18	39.46	53.16	53.52	47.58	47.72	73.98	74.88	0.08
70.8	5.20	0.00	39.20	39.68	53.10	53.54	47.58	47.72	74.16	75.04	0.08
71.2	5.18	0.04	39.24	39.88	53.02	53.34	47.58	47.72	74.02	74.48	0.08
71.5	5.20	0.00	39.30	40.00	52.62	53.52	47.60	47.76	73.80	74.98	0.08
71.9	5.18	0.04	39.46	40.18	52.78	53.30	47.60	47.80	73.76	74.44	0.08
72.3	5.20	0.00	39.50	40.36	52.40	53.58	47.58	47.74	74.30	74.66	0.08
72.6	5.20	0.00	39.66	40.50	52.30	53.22	47.64	47.78	73.72	74.46	0.09
73.0	5.18	0.04	39.76	40.76	52.16	53.02	47.62	47.78	72.70	73.16	0.09

MIQY-140M

137 to 143 MHz







CARRIER Freq. (MHz)	CONVERSION LOSS (dB)	SIDEBAND REJECTION LSB (-dBc)	SIDEBAND REJECTION USB (-dBc)	CARRIER REJECTION LSB (-dBc)	CARRIER REJECTION USB (-dBc)	3rd. HARMONIC REJECTION LSB (-dBc)	3rd. HARMONIC REJECTION USB (-dBc)	5th. HARMONIC REJECTION LSB (-dBc)	5th. HARMONIC REJECTION USB (-dBc)	DC OFFSET (mV)
137.000	5.76	35.71	36.70	33.27	33.31	45.22	57.87	79.42	81.57	-0.08
137.462	5.75	35.67	36.51	33.24	33.30	45.22	58.08	79.42	79.88	-0.16
137.923	5.77	35.45	36.52	33.19	33.29	45.30	58.58	78.70	77.98	-0.06
138.231	5.76	35.18	36.15	33.22	33.28	45.40	58.58	79.20	79.38	-0.07
138.385	5.76	35.33	36.27	33.23	33.27	45.50	58.58	78.60	79.78	-0.13
138.846	5.77	35.21	36.25	33.15	33.26	45.69	58.78	80.69	77.68	-0.19
139.308	5.76	35.06	36.14	33.13	33.19	45.79	59.07	78.39	78.87	-0.08
139.615	5.77	35.13	36.06	33.15	33.25	45.80	59.27	77.00	78.97	-0.11
139.769	5.76	35.09	35.94	33.18	33.20	45.78	59.47	76.28	77.87	-0.07
140.077	5.76	35.13	35.90	33.15	33.19	45.89	59.77	77.39	77.17	-0.07
140.539	5.77	34.97	35.99	33.14	33.19	46.10	60.17	74.80	75.37	-0.18
140.846	5.76	34.94	36.12	33.09	33.22	45.98	60.37	77.28	76.87	-0.17
141.000	5.77	34.92	35.98	33.10	33.21	46.09	60.38	76.59	75.38	-0.17
141.461	5.76	34.90	36.02	33.10	33.13	46.20	60.78	75.40	75.98	-0.19
141.923	5.76	34.85	35.86	33.06	33.11	46.28	61.06	75.58	75.06	-0.17
142.231	5.75	34.85	35.95	33.05	33.16	46.39	61.28	76.29	74.88	-0.21
142.385	5.74	34.80	35.96	33.02	33.17	46.38	61.58	75.48	74.48	-0.11
142.692	5.75	34.72	35.93	33.04	33.11	46.30	61.58	74.60	73.38	-0.12
142.846	5.75	34.72	35.91	33.02	33.16	46.39	62.18	75.89	74.98	-0.10
143.000	5.75	34.65	36.01	33.02	33.11	46.49	61.58	75.59	72.48	-0.11

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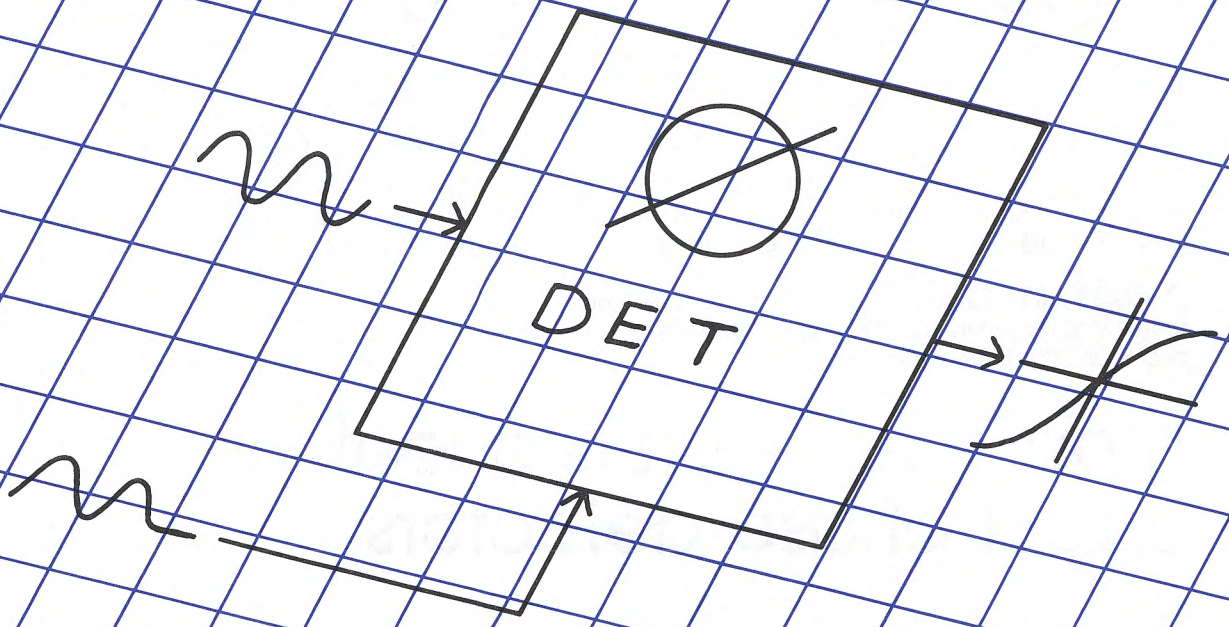
PHASE DETECTORS



contents of this section

technical

introduction, definition of terms 12-2
most often asked questions 12-3, 12-4
specifications check list
a guide form for requirements 12-5

product specifications

1 MHz to 400 MHz models 12-6

computer data and curves

CAPD information . . . . . 12-7 thru 12-8

phase detectors

Mini-Circuits high efficiency phase detectors are the only units in the world offering a figure-of-merit greater than 125.
The figure-of-merit M or efficiency of a phase detector can be defined as the ratio of maximum DC output voltage (in mV) divided by the RF power (in dBm). The maximum DC output from these units is 1000 mV with +7 dBm applied to the LO and RF ports. Thus, its figure-of-merit M is 143, which indicates a highly efficient phase detector. DC offset is typically 400 microvolts. For comparison, a double-balanced mixer used as a phase detector offers 350 mV DC output with the same LO and RF inputs for a figure-of-merit M of 50. So when your system requires a high output phase detector, specify Mini-Circuits' phase detectors, available in a wide variety of package styles.

modern definition of terms

phase detector
Provides a DC output voltage proportional to the difference in phase between two RF input signals. A double-balanced mixer can perform as a phase detector when the LO and RF signal inputs are at the same frequency.

dc offset
The small amount of voltage present at the output when there should actually be zero voltage, such as when only one input is present, or when the two RF input signals are 90° out of phase. This offset voltage is due to slight mismatches in the diodes and/or imperfect balance in the transformer windings.

maximum dc output
from a phase detector occurs when the RF and LO signals are in phase or 180 degrees out-of-phase.

figure-of-merit, M
A method for defining the efficiency of a phase detector. It is the ratio of maximum DC output voltage, in mV, divided by the RF power in dBm.

frequency range spec
Refers to the frequency range of operation of the phase detector, such that the figure of merit decreases to 75 percent of its mid-band value.

scale factor
The phase detector output measured in mV per degree in the approximate linear range of operation, 0 to 57.3°, or 1 radian.

most often asked questions about phase detectors

Q. *Can you explain, briefly, how a DBM works as a phase detector?*

A. When a DBM is used as a phase detector, this is merely a special case of mixing action where the LO and RF signals are at the same frequency. Now, let's look at the mixer equation:

$$\text{IF output} = A_1 \cos[(\omega_{LO} - \omega_{RF})t - (\phi_{LO} - \phi_{RF})] + A_2 \cos[(\omega_{LO} - \omega_{RF})t - (\phi_{LO} - \phi_{RF})] + [\text{higher order frequency terms}]$$

In a phase detector application, $\omega_{LO} = \omega_{RF}$; therefore in the first term, $\omega_{LO} - \omega_{RF} = 0$ and thus the IF output is only a function of $A_1 \cos(\phi_{RF} - \phi_{LO}) + A_2 \cos(2\omega t)$ + higher frequency terms. With proper filtering, the $2\omega t$ terms and higher can be eiliminated so the IF ouput is equal to $A_1 \cos(\phi_{RF} - \phi_{LO})$.

Specifications of a DBM that are important in a phase detector application include:
(1) DC offset, (2) maximum DC output, (3) isolation between ports, (4) polarity of output voltage, (5) frequency response, (6) temperature variation of DC offset.

Q. *How is DC offset affected by temperature?*

A. If only one input is present, say LO, there should be zero output. However, due to slight mismatch in the diodes and imperfect balance in the transformer

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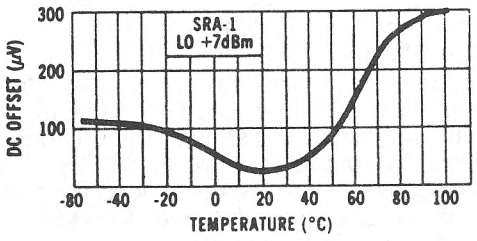
windings, a small DC voltage will appear at the IF output. This is called the DC offset voltage.

The value of the DC offset varies with temperature. Over a wide temperature range, say from −55 to +100°C, the unbalance of the mixer diodes will have a major influence on the DC offset with only a slight contribution from the transformer.

An effective technique to minimize DC offset variation with temperature is to use diodes whose characteristics track with temperature. This can be accomplished by using diodes manufactured from the same wafer in the same production lot. At Mini-Circuits, this selection technique is used exclusively in the production of mixers. Also Mini-Circuits employs specially-designed winding machines so that the assembled transformers have well-matched windings.

The net result—Mini-Circuits offers ultra-low DC offset characteristics; less than 300 to 400 μV over a −55 to 100°C temperature range.



DC Offset Temperature Characteristics

Q. *Why is DC offset so important?*
A. In many phase detector applications, one of the two signals may be 90° out of phase with the other. Theoretically, the phase detector output would be zero. However, there will be a slight DC output due to the offset voltage. This would then be interpreted as a phase difference of other than 90°. Thus, the lower the DC offset voltage, the more accurately the phase detector performs its function.

Q. *Suppose the DC output of a DBM phase detector is insufficient for my application. What do you suggest?*
A. Use a higher level mixer than you had selected. Or specify one of Mini-Circuits RPD series of high "figure-of-merit" phase detectors. Or use an op amp.

Q. *I want to compare the phase of two square waves. Do I have to convert them to sine waves before applying them to a phase detector?*

A. No. Since the phase detector operates in a saturated mode and tends to square up a sine wave, it is not necessary to alter the square wave inputs.

Q. *Is there any difference in the frequency range spec when a DBM is used as a phase detector?*
A. Yes. The frequency specs for RF apply to a DBM operating in an unsaturated mode. When used as a phase detector, the DBM is operating in a saturated mode, which tends to shrink the bandwidth. Thus, to be conservative when using a DBM as a phase detector, select a mixer with a bandwidth 1.5 times wider than the unsataurated specs. For example, if your phase detector application covers 1-500 MHz, select a mixer whose RF port specification is at least 0.66-750 MHz.

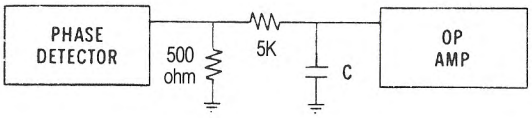
Q. *Isolation specs for LO to RF and LO to IF are generally included in mixer specs, but RF to IF isolation is often not listed. What are typical values?*
A. In a mixer application, the RF signal level is generally very low and thus the RF-IF isolation parameter is unimportant. However, in a phase detector application, the RF level is high and thus the RF-IF isolation becomes important. As a rule of thumb, LO-IF isolation is generally less than LO-RF isolation—10dB less at low frequency, 15-20 dB less at mid- and high-frequency.

Q. *I intend to use an op amp following the phase detector. What potential problems do I face?*
A. There are three potential problems. First, although the op amp theoretically will have zero DC volts at its input, it will actually have some small DC voltage; thus when the op amp is connected to the phase detector, this voltage will cause an unbalance in the phase detector diode circuit. Second, the op amp exhibits a high impedance while the phase detector offers 50 ohm impedance, posing a serious mismatch. Finally, it is necessary to filter out the sum frequency components created by the mixing action of the DBM acting as a phase detector.

A solution to remedy these problems involves a simple RC filter as shown. Since the op amp has a very high input impedance. The 1K series resistor does

most often asked questions cont.

not attenuate the DC output from the phase detector. Also any small DC voltage at the op amp is attenuated by 20:1 (by the 1K and 51-ohm resistor combination) at the phase detector output. The RC combination acts as a low-pass filter to attenuate the sum frequencies; if additional filtering is required, a multiple-section RC filter can be used.



Filtering the Phase Detector Output

Q. *Is it necessary to provide a filter at the output of the phase detector?*

A. In many cases, yes, the RF_1 and RF_2 term $(\omega_1+\omega_2)$ must be removed since it may cause system degradation. The frequency terms in the IF output can leak into the system and cause amplifier saturation or other seemingly unexplained results.

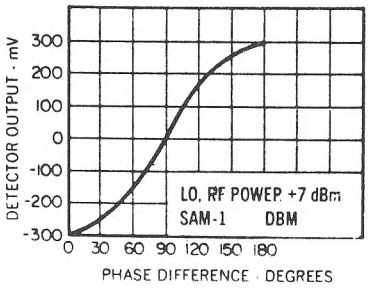
Q. *What are the basic steps to select the proper phase detector?*

A. First, decide on the maximum DC output needed. Next, select a phase detector with adequate bandwidth. Then decide on the required isolation and make sure the detector you select meets the requirement.

Finally, if phase accuracy is critical, specify the maximum DC offset tolerable for the intended frequency range and, at your request, Mini-Circuits will test and screen to insure this requirement is met at minimal or no charge.

Q. *What is the performance characteristic of a phase detector?*

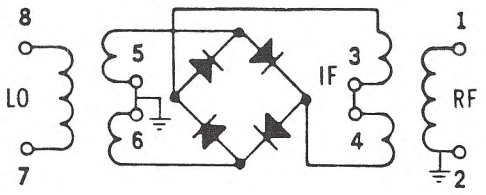
A. The phase detector performance curve displays the variation of DC output at the IF port with phase difference between the RF inputs at the Reference and RF ports. The performance curve is sinusoidal for a double-balanced mixer, DBM, used as a phase detector.



Phase Detector Performance Curve

Q. *Is the DC polarity output of a phase detector fixed by the manufacturer or can the polarity be reverse at the user's discretion?*

A. When the signals are in phase, Mini-Circuits detectors are manufactured to provide a negative output, see schematic shown. If the user requires a positive DC output, he would merely reverse the connections at the reference port; for positive DC output, pin 8 is grounded with the reference input applied to pin 7.



Phase Detector Schematic

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Phase Detectors

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Frequency range LO/RF ports _____ MHz
Output port _____ MHz
LO power level _____ dBm
RF power level _____ dBm
Max DC output voltage required _____ mV
Polarity (for 2 in-phase input signals)
☐ positive ☐ negative
Max DC offset voltage _____ mV
Impedence
RF/LO ☐ 50 ohms ☐ 75 ohms
Output ☐ 500 ohms ☐ 50 ohms ☐ 75 ohms
For external output load
☐ 500 ohms ☐ 50 ohms ☐ 75 ohms ☐ Other
Isolation, min. LO-RF _____ dB

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N ☐ Other

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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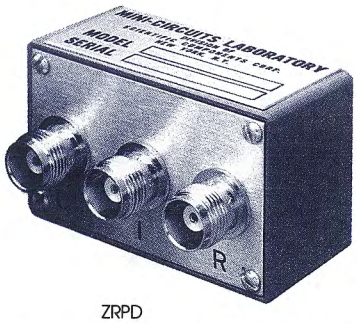
highest figure of merit

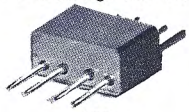
Phase Detectors

1000mV DC output, +7dBm RF



case style selection

outline drawings see Table of Contents


LPD


MPD


RPD


SYPD

ZRPD

	MODEL NO.	FREQUENCY MHz RF1 RF2	I	POWER IN RF1 RF2 (dBm)	SCALE FACTOR mV/degree	IMPEDANCE (ohms) OUTPUT LOAD I	ISOLATION (dB) RF1–RF2 Min.	OUTPUT POLARITY (RF1/RF2 In-phase)	DC OUTPUT (mV) Max. Typ.	Max. Min.	OFFSET Typ.	OFFSET Max.	FIGURE-OF-MERIT M Typ.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
LPD case BB48	LPD-1	1-100	DC-50	+7	8	500	40	neg.	1000	750	0.2	1	143	26.45	●	●
MPD case A11	MPD-1	1-100	DC-50	+7	8	500	40	neg.	1000	750	0.2	1	143	21.45	●	●
	MPD-2	10-200	DC-50	+7	8	500	40	neg.	1000	750	0.3	1	143	24.95	●	●
	MPD-21	50-400	DC-50	+7	7	500	40*	neg.	800	600	0.5	1	120	26.95	●	●
RPD case A01	RPD-1	1-100	DC-50	+7	8	500	40	neg.	1000	750	0.2	1	143	18.45	●	●
	RPD-2	5-150	DC-50	+7	8	500	40	neg.	1000	750	0.3	1	143	20.95	●	●
□ SYPD case TTT167	SYPD-1	1-100	DC-50	+7	8	500	40	neg.	1000	750	0.2	1	143	14.95	●	●
	SYPD-2	10-200	DC-50	+7	8	500	40	neg.	1000	750	0.3	1	143	18.95	●	●
ZRPD case M22	ZRPD-1	1-100	DC-50	+7	8	500	40	neg.	1000	750	0.2	1	143	57.95	●	

RF1 = RF input RF2 = RF reference

NOTES:

□ NON-HERMETIC

* 30 dB, 200 to 400 MHz

1. Maximum RF input power, 50 mW, peak IF current, 20mA.
2. Refer to Table of Contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing.
3. Prices and specifications subject to changewithout notice.

NSN GUIDE

MCL NO.	NSN
MPD-1	6625-01-294-7152
RPD-1	5895-01-250-8525

pin connections

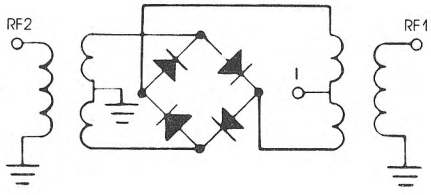
see case style outline drawing

Series		RPD	MPD	LPD	SYPD
RF REF.	RF2	8	8	8	2
RF in:	RF1	1	1	5	1
DC out:	I	*3,4	*3,4	4	3
GND◆		2,5,6,7	2,5,6,7	1,2,3,6,7	4,5,6
CASE GND.		2	2	1,2,3,6,7	—

◆Ground externally. All measurements made with GND pin(s) grounded externally.

*pins must be externally connected together

schematic



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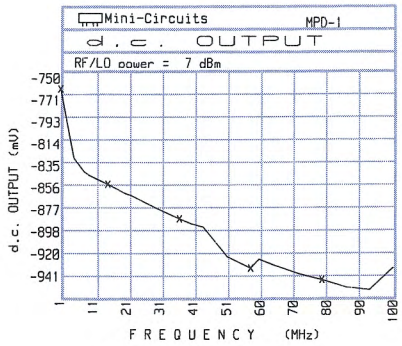
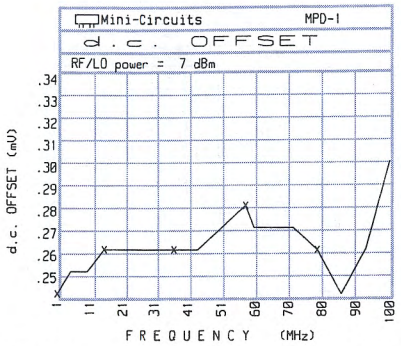
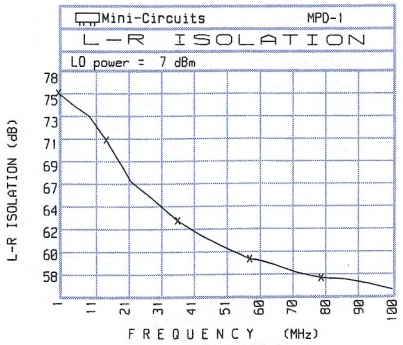
LPD-1, MPD-1, RPD-1, ZRDP-1, SYPD-1

1 to 100 MHz



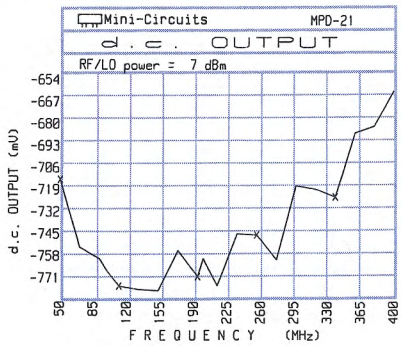


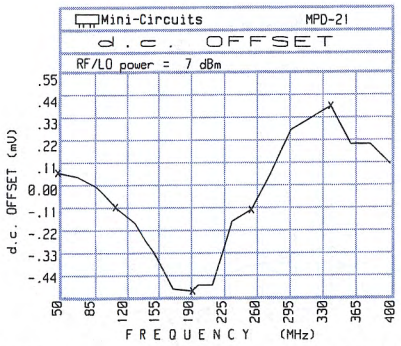


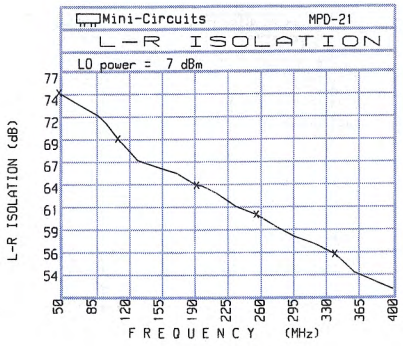
FREQUENCY	DC OUTPUT		DC OFFSET		L-R ISOLATION
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$
(MHz)	(mV)	(mV)	(mV)	(mV)	(dB)
1.000	-769.98	14.85	0.10	0.16	76.12
5.000	-830.34	8.90	0.11	0.18	75.09
8.071	-840.24	14.44	0.11	0.18	74.07
10.000	-843.71	14.61	0.10	0.18	73.19
15.143	-851.12	17.01	0.11	0.19	70.19
20.000	-859.20	18.91	0.11	0.19	68.10
22.214	-861.26	20.52	0.10	0.20	67.28
29.286	-872.02	22.55	0.11	0.21	65.14
36.357	-881.57	24.77	0.11	0.22	63.29
40.000	-886.86	25.39	0.12	0.23	62.38
43.429	-889.93	26.41	0.12	0.23	61.76
50.500	-917.82	25.99	0.14	0.25	60.51
57.571	-927.50	28.69	0.15	0.27	59.35
60.000	-917.14	33.08	0.15	0.26	59.18
64.643	-920.62	38.60	0.15	0.27	58.73
71.714	-925.22	45.18	0.17	0.31	57.82
78.786	-928.03	51.83	0.18	0.31	57.35
85.857	-932.34	57.31	0.17	0.31	57.15
92.929	-932.98	60.65	0.18	0.38	56.93
100.000	-909.17	74.27	0.23	0.43	56.36

MPD-21

50 to 400 MHz







FREQUENCY	DC OUTPUT		DC OFFSET		L-R ISOLATION
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$
(MHz)	(mV)	(mV)	(mV)	(mV)	(dB)
50.000	-709.82	3.59	0.08	0.04	70.65
70.588	-749.08	3.90	0.05	0.06	67.43
91.176	-754.30	4.74	-0.01	0.08	66.33
100.000	-761.44	5.14	-0.05	0.08	65.36
111.765	-768.79	5.90	-0.11	0.09	64.25
132.353	-768.89	7.05	-0.20	0.10	61.88
152.941	-767.63	8.30	-0.34	0.11	61.49
173.529	-742.21	9.53	-0.48	0.14	60.94
194.118	-755.32	11.20	-0.45	0.18	60.49
200.000	-744.32	11.29	-0.41	0.18	60.16
214.706	-758.79	12.19	-0.39	0.23	59.51
235.294	-727.66	13.02	-0.08	0.17	57.81
255.882	-725.26	15.07	-0.03	0.18	57.03
276.471	-736.71	17.30	0.14	0.15	55.98
297.059	-692.38	18.31	0.27	0.09	54.45
317.647	-691.52	20.64	0.31	0.11	53.62
338.235	-694.23	21.94	0.34	0.14	52.91
358.824	-656.91	21.62	0.19	0.10	52.02
379.412	-652.04	21.74	0.19	0.12	51.31
400.000	-632.47	20.37	0.11	0.09	50.99

highest figure of merit

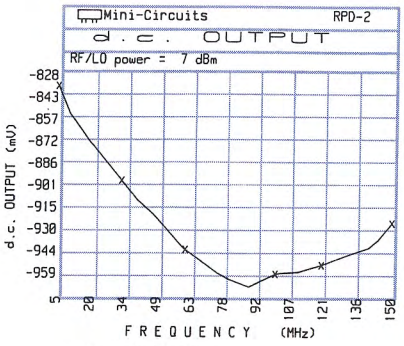
Phase Detectors

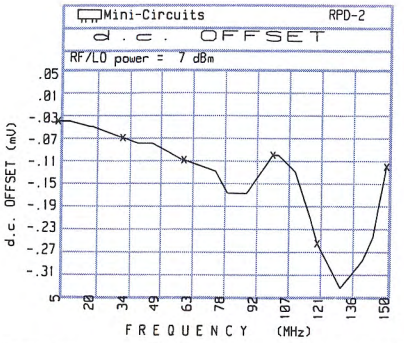
50 ohms

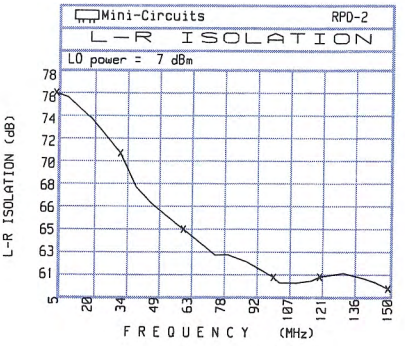
1000 mV DC output, +7 dBm RF

RPD-2

5 to 150 MHz



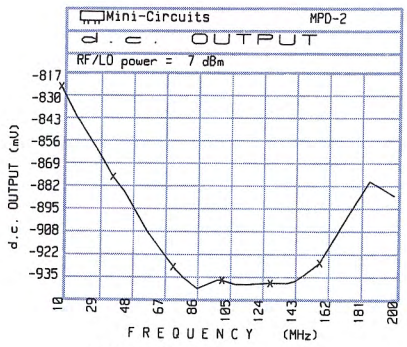


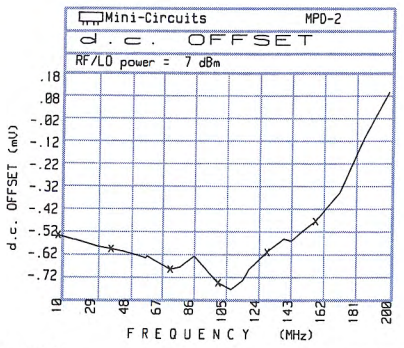


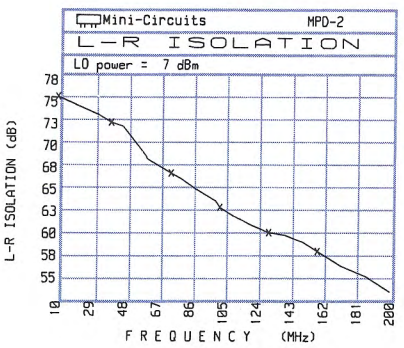
FREQUENCY	DC OUTPUT		DC OFFSET		L-R ISOLATION
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$
(MHz)	(mV)	(mV)	(mV)	(mV)	(dB)
5.000	-833.63	2.72	-0.01	0.26	75.70
10.000	-852.76	1.95	-0.01	0.27	75.30
18.929	-873.33	1.77	-0.02	0.26	73.81
20.000	-875.10	1.78	-0.02	0.26	73.45
32.857	-900.53	2.55	-0.05	0.24	69.84
40.000	-914.52	3.03	-0.07	0.24	67.79
46.786	-924.59	3.49	-0.08	0.23	66.39
60.000	-949.07	4.67	-0.13	0.23	64.23
60.714	-949.90	4.72	-0.13	0.23	63.98
74.643	-968.41	6.47	-0.18	0.22	62.11
80.000	-973.90	7.19	-0.21	0.22	61.80
88.571	-981.00	8.49	-0.28	0.23	61.68
100.000	-974.94	9.96	-0.28	0.26	60.73
102.500	-974.94	10.38	-0.28	0.27	60.33
110.000	-976.18	11.49	-0.27	0.25	59.71
116.429	-975.23	12.62	-0.30	0.23	59.57
120.000	-975.00	13.37	-0.33	0.22	59.53
130.357	-973.76	16.20	-0.41	0.19	59.73
140.000	-973.73	19.18	-0.45	0.22	59.76
144.286	-971.46	20.99	-0.47	0.25	59.67
150.000	-964.95	23.54	-0.42	0.33	59.40

MPD-2, SYPD-2

10 to 200 MHz







FREQUENCY	DC OUTPUT		DC OFFSET		L-R ISOLATION
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$
(MHz)	(mV)	(mV)	(mV)	(mV)	(dB)
10.000	-832.85	8.84	-0.20	0.31	73.96
20.000	-852.33	8.56	-0.21	0.32	71.39
32.857	-873.37	8.31	-0.22	0.33	68.61
40.000	-885.64	8.09	-0.23	0.33	67.41
46.786	-894.39	7.95	-0.23	0.33	66.22
60.714	-917.70	7.62	-0.22	0.35	64.00
74.643	-935.82	7.73	-0.25	0.37	61.81
80.000	-941.09	7.83	-0.24	0.37	61.28
88.571	-947.91	8.28	-0.23	0.38	60.45
100.000	-941.46	8.44	-0.28	0.40	59.49
110.000	-942.62	8.94	-0.29	0.41	58.55
120.000	-940.69	9.51	-0.22	0.40	57.75
130.357	-938.41	10.59	-0.19	0.39	57.17
140.000	-936.70	11.75	-0.16	0.37	56.90
144.286	-934.52	12.34	-0.17	0.36	56.82
150.000	-929.14	12.91	-0.13	0.38	56.68
158.214	-919.94	13.74	-0.08	0.40	56.42
172.143	-890.67	15.14	0.06	0.41	55.90
186.071	-863.24	17.28	0.28	0.31	55.11
200.000	-867.58	20.41	0.44	0.24	54.28

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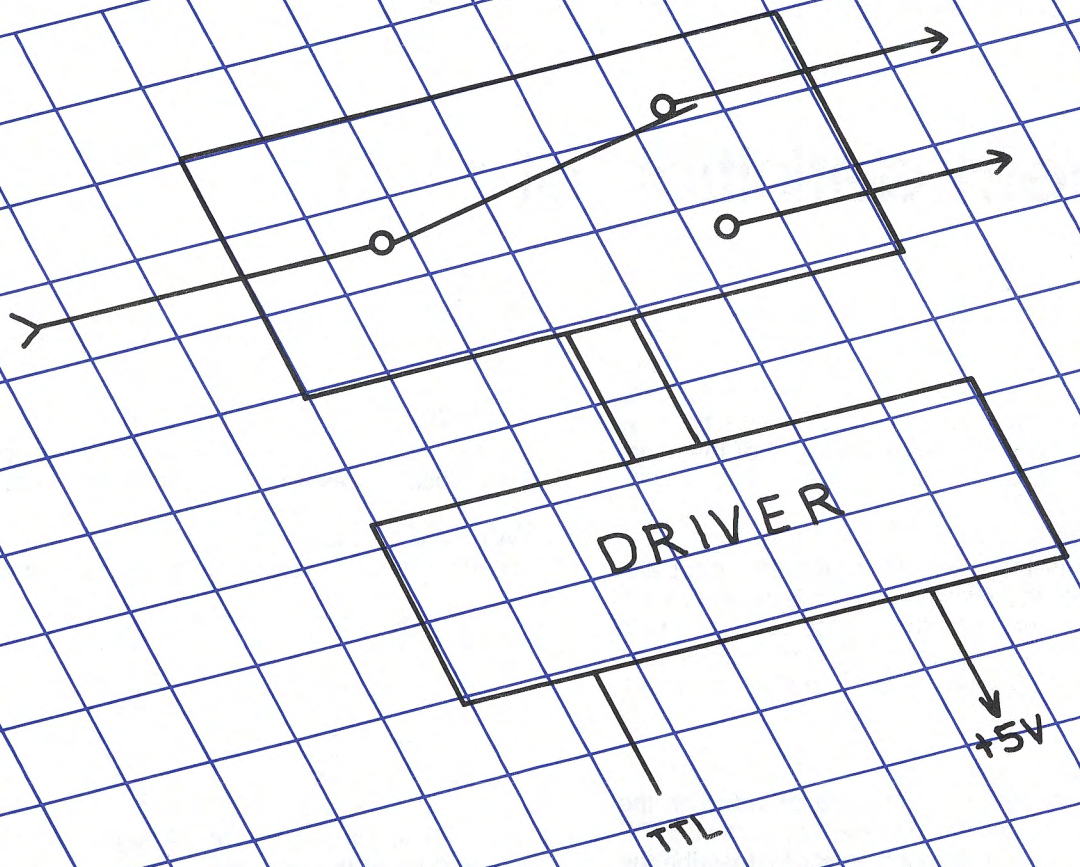
SECTION 13

SWITCHES



contents of this section

technical

introduction, definition of terms 13-2
most often asked questions 13-3, 13-4
specifications check list
a guide form for requirements 13-5

product specifications

SPDT & SP4T models with TTL drivers, ... 13-6, 13-7
GaAs SPDT and SPST models 13-8, 13-9
pin diode SPST/SPDT 13-10

computer data and curves

CAPD information . . . . . 13-11 thru 13-15

Switches

A wide variety of PIN diode and GaAs high-speed, high-isolation switches are available from Mini-Circuits, including models with built-in TTL drivers, operating up to 5 GHz. Select from SPST, SPDT, and SP4T models in EMI-shielded plug-in, TO-8, surface-mount and connectorized packages.

PIN diode units are available in SPST/SPDT configurations as well as SPDT/SP4T models with built-in drivers with 2 μsec switching speed, tough enough to pass stringent MIL-STD-202 tests. Despite their small size, the TO-8 models (TOSW-230 and TOSW-425) provide isolation as high as 40 dB, only 1.1 dB insertion loss, with a 1dB compression point of +27 dBm.

Switching speed as fast as 2 nsec is offered with Mini-Circuits GaAs switches, available in absorptive and reflective models, with and without TTL built-in drivers. All models are available with SMA connectorized or surface-mount packages. The connectorized packages are miniature, easily mountable, and well suited for test set-ups. Surface-mount units are offered in a low-cost plastic package and hermetic ceramic cases for military applications. These packages are rugged enough to pass MIL-STD-883 vibration, mechanical and thermal shock, fine and gross leak tests. These fast-acting switches can operate from DC up to 5 GHz with 50dB isolation and only 1 dB insertion loss. The absorptive models exhibit a typical VSWR of 1.5 in the "OFF" state.

modern definition of terms

insertion loss

The insertion loss is the attenuation between input and output ports of the switch when embedded in a circuit, when the switch control voltage corresponds to the "ON" state of the output port. For insertion loss measurement techniques see section O of the handbook.

isolation

The isolation is the attenuation between input and output ports of the switch when embedded in a circuit, when the switch control voltage corresponds to the "OFF" state of the output port. See insertion loss measurement techniques in Section O of the handbook.

vswr

VSWR (Voltage Standing Wave Ratio) indicates the degree of impedance match present at the switch RF port. In most cases, it is much easier to describe the impedance match in terms of return loss, dB. Return loss is equal to the amount of reflected power relative to the incident power at a port. Simply by measuring both incident and reflected power, the return loss can be measured and hence the VSWR can be calculated. For return loss measurements see section O of the handbook. For convenience, a conversion chart between VSWR and Return loss is given in section O.

transients

During switching, video transients occur which can disturb RF components following the switch. If lower transients are critical during the switching period, use a slower transition rate between control states.

noise figure

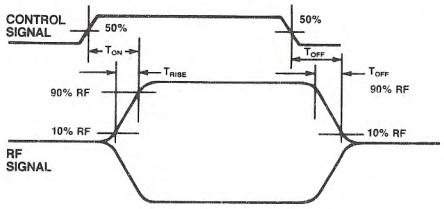
Noise Figure (N.F.) of a switch is considered equal to its insertion loss.

1dB compression point

The RF input power level at which the switch insertion loss increases by 1 db over its low-level value.

switching speed

The most popular parameters are listed below:



T_{Rise} = Rise Time, time for RF signal to rise from 10% to 90% of the "on" level.

T_{Fall} = Fall Time, time for RF signal to fall from 90% to 10% of the "on" level.

T_{On} = On Time, time from 50% of the control pulse to 90% of the "on" level.

T_{Off} = Off Time, time from 50% of the control pulse to 10% of the "on" level. Rise time and fall time affect the upper limit of switching rate and dictate the minimum time necessary for the switch to change state. On or Off time measures the total switching time starting at control pulse transition (50% point) to RF level stabilization (90% or 10% point). Switching speed is defined as the greater of these two values.

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most often asked questions about switches

Q. What is the difference between an absorptive and a reflective switch?

A. In a reflective switch, the impedance of the port that is OFF will not be 50 ohms and will have a very high VSWR. On the other hand, an absorptive switch will have a good VSWR on each port regardless of the switch mode.

Q. *Instead of working with one input and two outputs, can I use the switch in the opposite direction? I want to connect signals to the "output" ports and use the "input" as the output port.*

A. Yes you can. If, for example, you have two generators and want to maintain a 50-ohm load on the generator that is not switched to the common port, use an absorptive switch; otherwise, you can use a reflective switch.

Q. *When should I use an absorptive switch? A reflective switch?*

A. Use an absorptive switch when you need a good VSWR looking into the port that is not switched to the common port. Use a reflective switch when high OFF port VSWR does not matter and when the switch has some other desired performance feature. In most cases, an absorptive switch can be used instead of a reflective, but not vice versa.

Q. *What is the difference between PIN diode switches and GaAs switches?*

A. A PIN diode switch uses the PIN diode as the nonlinear element (low impedance, current in one direction; high impedance current in the opposite direction). At frequencies above approximately 10MHz, the PIN diode moves too slowly in responding to the polarity of the RF signal, so that the diode appears as a fixed impedance (low impedance for positive DC control current, high impedance for zero current or negative DC control voltage). The GaAs switch uses a GaAs FET as the nonlinear element (the transistor being in the fully "on" or fully "off" state depending upon bias conditions).

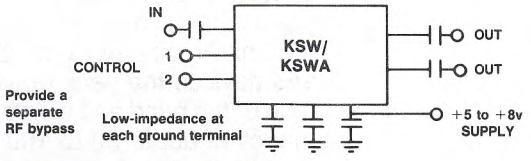
A PIN diode switch is more tolerant of high peak power when using pulsed RF input, being limited mainly by average dissipation; power rating of a GaAs switch is determined more by internal peak voltage and current ratings. On the other hand, GaAs switches are faster, switching ON and OFF in a few nanoseconds compared with microseconds for PIN switches. Also, GaAs switches have RF response extending down to DC, whereas in PIN switches there is a practical lower limit to the frequency range in which the diodes behave as linear resistors. Finally, switching-signal (video) leakage into the RF ports is lower in GaAs switches by a factor of 10.

Q. *I see that the MCL KSW and YSW series are specified down to DC. Will they actually work with DC voltage?*

A. Yes, but care has to be taken to ensure that excess voltage will not burn out the switch. As a practical matter, the value of the coupling capacitors at the RF input and output of the switch will determine the lowest frequency of operation.

Q. *I am working with a KSW/KSWA switch. Can I connect the switch to work on +V instead of −V?*

A. Yes. It can be done by floating the grounds as shown in the diagram. The switch will be limited at the lower frequencies due to the blocking capacitors. Control voltages must not exceed the supply voltage.



Q. *I only have -5V, not -8V. Will the KSW/KSWA work with -5V and what will the effect be?*

A. Yes, it will work but there will be as much as 6dB degradation in the 1dB compression point and the isolation between ports may degrade by a few dB.

most often asked questions cont.

Q. *I want to use the switch as a modulator. What is the maximum modulating frequency I can use?*

A. The highest modulating frequency which will switch ON and OFF fully is approximately

$$F = \frac{1}{(T_{on} + T_{off})}$$

Where T_{on} and T_{off} are defined below under "switching speed." A precaution: in modulator service the maximum allowable RF input power for the KSW/KSWA/KSWHA switches is reduced as follows:

Up to 200 MHz: reduce by 10 dB
200 to 2000 MHz: reduce by 6 dB
Above 2000 MHz: reduce by 5 dB

Q. *When I use the switch as a modulator, how much leakage (video break-through) of the modulating signal will appear at the output?*

A. It will depend on the individual switch. GaAs switches have typically 30mV peak-to-peak leakage. PIN diode switches have typically 300mV peak-to-peak.

Q. *I am using a switch to alternate between two generators. What is the isolation between the two inputs?*

A. It will be close to the isolation specified between the input and output when the port is switched off.

Q. *What is the peak power limit a Mini-Circuits' switch can handle?*

A. Both PIN diode and GaAs chips are used as switching elements in Mini-Circuits' designs. Generally speaking, for GaAs devices the peak power will be higher at the high end of the band and will degrade as a function of frequency at about 50 to 100 MHz. The same is true with PIN diodes; however, in this case, the point of degradation occurs when the PIN diode begins to behave as a normal diode.

Q. *Are Mini-Circuits' switches bi-directional?*

A. Yes. From an RF point of view, input and output are interchangeable.

Q. *Is the output of a switch open-circuit or closed-circuit in the "OFF" state?*

A. The absorptive switch output looks like a 50-ohm impedance in the "OFF" state. A reflective switch, on the other hand, in its "OFF" state represents a high reflection which could appear as an open or a short depending on the design of the switch, the frequency involved and the length of line between the switch and the point of measurement. At low frequencies the reflective switch looks like a short.

Q. *What can happen when a switch is driven into compression?*

A. It will generate harmonics and insertion loss will increase.

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SPECIFICATIONS CHECKLIST

Switches/Switches with drivers

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔ Important Parameter ✔

Application: ☐ Industrial/Commercial ☐ Military ☐ Space

Electrical:

Type: ☐ SPST ☐ SPDT ☐ SP3T ☐ SP4T
☐ with driver ☐ without driver
Frequency Range _____ MHz
Power input max. _____ dB
Insertion loss max. _____ dB
Isolation (in-out) min. _____ dB
VSWR or return loss (dB)
☐ 50 ohms ☐ 75 ohms ☐ Other
Input _____ output _____
Switching time* ___ μsec. Rise time ___ μsec.
Supply current (for driver) _____ mA
Supply voltage (for driver) _____ volts
Control voltage ___ Vmax. Current ___ mA
Logic ☐ TTL ☐ CMOS ☐ not applicable
Operating temperature _____ °C
*50% control to 90% RF (on) to 10% RF (off)

Environmental requirements:

_____
_____
_____
_____
_____
_____
_____

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

PC Board Mounting
☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
☐ BNC ☐ TNC
☐ SMA ☐ Type N

Special Requirements: _____

_____

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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Switches, with TTL Drivers

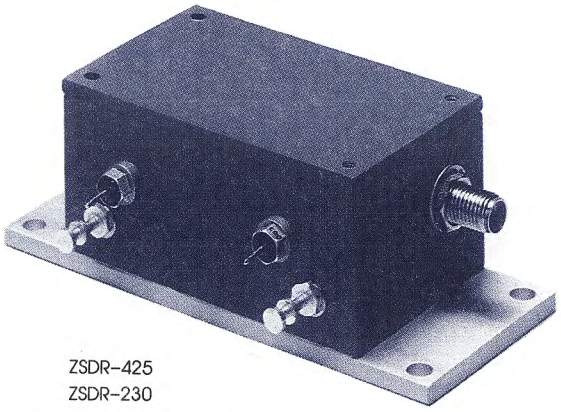
SPDT/SP4T
pin diode
10 to 3000 MHz

case style selection

outline drawings see Table of Contents



TOSW



ZSDR-425
ZSDR-230

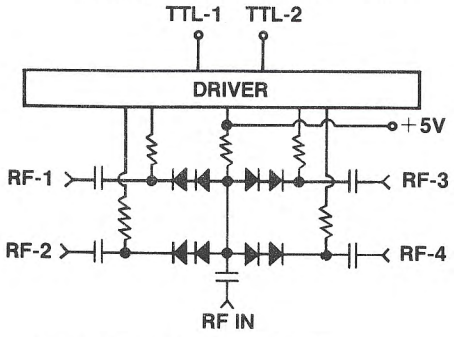
	MODEL NO.	TYPE	FREQUENCY MHz f_L-f_U	INSERTION LOSS dB low-band lw Typ.	lw Max.	upper band U Typ.	U Max.	IN-OUT ISOLATION dB L Typ.	L Min.	M Typ.	M Min.	U Typ.	U Min.	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
TOSW case QQ96	TOSW-230	SPDT	10-3000	1.3	1.9	1.8	2.7	60	40	40	28	35	22	49.95	•	•
	TOSW-425	SP4T	10-2500	1.1	1.7	1.5	2.5	60	40	40	30	35	22	69.95	•	•
ZSDR case CCC-127	ZSDR-230	SPDT	10-3000	1.3	1.9	1.8	2.7	60	40	40	28	35	22	89.95	•	
case GGG-126	ZSDR-425	SP4T	10-2500	1.1	1.7	1.5	2.5	60	40	40	30	35	22	109.95	•	

L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)
lw=low band (f_L to f_U/2)

ADDITIONAL SPECIFICATIONS

VSWR ("on" state): typ. 1.3, 1.6 max.
Switching time (μ sec): all switches, typ. 2.0, 4.0 max.
Max. RF input for all switches: 20 dBm for low range, 28 dBm for mid range, & 30 dBm for upper range.
Supply voltage for all switches, +5V (10 mA max.)
1 dB compression point for all switches: from 10-100 MHz increase from 6 to 19 dBm. Above 100 MHz, 19 dBm min.
TTL input high threshold 2 volts min.
TTL input low threshold 0.8 volts max.

MODEL TOSW-425 & ZSDR-425



TTL LOGIC FOR ZSDR-425 & TOSW-425

	TTL-1	TTL-2
RF-1	1	0
RF-2	1	1
RF-3	0	1
RF-4	0	0

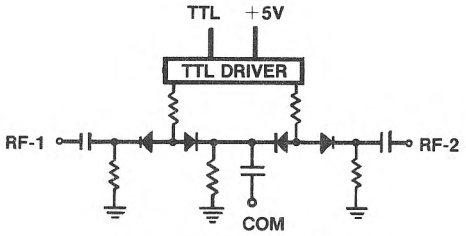
pin connections

see case style outline drawings

Series	TOSW	
Models	425	230
RF IN	8	8
RF-1	4	5
RF-2	6	11
RF-3	10	—
RF-4	12	—
TTL-1	2	3*
TTL-2	3	—
+5 VDC	1	1
CASE GND	5,7,9,11	2,4,6,7, 9,10,12

*TTL: pin 3

MODEL TOSW-230 & ZSDR-230



TTI LOGIC FOR ZSDR-230 & TOSW-230

TTL 1:	RF-1/OFF	RF-2/ON
TTL 0:	RF-1/ON	RF-2/OFF

NOTES:
1. Refer to Table of Contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing
2. Prices and specifications subject to change without notice.

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Mini-Circuits

SPDT
GaAs, reflective and absorptive
dc to 5 GHz



ZYSWA
ZYSW

case style selection

see case style outline drawings



VSWA
VSW



YSWA
YSW

	MODEL NO.	FREQ. GHz	REFLECT.	ABSORT.	INSERTION LOSS, dB FREQUENCY BAND A Typ.	A Max.	B Typ.	B Max.	C Typ.	C Max.	1dB COMPRESSION, dBm FREQUENCY BAND A Typ.	A Min.	B Typ.	B Min.	C Typ.	C Min	IN-OUT *ISOLATION dB A Typ.	A Min.	B Typ.	B Min.	C Typ.	C Min.	PRICE Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
VSW	VSW-2-50DR	DC-5	●		1.0	1.5	1.2	1.7	1.5	2.1	20	15	20	19	24	22	50	41	40	32	28	22	42.95	●	●
case AG191	VSWA-2-50DR	DC-5		●	1.1	1.5	1.4	1.9	1.9	2.7	18	13	20	17	22.5	20	50	38	38	27	30	19	43.95	●	●
o□YSW	YSW-2-50DR	DC-5	●		0.9	1.5	1.3	1.7	1.4	2.1	20	15	20	19	24	22	50	41	40	32	28	22	19.95	●	●
case KKK-155	YSWA-2-50DR	DC-5		●	1.1	1.5	1.4	1.9	1.9	2.7	18	13	20	17	22.5	20	42	38	31	27	20	19	23.95	●	●
ZYSW	ZYSW-2-50DR	DC-5	●		0.9	1.5	1.3	1.7	1.4	2.1	20	15	20	19	24	22	50	41	40	32	28	22	59.95	●	
case ZZ-121	ZYSWA-2-50DR	DC-5		●	1.1	1.5	1.4	1.9	1.9	2.7	18	13	20	17	22.5	20	42	38	31	27	20	19	69.95	●	

A=DC to 500MHz B=500MHz to 2000MHz C=2000MHz to 5000MHz

*Typical isolation at 5 MHz, is 80 dB and decreases 5 dB/octave from 5-1000 MHz.

ADDITIONAL SPECIFICATIONS

	MIN.	TYP.	MAX.	UNITS
VSWR (ON)	—	1.4	2.0	
@ VIDEO BREAK THROUGH TO RF	—	30	—	mV P-P
RISE/FALL TIME (10% TO 90%)	—	1.5	3.0	nsec
SWITCHING TIME				
(FROM 50% TTL TO 90% RF)	—	3.0	5.0	nsec
POSITIVE SUPPLY VOLTAGE (PIN-19)	4.5	5.0	5.5	V
NEGATIVE SUPPLY VOLTAGE (PIN-7)	4.5	5.0	5.5	V
+5 V POWER SUPPLY CURRENT		12	20	mA
−5 V POWER SUPPLY CURRENT		12	20	mA
TTL LOGIC				
TTL INPUT HIGH	△RF-OUT #1 OFF, RF-OUT #2 ON			
TTL INPUT LOW	△RF-OUT #2 OFF, RF-OUT #1 ON			
TTL SPECS				
TTL VOLTAGE	0	—	5.5	V
TTL TOGGLE RATE	0	80	—	MHz
TTL INPUT				
HIGH, THRESHOLD	2.0	—	—	V
HIGH, CURRENT	—	2	5	mA
LOW, THRESHOLD	—	—	0.8	V
LOW, CURRENT	—	—	0.2	mA

△ For YSW-2-50DR,ZYSW-2-50DR OFF state of RF output is low impedance.
@ Video break thru is defined as leakage of TTL switching signal to RF output ports.

TEMPERATURE				
OPERATING	−55	-	85	°C
STORAGE	−62	—	100	°C
MAX. RF INPUT (No Damage)*				
DC-2 GHz	—	—	+22	dBm
2-5 GHz	—	—	+24	dBm

● For YSWA-2-50DR: +20dBM at "OFF" port, +24 dBM total
□ NON-HERMETIC
o Tape and Reel available. Please consult factory.

PIN CONFIGURATION

FUNCTION	VSW, YSW	ZYSW PORT
RF-IN	4	3
RF-OUT 1	12	2
RF-OUT 2	14	1
TTL-IN	2	4
+5V	19	+5 VDC
−5V	7	−5 VDC
No Connection	9, 17	—
GND	1,3,5,6,8,10,11 13,15,16,18,20	GND

features

- excellent repeatability, specification limits 4.5 σ typical from mean.
- high isolation, 80 dB typical at 5 MHz.
- low video break thru, 30 mV P-P typical.
- very fast switching, 3 nsec typical.
- low DC power consumption, 120 mW typical.
- YSW/A-2-50DR available in tape & reel.

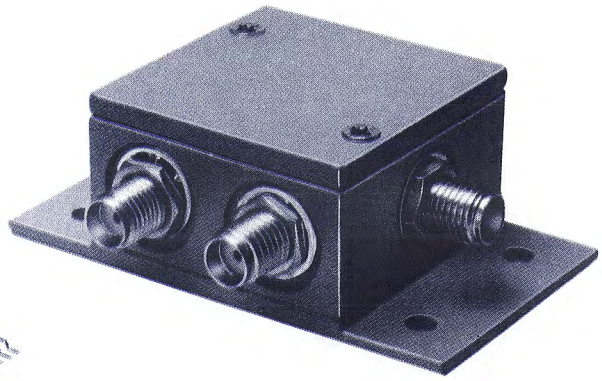
In Stock...Immediate Delivery

CAPO now available! computer-automated performance data see model index

GaAs <5 nsec

Switches

SPDT
reflective and absorptive
dc to 4.6 GHz



case style selection

see case style outline drawings



KSW

ZFSW

	MODEL NO.	FREQ. GHz	ABSORP.	REFLECT.	INSERTION LOSS, dB FREQUENCY BAND A Typ.	A Max.	B Typ.	B Max.	C Typ.	C Max.	1dB COMPRESSION, dBm FREQUENCY BAND A Typ.	B Typ.	C Typ.	IN-OUT ISOLATION dB A Typ.	A Min.	B Typ.	B Min.	C Typ.	C Min.	PRICE Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
KSW	KSW-2-46	DC-4.6		•	0.9	1.1	1.0	1.3	1.3	1.7	+10	+17	+27	60	50	45	40	30	23	36.95	•	•
case XX112	KSWA-2-46	DC-4.6	•		0.8	1.1	0.9	1.3	1.5	2.6	+10	+17	+27	60	45	50	40	30	25	58.95	•	•
ZFSW	ZFSW-2-46	DC-4.6		•	0.9	1.1	1.0	1.3	1.3	1.7	+10	+17	+27	60	50	45	40	30	23	79.95	•	
case G144	ZFSWA-2-46	DC-4.6	•		0.8	1.1	0.9	1.3	1.5	2.6	+10	+17	+27	60	45	50	40	30	25	89.95	•	

A=DC to 200MHz B=200MHz to 1000MHz C=1000MHz to 4600MHz

NOTES:

1. To ensure proper performance, connect case to pc board. Ground and interconnect top and bottom of pc board. Ground very close to case position.
2. Control voltage −8V on
   Logic 0V off
3. All specifications, except compression, apply for control voltage −8V to −5V (2.5 mA typ.).
4. Control voltage −10V max.
5. Switching speed: Rise time 2 nanosec typ., Fall time 2 nanosec typ.
6. VSWR 1.3 to 1 typical over most of frequency range.
7. Maximum RF input for no damage +27 dBm below 500 MHz, +30 dBm above 500MHz.
   MTBF: 15 million hours at 55°C
   KSW-2-46 = 7 million hours at 100°C.
   KSWA-2-46 = 11 million hours at 100°C.
8. Prices and specifications subject to change without notice.

FUNCTION	KSW KSWA PIN	ZFSW ZFSWA PORT
Control 2	1	1
RF-IN	2	S
Control 1	3	4
Ground	4	—
RF Out 1	5	3
Ground	6	—
Ground	7	—
RF Out 2	8	2

Control 1	Control 2	RF Out 1	RF out 2
−8V	0V	ON	OFF△
0V	−8V	OFF△	ON

△ For KSW-2-46, OFF state of RF output is low impedance.
For KSWA-2-46, OFF state of RF output is 50 ohms to ground

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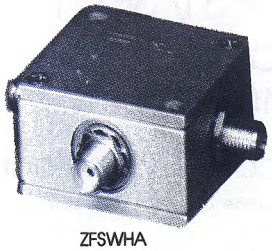
Mini-Circuits

SPST
hi-isolation, absorptive
dc to 2 GHz



KSWHA



ZFSWHA

	MODEL NO.	FREQ. GHz	ABSORPT.	INSERTION LOSS, dB FREQUENCY BAND A Typ.	A Max.	B Typ.	B Max.	1dB COMPRESSION, dBm FREQUENCY BAND A Typ.	B Typ.	IN-OUT ISOLATION dB A Typ.	A Min.	B Typ.	B Min.	PRICE Qty. (1-9)	DISTRIBUTOR FACTORY	LOCAL
KSWHA case XX-112	KSWHA-1-20	DC-2.0	•	0.8	1.2	1.3	1.7	+19	+26	75	60	65	58	34.95	•	•
ZFSWHA△ case J17	ZFSWHA-1-20	DC-2.0	•	0.8	1.2	1.3	1.7	+19	+26	75	60	65	58	74.95	•	

A=DC to 200MHz B=200MHz to 2000MHz

ADDITIONAL SPECIFICATIONS

		A	B	UNITS
3rd ORDER INTERCEPT	TYP.	+35	+46	dBm
VSWR "ON" IN & OUT,	MAX.	1.25:1	1.50:1	
VSWR "OFF" IN,	MAX.	1.25:1	1.50:1	
OUT,	MAX.	1.40:1	1.50:1	

MAXIMUM RF POWER (NOTE 5)

	DC-20 MHz	20-500 MHz	500-2000 MHz
AT CONSTANT 0/-8V CONTROL	200 mW	1000 mW	2000 mW
AS MODULATOR (NOTE 6)	30 mW	100 mW	500 mW

	TYP.	MAX.	UNITS
RISE/FALL TIME (10%-90%)	3	5	ns
SWITCHING TIME, 50% OF CONTROL TO:			
90% RF (TURN ON)	7	10	ns
10% RF (TURN OFF)	3	10	ns
VIDEO LEAKAGE, 0/-5V CONTROL	30	50	mV p-p

OPERATING TEMPERATURE: -55 to 100 Deg. C.
STORAGE TEMPERATURE: -55 to 150 Deg. C.

FUNCTION	KSWHA PIN	ZFSWHA PORT
RF-IN	1	1
RF-OUT	5	2
CONTROL 1	2	4
CONTROL 2	3	3
CASE GND	4,6,7,8	—

NOTES:

1. To ensure proper performance, connect case to upper PC board ground, and interconnect top and bottom PC board grounds very close to case location.
2. Control logic:

	ON	OFF
Control 1	-V	0
Control 2	0	-V

3. All specifications, except compression and intercept, apply for control voltage -8V to -5V Control current is 200 μA max. in this voltage range.
4. Maximum control current for no damage 500 μA. (Occurs at -9 to -12V typ.)
5. Above 20 deg. C derate power linearly to zero at 150 deg. C.
6. In modulator service, unrestricted switching is permitted with rf applied.
7. MTBF: 15 million hours at 55 deg. C, 11 million hours at 100 deg. C.

△ Available with SMA connections only.

features

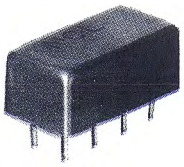
- hi-isolation absorptive switch, 75 dB at 200 MHz, 65 dB at 2 GHz.
- very fast switching, 3 ns typical.
- hermetically sealed glass-metal package.
- compatible with surface mount soldering techniques.

Switches

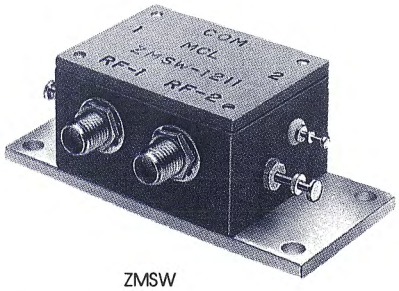
SPST/SPDT pin diode 10 to 2500 MHz

case style selection

outline drawings see Table of Contents



PSW



ZMSW

	MODEL NO.	TYPE	FREQUENCY MHz	INSERTION LOSS dB				IN-OUT ISOLATION dB						PRICE $	DISTRIBUTOR	
				low-band		upper band		L		M		U			FACTORY	LOCAL
				lw		U								Qty.		
			f_L-f_U	Typ.	Max.	Typ.	Max.	Typ.	Min.	Typ.	Min.	Typ.	Min.	(1-9)		
PSW	PSW-1111	SPST	10-2500	1.1	1.7	1.7	2.7	50	40	35	30	28	22	32.95	•	•
case A06	PSW-1211	SPDT	10-2500	1.1	1.7	1.7	2.7	50	40	35	30	28	22	32.95	•	•
ZMSW	ZMSW-1111	SPST	10-2500	1.1	1.7	1.7	2.7	50	45	35	30	28	22	69.95	•	
case JJ77	ZMSW-1211	SPDT	10-2500	1.1	1.7	1.7	2.7	50	45	35	30	28	22	69.95	•	

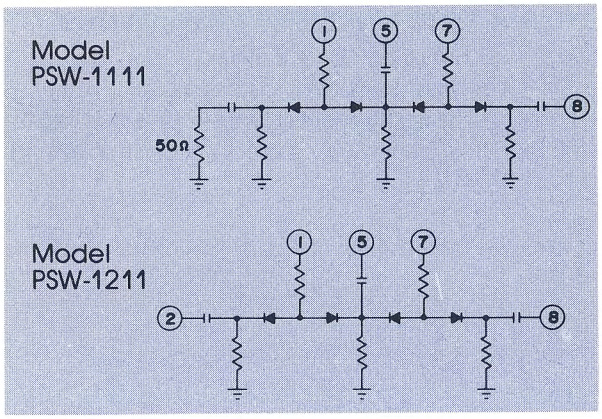
L=low range (f_L to 10 f_L) M=mid range (10f_L to f_U/2) U=upper range (f_U/2 to f_U)
lw=low band (f_L to f_U/2)

NOTES:
1. Refer to Table of Contents for quality control procedures, environmental specifications, absolute maximum ratings, and hi-rel testing.
2. For PSW and ZMSW models
   a) VSWR 1.6 max. ("on" state)
   b) Switching time 4μ sec. max., 2μ sec. rise time.
   c) Maximum RF input +20 dBm
   d) Control voltage +5V (5mA max.) on condition
      0V off condition
3. 1 dB compression for all pin diode switches from 10 to 100 MHz increase from 6 to 19 dBm. Above 100 MHz, 19 dBm min.
4. Prices and specifications subject to change without notice.

NSN GUIDE

MCL NO.	NSN
PSW-1211	5985-01-328-8006

schematic



pin and coaxial connections

see case style outline drawings

Series	PSW		ZMSW	
Models	1111	1211	1111	1211
RF COMMON	5	5	com	com
RF-1 port	8	2	—	RF-1
RF-2 port	—	8	RF-2	RF-2
CONTROL RF-1	7	1	—	1
CONTROL RF-2	—	7	2	2
CONTROL 50 ohm TERMINATION	1	—	1	—
GND	2,4	4	—	—
CASE GND	3,6	3,6	—	—

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SPST Switches

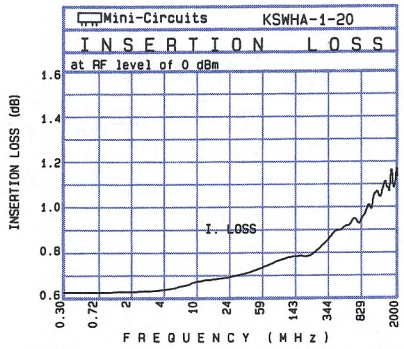
Mini-Circuits

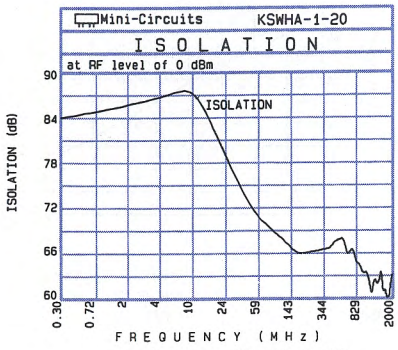
50 ohms

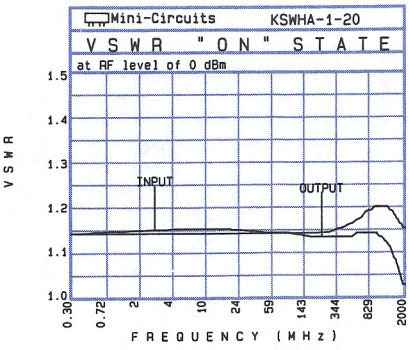
KSWHA-1-20, ZFSWHA-1-20

absorptive

DC to 2.0 GHz







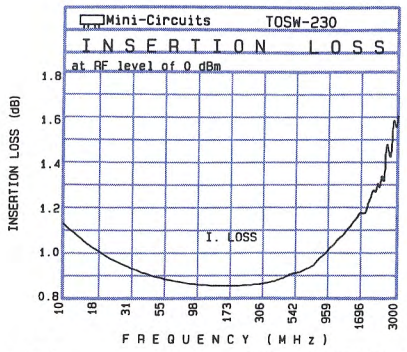
FREQ. (MHz)	ON INSERTION LOSS (dB) (ctrl1 @ -8V, ctrl2 @ 0V) IN-OUT		OFF ISOLATION (dB) (ctrl1 @ 0V, ctrl2 @ -8V) IN-OUT		VSWR IN	VSWR OUT ON	VSWR OUT OFF
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	$\bar{x}$	$\bar{x}$
0.300	0.62	0.01	90.61	3.68	1.15	1.15	1.03
5.299	0.63	0.01	85.48	6.29	1.16	1.15	1.03
10.298	0.69	0.01	83.23	4.25	1.16	1.15	1.03
100.285	0.79	0.01	67.92	1.22	1.15	1.15	1.03
280.258	0.85	0.01	66.96	1.83	1.15	1.14	1.03
390.241	0.92	0.00	67.09	1.35	1.15	1.14	1.03
445.233	0.90	0.01	67.05	1.41	1.16	1.15	1.03
610.208	0.96	0.01	65.89	1.85	1.16	1.15	1.04
780.183	0.99	0.01	64.48	1.97	1.17	1.16	1.05
890.166	1.02	0.01	63.58	2.32	1.18	1.16	1.06
945.158	1.04	0.01	63.07	2.05	1.18	1.16	1.07
1000.150	0.99	0.00	62.55	1.47	1.18	1.15	1.08
1165.125	1.09	0.02	61.49	2.35	1.18	1.15	1.09
1335.100	1.11	0.02	61.45	1.70	1.17	1.14	1.12
1445.083	1.14	0.02	61.66	1.64	1.16	1.13	1.13
1500.075	1.09	0.02	62.32	2.10	1.16	1.12	1.14
1665.050	1.17	0.01	60.72	1.78	1.15	1.10	1.17
1835.025	1.13	0.01	60.34	0.70	1.14	1.07	1.20
1945.008	1.22	0.03	60.54	1.60	1.13	1.06	1.22
2000.000	1.17	0.01	61.08	1.47	1.13	1.05	1.23

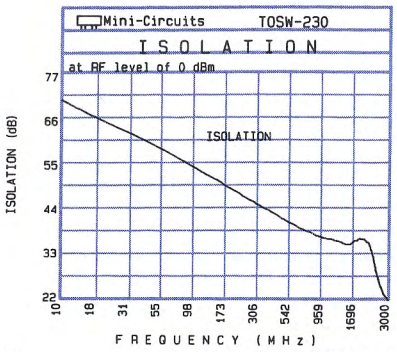
pin diode
Switches, with TTL driver

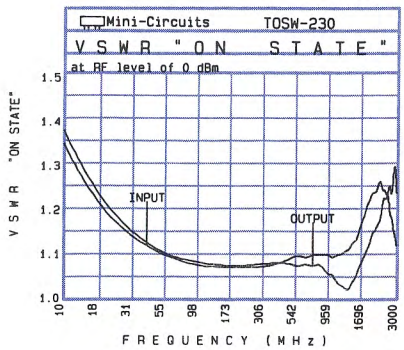
TOSW-230, ZSDR-230

SPDT

10 to 3000 MHz





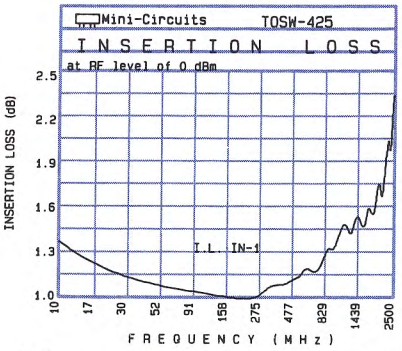


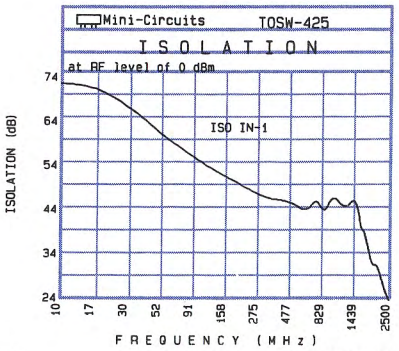
FREQ. (MHz)	ON (TTL LOW @ 0V) INSERTION LOSS (dB) IN-OUT		AMP. UNBAL.		OFF (TTL HIGH @ 5V) ISOLATION (dB) IN-OUT		DELTA		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
10.000	1.18	0.04	0.03	0.02	74.26	1.60	1.14	0.39	1.37	1.41	31.26
20.000	1.06	0.05	0.05	0.05	69.20	1.46	1.45	1.51	1.20	1.22	30.31
50.000	0.92	0.03	0.02	0.01	61.84	1.14	1.60	1.01	1.12	1.12	30.07
100.000	0.88	0.03	0.02	0.01	55.48	0.61	0.75	0.63	1.09	1.10	30.07
200.000	0.88	0.02	0.02	0.01	49.81	0.72	0.64	0.70	1.09	1.09	30.49
500.000	0.94	0.02	0.02	0.01	42.32	0.56	0.53	0.77	1.11	1.11	29.97
552.910	0.94	0.02	0.01	0.01	41.56	0.50	0.61	0.74	1.12	1.10	28.88
792.000	1.02	0.01	0.01	0.01	39.41	0.46	0.68	0.76	1.13	1.12	26.27
1000.000	1.06	0.01	0.01	0.01	37.86	0.40	0.67	0.71	1.12	1.10	24.84
1102.820	1.10	0.01	0.01	0.01	37.96	0.40	0.70	0.73	1.12	1.08	22.83
1341.910	1.16	0.01	0.02	0.01	37.13	0.42	0.94	0.69	1.12	1.06	21.66
1509.270	1.19	0.02	0.02	0.01	36.81	0.45	0.96	0.75	1.14	1.07	20.69
1652.730	1.21	0.01	0.02	0.01	37.32	0.53	0.89	0.79	1.17	1.09	19.92
1891.820	1.27	0.02	0.02	0.02	37.64	0.67	1.82	0.71	1.23	1.14	19.28
2130.910	1.38	0.02	0.02	0.03	38.60	1.13	0.82	0.94	1.27	1.20	24.87
2370.000	1.31	0.02	0.03	0.03	36.48	3.02	2.00	1.04	1.31	1.31	19.46
2609.090	1.50	0.04	0.06	0.03	30.37	2.46	0.49	0.56	1.34	1.37	11.80
2848.180	1.63	0.06	0.04	0.02	27.51	2.19	0.30	0.21	1.28	1.41	10.49
2919.910	1.56	0.04	0.03	0.02	26.87	2.12	0.56	0.28	1.27	1.41	9.46
3000.000	1.58	0.04	0.05	0.03	26.08	2.02	0.86	0.48	1.24	1.35	11.35

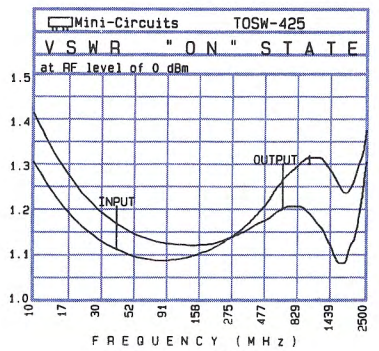
TOSW-425, ZSDR-425

SP4T

10 to 2500 MHz







FREQ. (MHz)	ON (TTL-1 HIGH @ 5V, TTL-2 LOW @ 0V) INSERTION LOSS (dB) IN-OUT		AMP. UNBAL.		OFF (TTL-1 LOW @ 0V, TTL-2 HIGH @ 5V) ISOLATION (dB) IN-OUT		DELTA		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
10.000	1.22	0.16	0.18	0.15	74.41	4.10	9.64	5.24	1.35	1.40	27.25
20.000	1.06	0.12	0.15	0.12	70.64	2.69	8.25	4.56	1.19	1.22	27.08
50.000	0.97	0.09	0.13	0.09	61.72	2.10	8.97	7.88	1.11	1.13	27.42
100.000	0.94	0.09	0.12	0.09	56.09	1.46	6.48	2.94	1.10	1.11	26.82
200.000	0.90	0.08	0.12	0.08	49.80	1.51	6.32	3.03	1.13	1.12	26.58
408.400	1.01	0.07	0.11	0.07	45.66	1.36	5.61	1.32	1.21	1.18	26.03
500.000	1.06	0.08	0.12	0.09	44.93	1.43	5.49	1.62	1.25	1.20	24.98
669.850	1.10	0.07	0.12	0.07	44.06	1.59	5.94	1.86	1.30	1.24	24.36
856.600	1.30	0.07	0.13	0.08	43.15	1.93	6.13	2.01	1.35	1.25	22.45
1000.000	1.39	0.05	0.11	0.07	44.52	3.69	8.35	2.97	1.37	1.24	20.59
1118.050	1.48	0.05	0.13	0.07	42.72	2.91	8.56	3.40	1.37	1.23	19.44
1250.000	1.37	0.06	0.13	0.06	42.75	2.61	10.05	4.95	1.36	1.22	19.15
1391.950	1.51	0.09	0.16	0.07	44.07	3.21	10.73	3.71	1.34	1.20	18.57
1578.700	1.47	0.05	0.15	0.05	40.41	2.62	9.61	3.27	1.31	1.16	17.15
1777.900	1.52	0.05	0.17	0.05	37.07	2.87	9.43	3.26	1.30	1.14	16.04
2002.000	1.66	0.12	0.20	0.08	34.27	3.55	9.08	1.82	1.30	1.16	13.88
2176.300	1.81	0.09	0.20	0.08	30.64	3.24	7.16	1.46	1.30	1.21	12.25
2363.050	1.82	0.07	0.19	0.04	26.86	2.95	5.63	1.07	1.28	1.28	9.41
2437.750	2.08	0.14	0.24	0.05	25.66	2.78	5.42	1.03	1.29	1.30	7.81
2500.000	2.14	0.16	0.25	0.05	25.03	2.28	5.15	1.27	1.30	1.31	7.10

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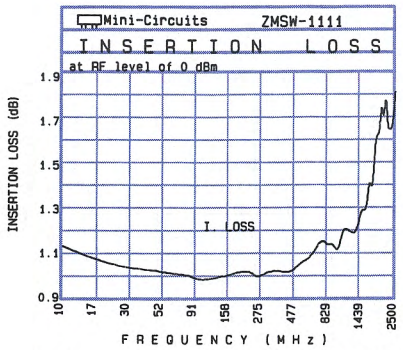
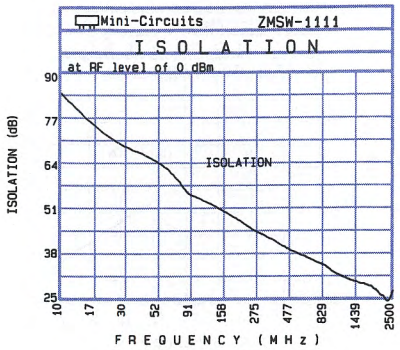
Mini-Circuits

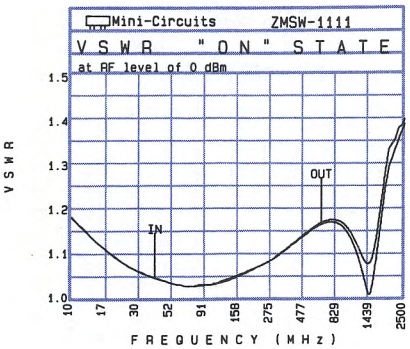
PSW-1111, ZMSW-1111

SPST

10 to 2500 MHz





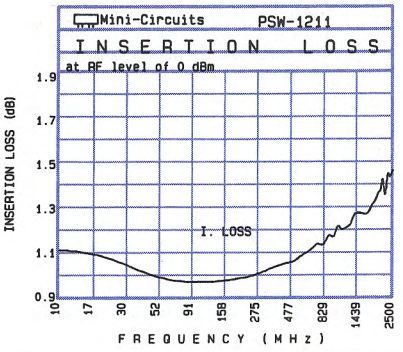


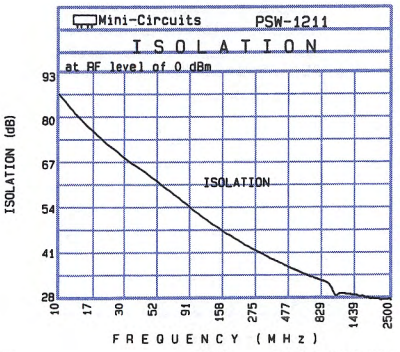
FREQ. (MHz)	ON (ctrl1 @ 5V) IN-OUT INSERTION LOSS (dB)		OFF (ctrl1 @ 0V) IN-OUT ISOLATION (dB)		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	x̄	x̄
10.000	1.29	0.11	76.25	6.59	1.20	1.21	30.07
22.450	1.19	0.10	70.93	4.23	1.10	1.10	30.07
97.150	1.07	0.07	58.52	1.61	1.05	1.05	27.77
159.400	1.08	0.05	52.73	1.00	1.07	1.07	25.87
377.275	1.09	0.06	43.44	0.67	1.13	1.14	19.20
520.450	1.14	0.05	40.30	0.80	1.17	1.17	15.71
595.150	1.16	0.06	39.39	0.70	1.18	1.19	14.22
813.025	1.21	0.06	36.87	0.68	1.20	1.20	11.58
1037.125	1.29	0.06	34.02	0.70	1.17	1.18	10.27
1180.300	1.30	0.06	32.88	0.61	1.13	1.15	10.35
1248.775	1.26	0.06	32.28	0.66	1.10	1.13	10.47
1255.000	1.27	0.06	32.32	0.69	1.10	1.13	10.50
1472.875	1.34	0.05	31.11	0.62	1.04	1.10	12.99
1696.975	1.43	0.07	30.68	0.62	1.12	1.17	23.96
1840.150	1.63	0.09	29.53	0.60	1.19	1.24	76.42
1914.850	1.61	0.08	29.66	0.67	1.22	1.28	429.47
2132.725	1.79	0.09	28.33	0.92	1.28	1.34	42.78
2350.600	1.67	0.07	26.88	1.15	1.36	1.37	205.26
2425.300	1.71	0.07	27.69	1.12	1.38	1.39	152.56
2500.000	1.79	0.09	28.69	1.09	1.40	1.40	62.42

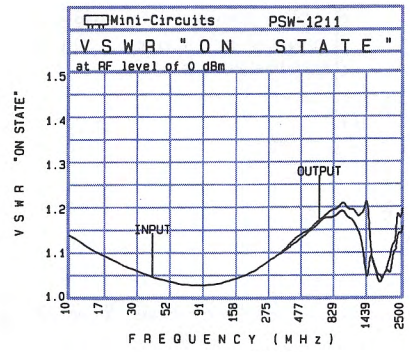
PSW-1211, ZMSW-1211

SPDT

10 to 2500 MHz





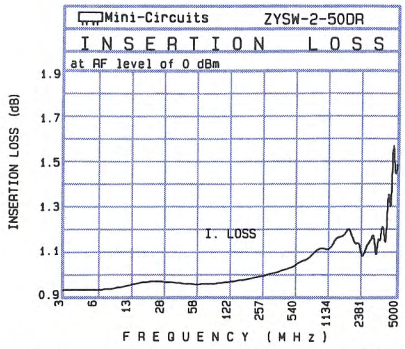


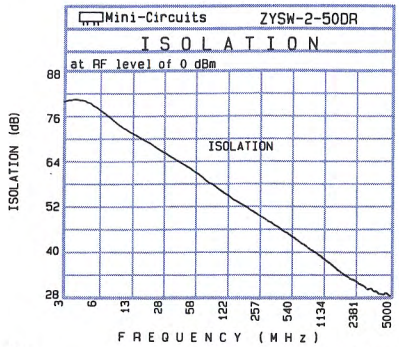
FREQ. (MHz)	ON (ctrl1 @ 5V) IN-OUT INSERTION LOSS (dB)		AMP. UNBAL.		OFF (ctrl1 @ 0V) IN-OUT ISOLATION (dB)		DELTA		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
10.000	1.29	0.19	0.13	0.12	88.14	5.32	5.52	5.48	1.20	1.20	27.17
20.000	1.22	0.14	0.09	0.06	80.95	3.49	5.99	5.45	1.12	1.12	25.49
50.000	1.10	0.10	0.07	0.06	66.03	2.18	0.79	0.77	1.06	1.06	26.18
100.000	1.07	0.09	0.07	0.06	56.13	2.48	0.63	1.00	1.05	1.04	24.91
200.000	1.08	0.09	0.06	0.05	47.23	1.83	0.65	0.71	1.07	1.07	24.71
409.450	1.15	0.08	0.07	0.05	40.05	1.43	0.45	0.39	1.15	1.15	23.36
500.000	1.16	0.08	0.06	0.04	38.02	1.28	0.50	0.28	1.17	1.18	22.80
672.450	1.22	0.08	0.06	0.04	35.50	1.05	0.49	0.36	1.21	1.22	21.45
863.730	1.29	0.08	0.06	0.04	33.51	0.92	0.71	0.29	1.23	1.24	19.28
1000.000	1.32	0.07	0.05	0.03	29.59	0.41	3.76	0.96	1.23	1.24	19.05
1126.730	1.30	0.08	0.06	0.05	30.50	0.46	2.81	0.52	1.22	1.25	17.59
1246.270	1.30	0.07	0.07	0.06	30.00	0.41	3.80	0.53	1.19	1.24	17.26
1389.730	1.67	0.09	0.41	0.09	29.58	0.43	1.32	1.45	1.08	1.28	15.74
1581.000	1.35	0.07	0.05	0.04	29.04	0.47	0.58	0.46	1.12	1.13	14.86
1772.270	1.39	0.08	0.05	0.05	27.59	0.59	1.64	0.77	1.08	1.09	13.60
1987.450	1.43	0.07	0.05	0.04	27.44	0.74	2.62	0.92	1.09	1.11	12.58
2178.730	1.42	0.08	0.06	0.04	27.34	0.87	3.10	1.03	1.12	1.14	14.41
2370.000	1.51	0.09	0.08	0.05	26.88	1.06	3.36	1.25	1.16	1.19	12.24
2441.730	1.51	0.08	0.07	0.04	27.35	1.15	3.49	1.39	1.16	1.20	10.69
2500.000	1.56	0.09	0.08	0.06	26.81	1.21	3.44	1.50	1.17	1.21	11.44

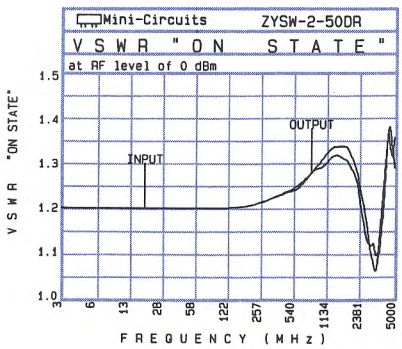
GaAs <5 nsec

SPDT Switches, with TTL driver

YSW-2-50DR, ZYSW-2-50DR, VSW-2-50DR reflective DC to 5 GHz

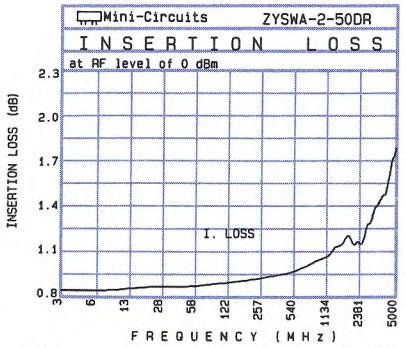


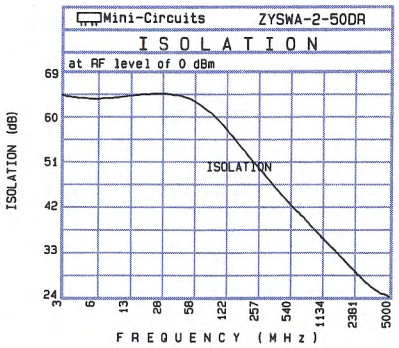


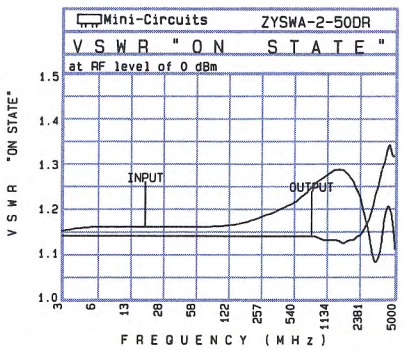


FREQ. (MHz)	ON (TTL LOW @ 0V) INSERTION LOSS (dB) IN-OUT		AMP. UNBAL.		OFF (TTL HIGH @ 5V) ISOLATION (dB) IN-OUT		DELTA		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
3.000	0.93	0.03	0.01	0.00	82.19	2.73	4.56	2.14	1.20	1.21	5.09
5.000	0.93	0.03	0.01	0.01	81.63	2.81	2.23	1.14	1.21	1.21	5.07
10.000	0.93	0.02	0.01	0.01	75.09	1.32	1.62	0.75	1.21	1.21	5.08
20.000	0.98	0.03	0.05	0.04	69.97	0.76	1.59	1.48	1.21	1.21	5.06
50.000	0.94	0.03	0.01	0.01	63.18	0.95	1.77	0.64	1.20	1.20	5.04
100.000	0.96	0.03	0.01	0.00	57.83	0.41	0.52	0.21	1.20	1.20	5.00
200.000	0.98	0.03	0.01	0.00	52.68	0.23	0.35	0.28	1.20	1.20	4.97
500.000	1.03	0.03	0.00	0.00	45.93	0.26	0.34	0.16	1.23	1.24	4.90
1000.000	1.11	0.03	0.01	0.01	40.28	0.28	0.34	0.14	1.29	1.29	5.01
1150.640	1.11	0.02	0.01	0.01	38.91	0.25	0.37	0.13	1.31	1.31	5.07
1724.450	1.24	0.01	0.03	0.02	34.88	0.27	0.32	0.09	1.33	1.33	5.43
2441.730	1.11	0.01	0.01	0.01	32.17	0.39	0.21	0.13	1.26	1.26	6.07
2561.270	1.17	0.03	0.02	0.02	31.99	0.39	0.14	0.12	1.24	1.23	6.23
2848.180	1.18	0.02	0.01	0.01	31.20	0.40	0.13	0.07	1.20	1.19	5.96
3135.090	1.19	0.09	0.04	0.04	30.98	0.42	0.15	0.17	1.14	1.13	6.12
3708.910	1.22	0.03	0.06	0.02	30.08	0.46	0.38	0.38	1.16	1.13	6.11
4282.730	1.38	0.10	0.11	0.02	28.98	0.46	0.82	0.28	1.33	1.32	6.05
4713.090	1.45	0.04	0.05	0.04	29.12	0.35	0.88	0.29	1.37	1.34	5.07
4856.550	1.51	0.04	0.06	0.04	28.90	0.33	0.84	0.25	1.36	1.39	5.02
5000.000	1.54	0.04	0.06	0.04	28.56	0.30	0.87	0.28	1.35	1.40	4.92

YSWA-2-50DR, ZYSWA-2-50DR, VSWA-2-50DR absorptive DC to 5 GHz







FREQ. (MHz)	ON (TTL LOW @ 0V) INSERTION LOSS (dB) IN-OUT		AMP. UNBAL.		OFF (TTL HIGH @ 5V) ISOLATION (dB) IN-OUT		DELTA		VSWR IN	VSWR OUT (RF 1) ON	VSWR OUT (RF 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
3.000	0.84	0.01	0.01	0.01	65.32	0.46	0.44	0.35	1.16	1.16	1.17
5.000	0.83	0.01	0.01	0.01	65.59	1.00	0.97	0.43	1.17	1.16	1.17
10.000	0.83	0.02	0.01	0.01	65.42	0.63	0.56	0.20	1.17	1.16	1.17
20.000	0.89	0.04	0.02	0.02	66.30	0.68	0.76	0.63	1.17	1.16	1.17
50.000	0.85	0.01	0.01	0.01	65.63	1.12	1.37	0.50	1.17	1.16	1.18
100.000	0.87	0.02	0.01	0.01	61.02	0.81	1.22	1.06	1.17	1.16	1.18
200.000	0.89	0.02	0.01	0.01	53.60	0.42	0.37	0.32	1.18	1.16	1.18
500.000	0.95	0.02	0.00	0.01	43.89	0.27	0.52	0.15	1.22	1.16	1.20
1000.000	1.05	0.02	0.01	0.01	37.39	0.23	0.62	0.12	1.28	1.15	1.23
1150.640	1.05	0.02	0.01	0.01	36.05	0.25	0.62	0.11	1.29	1.15	1.24
1724.450	1.22	0.02	0.04	0.02	32.34	0.30	0.73	0.08	1.29	1.14	1.26
2000.000	1.13	0.01	0.01	0.01	30.92	0.28	0.76	0.06	1.27	1.13	1.25
2441.730	1.17	0.01	0.01	0.01	29.06	0.27	0.69	0.11	1.22	1.15	1.22
2561.270	1.25	0.03	0.02	0.01	28.66	0.27	0.62	0.15	1.20	1.15	1.22
3135.090	1.42	0.05	0.06	0.00	26.96	0.30	0.23	0.14	1.11	1.21	1.15
3708.910	1.48	0.04	0.06	0.02	25.86	0.28	0.33	0.18	1.14	1.27	1.16
4282.730	1.58	0.06	0.12	0.04	25.02	0.36	0.41	0.23	1.23	1.33	1.24
4713.090	1.73	0.05	0.02	0.01	24.78	0.31	0.62	0.26	1.21	1.33	1.24
4856.550	1.80	0.05	0.03	0.02	24.69	0.32	0.65	0.26	1.18	1.34	1.25
5000.000	1.80	0.06	0.04	0.02	24.46	0.30	0.58	0.26	1.15	1.34	1.26

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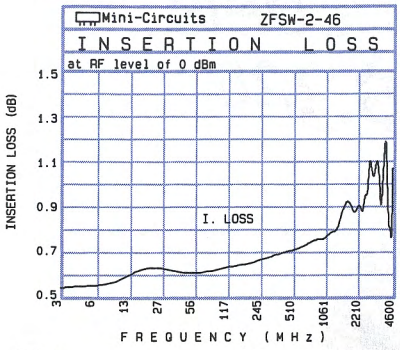
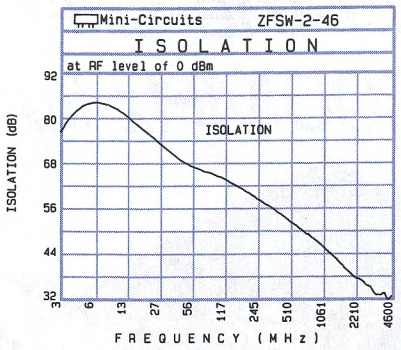
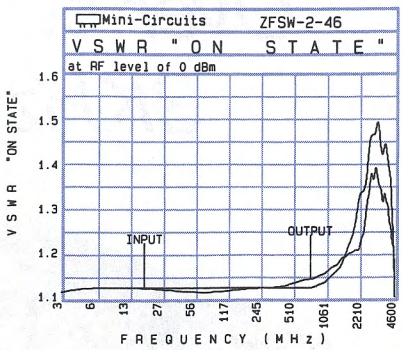
50 ohms without driver

Mini-Circuits

KSW-2-46, ZFSW-2-46 — reflective — DC to 4.6 GHz

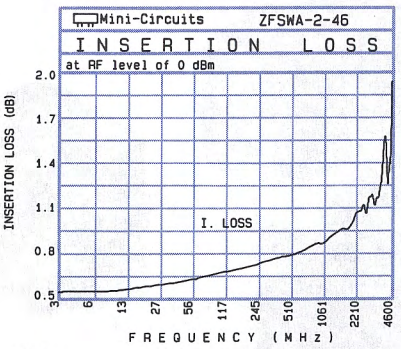


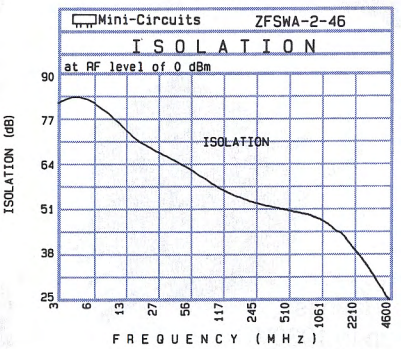


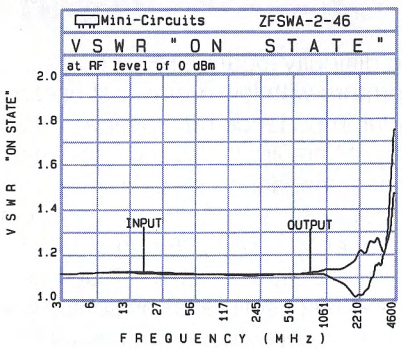


FREQ. (MHz)	ON INSERTION LOSS (dB) (ctrl1 @ -8V, ctrl2 @ 0V) IN-OUT		AMP. UNBAL.		OFF ISOLATION (dB) (ctrl1 @ 0V, ctrl2 @ -8V) IN-OUT		DELTA		VSWR IN	VSWR OUT (PORT 1) ON	VSWR OUT (PORT 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
3.000	0.54	0.04	0.00	0.01	83.44	4.68	4.17	4.43	1.12	1.12	16.46
5.000	0.54	0.04	0.00	0.01	83.46	2.97	4.24	2.92	1.12	1.12	16.21
10.000	0.54	0.04	0.00	0.01	81.44	2.66	3.62	2.10	1.12	1.12	16.21
20.000	0.61	0.06	0.02	0.01	76.29	2.13	3.54	2.62	1.12	1.12	16.04
50.000	0.59	0.04	0.02	0.01	69.27	0.92	2.97	0.57	1.12	1.12	15.37
100.000	0.62	0.04	0.01	0.01	66.59	1.42	1.47	1.27	1.12	1.12	14.63
200.000	0.65	0.04	0.02	0.01	61.43	0.74	0.97	0.52	1.12	1.12	14.00
500.000	0.70	0.04	0.02	0.01	53.61	0.93	0.41	0.55	1.13	1.13	12.83
911.550	0.75	0.04	0.01	0.01	47.64	0.59	0.37	0.25	1.14	1.15	11.86
1000.000	0.76	0.04	0.02	0.01	46.91	0.61	0.22	0.15	1.14	1.16	11.79
1581.000	0.92	0.05	0.01	0.02	41.27	0.47	0.12	0.08	1.22	1.20	11.85
2107.000	0.92	0.06	0.02	0.01	37.77	0.41	0.13	0.06	1.36	1.21	11.91
2370.000	0.88	0.06	0.02	0.02	37.33	0.42	0.21	0.11	1.37	1.26	9.64
2489.550	1.01	0.07	0.03	0.03	36.86	0.43	0.22	0.13	1.41	1.34	9.98
2752.550	1.17	0.09	0.03	0.03	35.65	0.39	0.29	0.16	1.51	1.42	9.70
3278.550	1.15	0.11	0.03	0.01	33.10	0.42	0.49	0.41	1.53	1.39	13.14
3804.550	1.16	0.08	0.05	0.05	33.46	0.37	0.50	0.31	1.50	1.35	13.37
4330.550	0.87	0.05	0.05	0.01	31.99	0.42	0.36	0.34	1.31	1.24	15.41
4474.000	0.70	0.04	0.07	0.02	32.16	0.40	0.35	0.34	1.23	1.23	17.84
4600.000	1.08	0.04	0.05	0.02	32.78	0.42	0.47	0.33	1.13	1.16	14.40

KSWA-2-46, ZFSWA-2-46 — absorptive — DC to 4.6 GHz







FREQ. (MHz)	ON INSERTION LOSS (dB) (ctrl1 @ -8V, ctrl2 @ 0V) IN-OUT		AMP. UNBAL.		OFF ISOLATION (dB) (ctrl1 @ 0V, ctrl2 @ -8V) IN-OUT		DELTA		VSWR IN	VSWR OUT (PORT 1) ON	VSWR OUT (PORT 1) OFF
	x̄	σ	x̄	σ	x̄	σ	x̄	σ	x̄	x̄	x̄
3.000	0.55	0.01	0.01	0.01	82.53	2.67	6.52	3.36	1.12	1.12	1.02
5.000	0.55	0.02	0.00	0.00	85.42	4.39	5.34	3.44	1.12	1.12	1.02
10.000	0.55	0.02	0.00	0.01	84.71	7.84	7.47	5.66	1.13	1.13	1.02
20.000	0.63	0.04	0.03	0.02	74.57	2.52	2.12	1.67	1.13	1.12	1.02
50.000	0.62	0.02	0.01	0.01	64.87	0.76	3.54	0.53	1.12	1.12	1.02
100.000	0.67	0.02	0.02	0.01	58.56	0.45	3.09	0.42	1.12	1.12	1.02
200.000	0.72	0.02	0.02	0.01	54.29	0.36	3.05	0.27	1.12	1.11	1.02
500.000	0.80	0.02	0.03	0.01	51.52	0.42	2.31	0.41	1.13	1.12	1.02
911.550	0.90	0.02	0.02	0.02	48.87	1.18	0.79	0.41	1.16	1.11	1.04
1000.000	0.90	0.03	0.03	0.02	48.56	1.23	0.63	0.38	1.17	1.10	1.05
1581.000	1.01	0.04	0.02	0.02	44.26	1.63	1.16	0.32	1.20	1.04	1.11
2107.000	1.10	0.03	0.02	0.02	39.70	1.28	0.84	0.43	1.30	1.09	1.14
2370.000	1.15	0.05	0.03	0.03	37.89	1.12	0.73	0.47	1.31	1.11	1.15
2489.550	1.26	0.06	0.03	0.03	37.25	0.97	0.65	0.57	1.32	1.14	1.17
2752.550	1.32	0.07	0.04	0.03	35.59	0.62	0.67	0.50	1.41	1.22	1.23
3278.550	1.26	0.04	0.05	0.03	31.74	1.06	0.54	0.53	1.44	1.35	1.29
3804.550	1.63	0.09	0.10	0.07	28.75	0.72	0.42	0.61	1.39	1.41	1.38
4330.550	1.52	0.06	0.10	0.04	25.75	0.41	0.71	0.70	1.49	1.78	1.65
4474.000	1.47	0.09	0.11	0.06	25.51	0.36	0.78	0.73	1.57	1.94	1.73
4600.000	1.98	0.06	0.09	0.05	25.42	0.32	0.84	0.83	1.55	1.87	1.67

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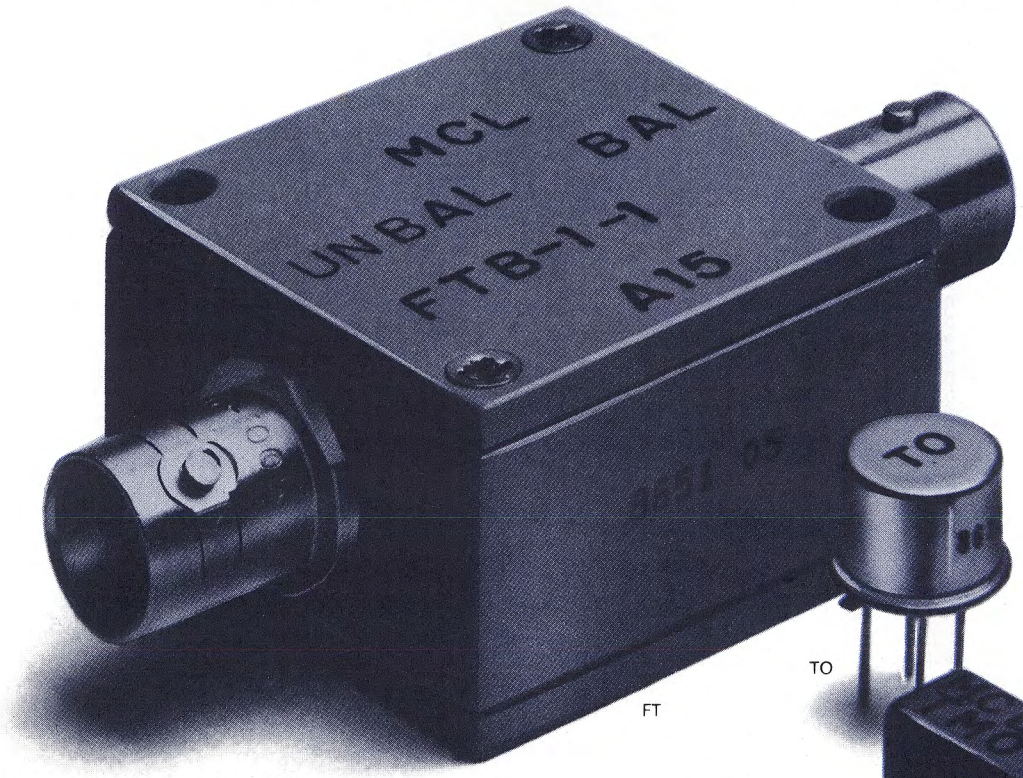

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TO

TMO

T, TH, TT

T, TH, TT
bent lead version
style KK81

T, TH, TT
bent lead version
style X 65

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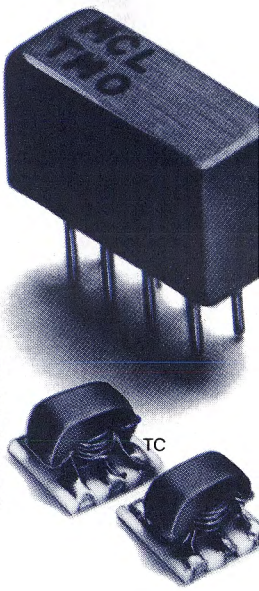
FTB1-6	5950-01-225-8773	TMO2.5-6	5950-01-215-4038
T1-1	5950-10-128-3745	TMO2.5-6T	5950-01-215-8697
T1-1T	5950-01-153-0668	TMO3-1T	5950-01-168-7512
T2-1	5950-01-106-1218	TMO4-1	5950-01-067-1012
T3-1T	5950-01-153-0298	TMO4-2	5950-01-091-3553
T4-1	5950-01-024-7626	TMO4-6	5950-01-132-8102
T9-1	5950-01-105-8153	TMO5-1T	5950-01-183-0779
T16-1	5950-01-094-7439	TMO9-1	5950-01-141-0174
TMO1-1	5950-01-178-2612	TMO16-1	5950-01-138-4593



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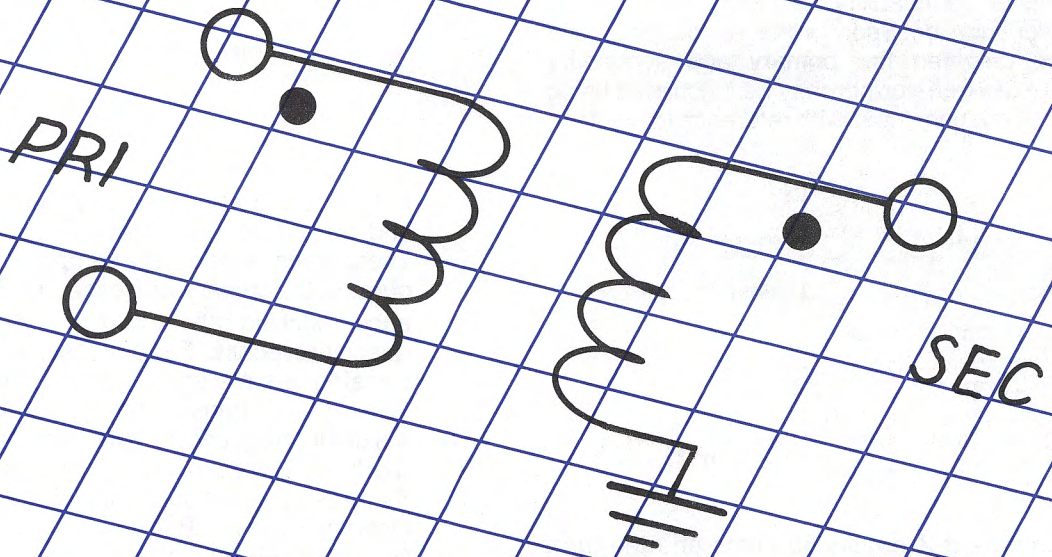
C71 REV. B

RF TRANSFORMERS



contents of this section

technical

introduction 14-2
definition of terms 14-3
most often asked questions 14-4
specifications check list
a guide form for requirements 14-5

product specifications

12.5 to 1800 ohm models 14-6, 14-7

computer data and curves

CAPD information . . . . . 14-8 thru 14-22

RF Transformers

RF transformers are widely used in low-power electronic circuits for impedance matching to achieve maximum power transfer, for voltage step-up or step-down, and for isolating dc from two circuits while maintaining ac continuity. They are also used for common mode rejection and as baluns.

Essentially, an RF transformer consists of two windings linked by a mutual magnetic field. When one winding, the primary has a ac voltage applied to it, a varying flux is developed; the amplitude of the flux is dependent on the applied voltage and number of turns in the winding. Mutual flux linked to the secondary winding induces a voltage whose amplitude depends on the number of turns in the secondary winding. By designing the number of turns in the primary and secondary windings, any desired step-up or step-down voltage ratio can be realized. Mutual coupling is accomplished simply with an air core but considerably more effective flux linkage is obtained with the use of a core of iron or ferromagnetic material with higher permeability than air.

The relationship between voltage, current, and impedance between the primary and secondary windings of the transformer may be calculated using the following relationships. With reference to Figure 1,

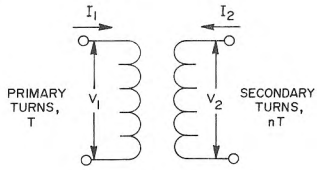


FIGURE 1

$$V_2 = nV_1$$

$$I_2 = I_1/n$$

$$Z_2 = \frac{V_2}{I_2} = \frac{nV_1}{I_1/n} = n^2\frac{V_1}{I_1} = n^2Z_1$$

thus $Z_2 = n^2Z_1$.

As an example, if Z equals 50 ohms and the turns ratio equals 2, the secondary impedance equals 200 ohms. In this case, the secondary voltage is twice the primary voltage and the secondary current is one-half the primary current.

The basic phase relationship between the RF signals at the transformer input and output ports may be in-phase, 0 degrees, or out-of-phase, 180 degrees. Conventionally, the ports that are in-phase 1 and 3 are marked by dot notation as shown in Figure 2. Ports 1, 4 and 2, 3 are out-of-phase, 180 degrees.

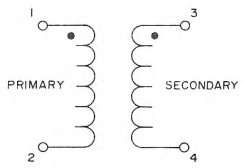


FIGURE 2

Mini-Circuits' transformers are physically assembled by winding a pair of twisted wires around a ferrite toroidal core. The ends of the primary and secondary wires which leave the same side of the toroid are in the in-phase ports. See Figure 3.

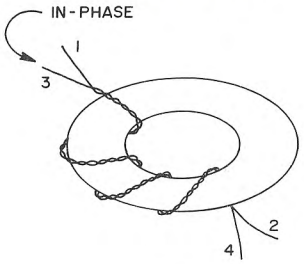


FIGURE 3

For transformers that have a secondary winding with a center-tap, the schematic representation and dot locations are shown in Figure 4.

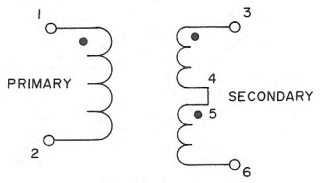
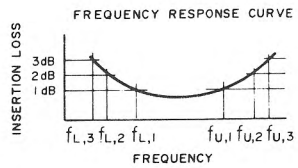


FIGURE 4

In this case ports 1 and 3 are in-phase, 0 degrees, and ports 1 and 6 are out-of-phase, 180 degrees. These transformers may be operated as low as 12.5 ohms at the primary with essentially the same impedance matching ratio and only a slight change in frequency response. For convenience, all Mini-Circuits transformers are specified as a step-up.

For each RF transformer model, the minimum and maximum frequency is given for the insertion loss at the 3 dB, 2 dB and 1 dB points, as shown in Figure 5 and listed in the data chart. For example, the T1-1 insertion loss is 1 dB from 2 to 50 MHz and 3 dB from 0.15 to 400 MHz.



Mini-Circuits offers various transformer package styles for assembly on a printed circuit board. These include:

(1) plastic-case T series, style X65, plug-in leads
(2) plastic-case T series, style W38, flat-pack leads
(3) plastic-case T series, style KK81, surface-mount gull wing leads

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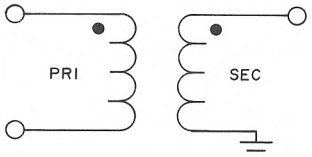
(4) metal-case TMO series, plug-in leads
(5) open construction TC series, surface-mount leadless

For these various types, the electrical configurations that are available are:

(A) DC isolated primary and secondary, center-tap secondary
(B) DC isolated primary and secondary, center-tap primary and secondary
(C) DC isolated primary and secondary
(D) unbalanced primary and secondary
(E) DC isolated primary and secondary, balanced primary and unbalanced secondary
(F) DC isolated, three open windings

Coaxial connector models are available from 5 KHz to 500 MHz and are offered with 50 ohm and 75 ohm impedances; 75 ohm connectors are used at 75 ohm ports. The FT1.5-1, with unbalanced input and output is especially useful for 50 ohm to 75 ohm matching applications. The FTB series with unbalanced output and balanced input (connector ground insulated from the case) helps eliminate ground loop problems, especially when long cable runs are involved.



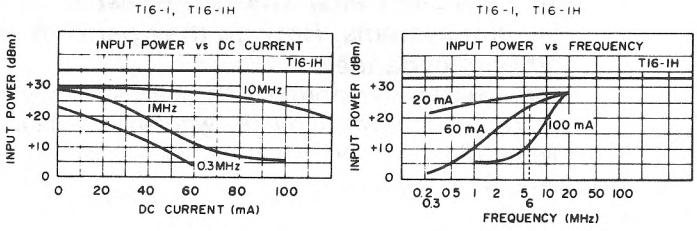
In some applications there is a need to pass a relatively high DC current through the primary winding. In this case, the transformer core may saturate resulting in reduced transformer bandwidth and power handling capability. Mini-Circuits TH series of transformers are designed to handle up to 100 mA in the primary winding without appreciable saturation and change in RF characteristics.

Transformer core saturation is influenced by (1) DC current through the winding, (2) RF input power, and (3) frequency of operation. These three variables interact to affect the point at which saturation occurs. See Figures 7 and 8 in which conventional transformer saturation is compared to the TH series.

Mini-Circuits has developed many special transformer impedance ratios and configurations where high DC current is passed through one winding of the transformer. Many of these designs have been for open package surface-mount requirements. Consult our Applications Department for your particular needs.

performance saturation curves T, TH series

(RF power & DC current at which signal saturation begins)



modern definition of terms

amplitude balance
is a measure of the absolute difference in signal amplitude between each output of a center-tapped transformer relative to the center-tap.

phase balance
is a measure of the difference in signal phase between each output of a center-tapped transformer relative to the center-tap.

insertion loss
is the amount of power lost through the transformer under matched conditions.

balun
is a transformer that has a balanced input, where both ports are isolated from ground, to an unbalanced output where one side is connected to ground.

autotransformer
is a transformer where the secondary winding also comprises a portion of the primary winding.

1 dB bandwidth
is the frequency range over which insertion loss is less than 1dB referenced to the midband insertion loss.

most often asked questions about transformers

Q: *Explain the difference between DC-isolated and non-isolated transformers.*

A: A DC-isolated transformer is one that does not allow a DC current to pass between the primary and secondary windings.

Q: *Mini-Circuits transformers are tested with 50-ohm systems. How do they perform at other impedance?*

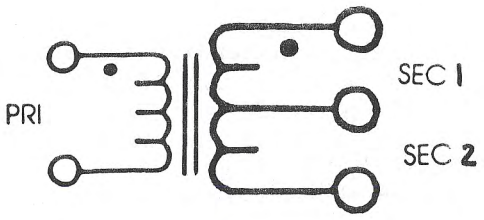
A: Mini-Circuits' transformers can be used over a wide range of impedance ranges with an impedance as low as 12.5 ohms with a only small change in the bandwidth.

Q: *Are Mini-Circuits' transformers step-up or step-down?*

A: All Mini-Circuits transformers are specified as step-up transformers. However, they are tested both ways and may be used as a step-up or a step-down.

Q: *Can I just use one side of a center-tapped transformer?*

A: Yes. You may use one side of the transformer but you should remember you will obtain only one-fourth of the impedance ratio.



Q: *Can Mini-Circuits supply MIL-tested transformers?*

A: Yes, Mini-Circuits' hermetically-sealed TMO transformers meet military needs. Please submit your environmental requirements to Mini-Circuits for review.

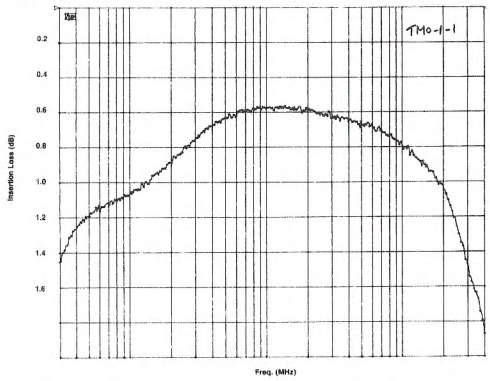
Q: *What are the effects of temperature extremes on Mini-Circuits transformers?*

A: The permeability of the core is influenced by temperature. As the temperature decreases, there is a change in the permeability causing an increase in the insertion loss at low frequency.

As temperature increases, the permeability increases thereby slightly decreasing insertion loss at low frequency. This is true, however, as long as the temperature does not increase above the Curie temperature of the core. Mini-Circuits' designs use cores that have a Curie temperature much higher than the highest specified operating temperature.

Q: *Explain the reasons for low-end and high-end losses of a transformer.*

A: The general curve for a transformer vs. insertion loss is shown below.



The low-end loss is heavily influenced by the primary inductance while the high-end loss is attributed to the interwinding capacitance and series inductance.

Q: *How do I measure the insertion loss of a transformer?*

A: The insertion loss is measured on two transformers connected back-to-back (impedance matched) and dividing the resulting insertion loss by two.

Q: *Can I build a power splitter with Mini-Circuits' transformers?*

A: You can use the Mini-Circuits' T2-1T, to create a 50- ohm, 180 degree power splitter.

The isolation between output ports and the output return loss of each port will not be as good as a Mini-Circuits' standard power splitter.

Q: *What are the breakdown voltage ratings of Mini- Circuits' transformers?*

A: Mini-Circuits does not typically specify a breakdown voltage. However, many of our transformers are able to handle up to 1000 VRMS. Please contact the factory about the transformer of your choice.

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Mini-Circuits

SPECIFICATIONS CHECKLIST

Transformers

If your particular requirements are not met with a Mini-Circuits catalog item, please complete the check list below and mail, phone, or fax it to Mini-Circuits, Applications Engineering.

Please indicate: Critical Parameter ✔✔
Important Parameter ✔

Application:

☐ Industrial/Commercial
☐ Military ☐ Space

Electrical:

Frequency range _____ MHz
Schematic ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F
Impedence
Primary ____ ohms, Secondary ____ ohms
VSWR or return loss (dB)
Primary _____ Secondary _____
Bandwidth
1 dB _____ MHz to _____ MHz
2 dB _____ MHz to _____ MHz
3 dB _____ MHz to _____ MHz
Amplitude unbalance _____ dB
Phase unbalance _____ deg.
DC current through windings
Primary _____ mA, Secondary _____ mA
Through center tap?
Primary ☐ Yes ☐ No Secondary ☐ Yes ☐ No
Insulation Resistance
Primary to secondary _____ ohms
Dielectric withstanding voltage _____ V.
☐ DC ☐ AC
Operating temperature _____ °C

Schematic

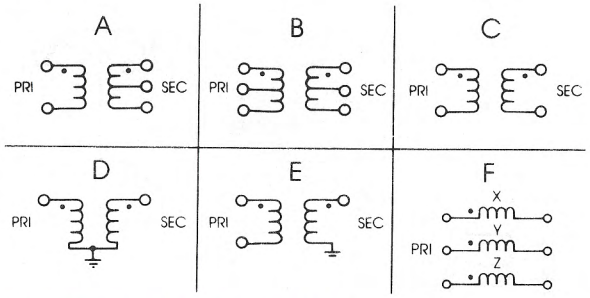

Diagram of application:

Mechanical:

Standard case style _____ *(for outline drawings see Table of Contents. Non-standard case, complete list below).*

Special Requirements: _____

PC Board Mounting

☐ Plug-in ☐ Flat pack
☐ Surface-mount

Coaxial Connector
(Specify connector for input & output separately)

☐ BNC ☐ TNC ☐ Isolated female BNC
☐ SMA ☐ Type N ☐ Other

Name _____ Title _____
Company _____ Dept. _____
Company address _____
Phone _____ Fax _____

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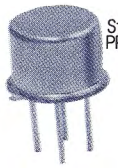
wideband

RF Transformers

3 KHz to 800 MHz

case style selection

outline drawings see Table of Contents


Style PP94


Style X65


Standard W38

T, TH, TT


Style KK81

		MODEL NO.	Ω RATIO	FREQUENCY MHz	INSERTION LOSS▲ 3db MHz	2db MHz	1db MHz	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
A*	T	T1-1T	1	.05-200	.05-200	.08-150	.2-80	4.45	●	●
		T1-6T	1	.015-300	.015-300	.021-150	.03-50	6.95	●	●
		T2-1T	2	.07-200	.07-200	.1-100	.5-50	4.95	●	●
		T2.5-6T	2.5	.01-100	.01-100	.02-50	.50-20	4.95	●	●
		T3-1T	3	.05-250	.05-200	.1-200	.5-70	4.95	●	●
		T4-1	4	.2-350	.2-350	.35-300	2-100	3.25	●	●
		T4-6T	4	.02-250	.02-250	.05-150	0.1-100	4.45	●	●
		T5-1T	5	.3-300	.3-300	.6-200	5-100	4.95	●	●
		T8-1T	8	**.3-140**	**.3-140**	**.7-90**	1-60	7.95	●	●
		T13-1T	13	.3-120	.3-120	.7-80	5-20	4.95	●	●
		T16-6T	16	.03-75	.03-75	.06-30	.1-20	5.65	●	●
	TH	T4-1H	4	10-350	10-350	15-300	25-200	5.95	●	●
	TMO	TMO1-1T	1	.05-200	.05-200	.08-150	.2-80	7.95	●	●
		TMO2-1T	2	.07-200	.07-200	.1-100	.5-50	8.45	●	●
		†TMO2.5-6T	2.5	.01-100	.01-100	.02-50	.05-20	8.45	●	●
		†TMO3-1T	3	.05-250	.05-250	.1-200	.5-70	7.95	●	●
		TMO4-1	4	.2-350	.2-350	.35-300	2-100	6.25	●	●
		TMO5-1T	5	.3-300	.3-300	.6-200	5-100	8.45	●	●
		TMO13-1T	13	.3-120	.3-120	.7-80	5-20	8.45	●	●
B*	TT	TT1-6	1	.004-500	.004-500	.02-200	.1-50	6.95	●	●
		TT1.5-1	1.5	.075-500	.075-500	.2-100	1-50	5.95	●	●
		TT2.5-6	2.5	.01-50	.01-50	.025-25	.05-10	6.45	●	●
		TT4-1	3	.05-200	.05-200	.2-50	1-30	5.95	●	●
		TT4-1A	4	0.1-300	0.1-300	0.2-250	0.3-180	6.95	●	●
		TT16-1	16	0.1-45	0.1-45	0.14-35	1-20	9.95	●	●
		TT25-1	25	.02-30	.02-30	.05-20	.1-10	9.95	●	●
	†TTMO	TTMO25-1	25	.02-30	.02-30	.05-20	.1-10	11.95	●	●
		TTMO1-1	1	.005-100	.005-100	.01-75	.05-40	11.45	●	●
		TTMO4-1A	4	0.1-300	0.1-300	0.2-250	0.3-180	13.95	●	●
C	T	T1-1	1	.15-400	.15-400	.35-200	2-50	3.25	●	●
		T1.18-3	1.18	0.01-250	0.01-250	0.02-200	0.03-50	5.65	●	●
		T1-6	1	.01-150	.01-150	.02-100	.05-50	5.65	●	●
		T1.5-1	1.5	.1-300	.1-300	.2-150	.5-80	4.45	●	●
		T1.5-6	1.5	.02-100	.02-100	.05-50	0.1-25	5.65	●	●
		T2.5-6	2.5	.01-100	.01-100	.02-50	.05-20	4.45	●	●
		T4-6	4	.02-200	.02-200	.05-150	.1-100	4.45	●	●
		T9-1	9	.15-200	.15-200	.3-150	2-40	3.95	●	●
		T16-1	16	.3-120	.3-120	.7-80	5-20	4.45	●	●
		T36-1	36	.03-20	.03-20	.05-10	.1-5	6.95	●	●
	TO	TO-75	1	10-500	—	10-500	40-250	6.95	●	●
	TH	T1-1H	1	8-300	8-300	10-200	25-100	5.95	●	●
		T9-1H	9	2-90	2-90	3-75	6-50	6.45	●	●
		T16-1H	16	7-85	7-85	10-65	15-40	6.45	●	●
	TMO	●TMO1-02	1	1-800	1-800	2-500	—	9.45	●	●
		TMO1-1	1	.15-400	.15-400	.35-200	2-50	6.25	●	●
		TMO1.5-1	1.5	.1-300	.1-300	.2-150	.5-8	8.45	●	●
		†TMO2.5-6	2.5	.01-100	.01-100	.02-50	.05-20	7.95	●	●
		†TMO4-6	4	.02-200	.02-200	.05-150	.1-100	7.95	●	●
		TMO6-1	6	.3-200	.3-200	.5-150	5-50	7.95	●	●
		TMO9-1	9	.15-200	.15-200	.3-150	2-40	7.95	●	●
		TMO16-1	16	.3-120	.3-120	.7-80	5-20	7.95	●	●

NOTES:

▲ Insertion loss referenced to mid-band loss. TMO: Case A11 except

† TMO, TTMO: Case A03

■ Denotes 75 ohm models, For coax connectors, 75 ohm BNC is standard.

1. For quality control procedures and environmental specifications, absolute maximum ratings see section 0 article. For T, TT, and TH series operating temperature, Temperature range is −20°C to +85°C.
2. Absolute maximum ratings; RF power 250 mW, DC current 30 mA.
3. For connector types and case mounting options, see case style outline drawing.
4. Prices and specifications subject to change without notice.

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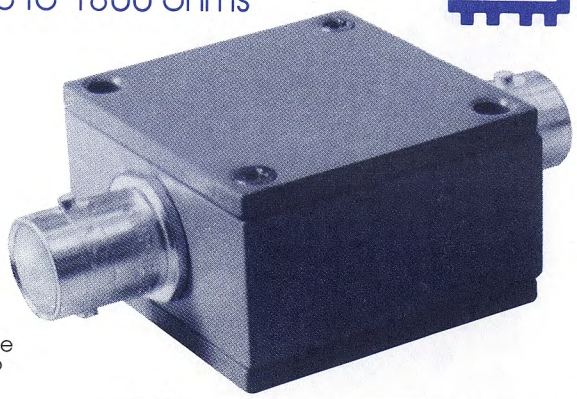
12.5 to 1800 ohms

Mini-Circuits



Style H16

FT, FTB



Style A11
†Style A03

TMO, TTMO

case style number see opposite page		MODEL NO.	Ω RATIO	FREQUENCY MHz	INSERTION LOSS▲ 3db MHz	2db MHz	1db MHz	PRICE $ Qty. (1-9)	DISTRIBUTOR FACTORY	DISTRIBUTOR LOCAL
D	T	T2-1	2	.050-600	.050-600	.1-400	.5-200	3.95	●	●
		T3-1	3	.5-800	.5-800	2-400	—	4.45	●	●
		T4-2	4	.2-600	.2-600	.5-500	2-250	3.95	●	●
		T8-1	8	.15-250	.15-250	.25-200	2-100	3.95	●	●
		T14-1	14	.2-150	.2-150	.5-100	2-50	4.95	●	●
	TMO	TMO2-1	2	.050-600	.050-600	.1-400	.5-200	7.95	●	●
		TMO3-1	3	.5-800	.5-800	2-400	—	8.45	●	●
		TMO4-2	4	.2-600	.2-600	.5-500	2-250	7.95	●	●
		TMO8-1	8	.15-250	.15-250	.25-200	2-100	7.95	●	●
		TMO14-1	14	.2-150	.2-150	.5-100	2-50	8.45	●	●
	FT	FT1.22-1	1.22	.005-100	.005-100	.01-50	.05-25	35.95	●	●
		FT1.5-1	1.5	.1-400	.1-400	5-200	1-100	35.95	●	●
E	FTB	FTB1-1	1	.2-500	.2-500	.5-300	1-100	36.95	●	●
		FTB1-6	1	.01-125	.01-125	.05-50	.1-25	36.95	●	●
		■ FTB1-1-75	1	.5-500	.5-500	5-300	10-100	36.95	●	●
F	T	T-622	1:1:1	0.1-200	0.1-200	0.5-100	5-80	3.25	●	●
		T-626	1:1:1	0.01-10	0.01-10	0.2-5	.04-2	3.95	●	●
		T2-613-1	1:1:2	0.07-200	0.07-200	0.1-100	0.5-50	1.95	●	●

* FOR A AND B CONFIGURATIONS

Typical Amplitude Unbalance
0.1 dB over 1 dB frequency range
0.5 dB over entire frequency range

Typical Phase Unbalance
1.0° over 1 dB frequency range
5.0° over entire frequency range

NSN GUIDE

MCL NO.	NSN
FTB1-1-75	5950-01-132-8034
FTB1-6	5950-01-225-8773
FT1.5-1	5950-01-325-4685
T1-1	5950-01-128-3745
T1-1-KK81	5950-01-347-0310
T1-1-X65	5950-01-327-5916
T2-1	5950-01-106-1218
T4-1	5950-01-024-7626

MCL NO.	NSN
T9-1	5950-01-105-8153
T16-1	5950-01-094-7439
T16-1-X65	5950-01-272-2297
T1-1T	5950-01-153-0668
T1-1T-X65	5950-01-340-7040
T1-6T	5950-01-256-2173
T2-1T-KK81	5950-01-347-0311
T3-1T	5950-01-153-0298

MCL NO.	NSN
T16-6T	5950-01-336-0939
T4-1H-X65	5950-01-328-8975
TT1-6-X65	5950-01-272-2298
TT4-1A	5950-01-331-7777
TMO1-1	5950-01-213-3735
TMO-1-1T	5950-01-326-2772
TMO2-1	5950-01-183-6414
TMO2.5-6	5950-01-215-4038

MCL NO.	NSN
TMO2.5-6T	5950-01-215-8697
TMO3-1T	5950-01-168-7512
TMO4-1	5950-01-067-1012
TMO4-2	5950-01-091-3553
TMO4-6	5950-01-132-8102
TMO5-1T	5950-01-183-0779
TMO9-1	5950-01-141-0174
TMO-13-1T	5950-01-168-7512
TMO16-1	5950-01-138-4593

pin connections see case style outline drawings.

CONFIGURATION CODE	*A		*B		C,E			D		F
CONFIGURATION	DC Isolated Center-Tap Secondary		DC Isolated Center-Tap Primary, Secondary		DC Isolated			Unbalanced Primary, Secondary		Windings Open**
Series	T, TH	TMO	TT	TTMO	T, TH	TO	TMO*	T	TMO	T
Primary DOT	4	1	4	1	4	1	1	6	1	X1 Y2 Z3
Primary	6	5	6	5	6	2	5	3◇	6◇◇	X6 Y5 Z4
Primary CT	—	—	5	3	—	—	—	—	—	
Secondary DOT	3	2	3	2	3	4	2	1	2	
Secondary	1	6	1	6	1	3	6	3◇	6◇◇	
Secondary CT	2	4	2	4	—	—	—	—	—	
Case Gnd.	—	7,8	—	7,8	—	—	7,8	—	7,8	

◇pin 3 must be grounded
◇◇pin 6 must be grounded

*For the TMO1-02 Primary: Pin 3 Primary Dot: Pin 1, Secondary: Pin 4. Secondary Dot: Pin 2. Pins 5, 6, 7, 8 not used.
**For the T2-613-1 Primary: X2, Y6, Z4. Primary Dot: X1, Y5, Z3.

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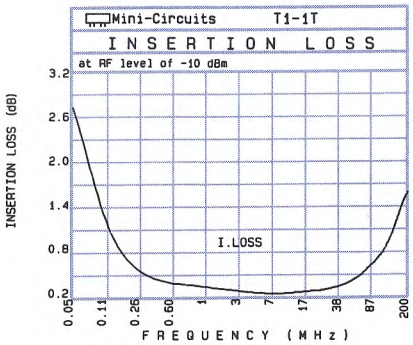
wideband
RF Transformers

Configuration A



T1-1T

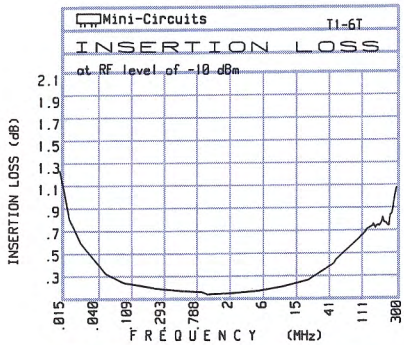
.05 TO 200 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.050	2.78	1.64
0.080	1.18	4.39
0.200	0.52	9.45
0.501	0.38	16.31
0.995	0.36	19.67
80.000	0.64	9.96
99.326	0.76	8.80
150.000	1.23	5.83
192.510	1.60	4.60
200.000	1.63	4.55

T1-6T

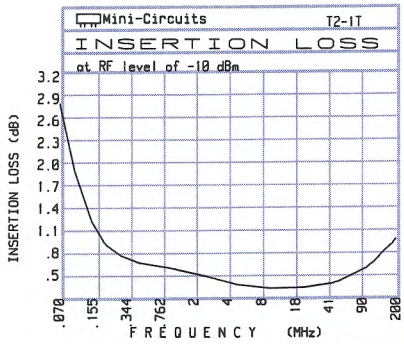
0.015 TO 300 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.015	1.24	11.77
.125	.21	26.45
1.153	.12	37.26
47.474	.40	19.27
111.989	.66	14.92
147.833	.74	14.64
175.753	.75	15.08
209.750	.77	16.64
250.250	.84	20.06
300.000	1.09	26.64

T2-1T

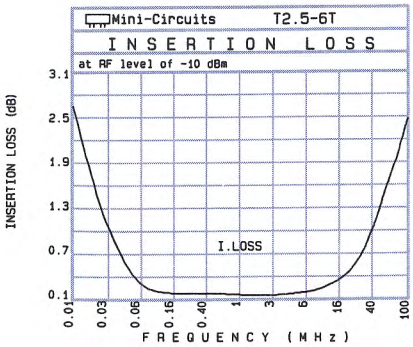
.07 TO 200 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.070	2.88	6.15
.201	.99	12.88
1.007	.64	17.80
10.025	.37	20.78
45.277	.44	19.59
108.526	.69	14.56
125.317	.76	13.17
142.439	.84	11.75
173.682	.95	9.47
200.000	1.04	7.77

T2.5-6T

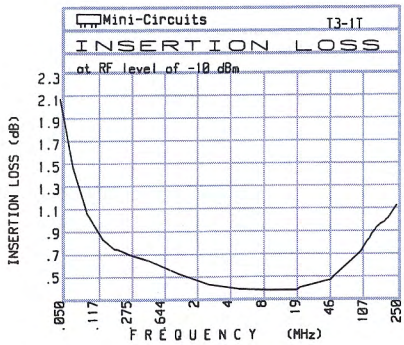
.01 TO 100 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	2.71	1.70
0.020	1.14	4.46
0.050	0.31	10.63
0.099	0.18	16.39
0.500	0.18	26.01
20.000	0.48	10.09
50.000	1.47	4.52
53.667	1.60	4.19
95.264	2.52	2.82
100.000	2.55	2.87

T3-1T

.05 TO 250 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.050	2.16	6.33
.201	.80	15.33
.468	.70	18.27
10.025	.43	24.05
45.277	.52	21.10
108.526	.83	13.49
125.317	.90	11.82
149.288	1.00	9.69
173.682	1.04	8.00
250.000	1.20	5.00

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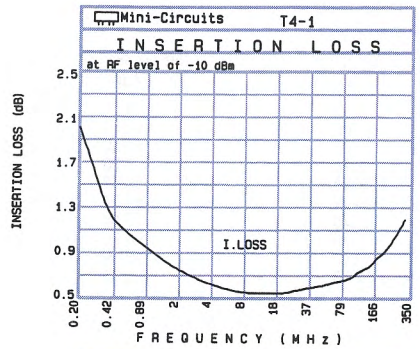
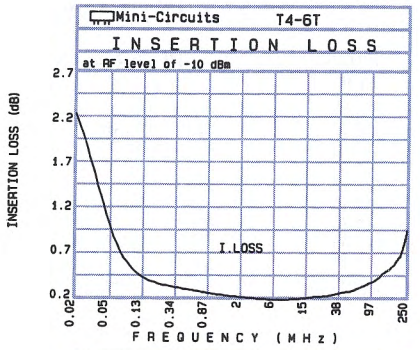


T4-1

.2 TO 350 MHz

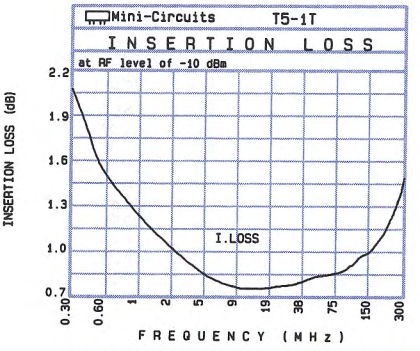
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.200	2.06	3.31
0.350	1.33	7.01
0.500	1.13	9.36
1.000	0.92	12.67
2.000	0.72	15.24
5.000	0.59	17.34
100.000	0.73	15.07
175.100	0.91	12.93
300.000	1.23	12.36
350.000	1.34	13.08



T4-6T

.02 TO 250 MHz

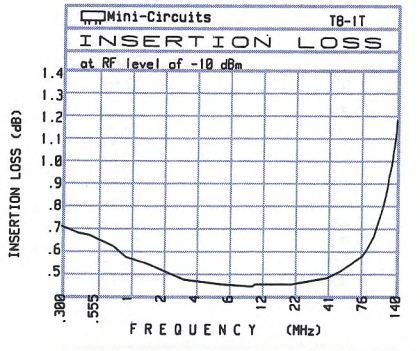
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.020	2.30	3.08
0.050	0.89	5.47
0.100	0.48	9.35
0.200	0.36	15.86
0.500	0.31	20.74
1.000	0.26	23.39
100.000	0.42	14.83
125.010	0.50	14.73
150.000	0.55	15.23
250.000	0.99	15.91



T5-1T

.3 TO 300 MHz

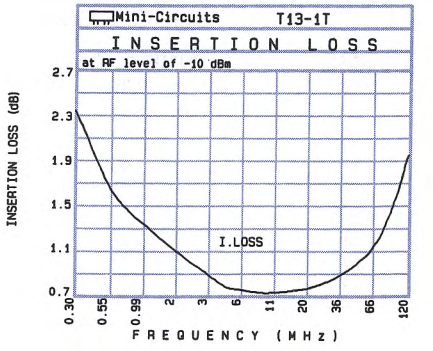
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.300	2.12	4.31
0.500	1.65	7.08
0.600	1.53	7.92
1.000	1.31	9.74
2.000	1.05	11.22
5.000	0.81	14.48
100.000	0.93	15.65
144.980	1.01	15.62
200.000	1.14	15.49
300.000	1.52	13.11



T8-1T

.3 TO 140 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.300	.66	15.02
.784	.57	16.74
2.874	.42	18.05
10.535	.40	17.12
49.743	.46	8.63
81.069	.56	5.31
97.981	.67	4.11
114.257	.80	3.35
126.986	.94	2.87
140.000	1.15	2.40



T13-1T

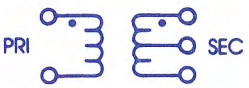
.3 TO 120 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.300	2.39	3.34
0.501	1.75	5.79
0.700	1.53	7.36
2.010	1.04	11.63
5.000	0.78	16.07
20.000	0.78	14.77
57.878	1.09	8.61
80.000	1.36	6.71
114.770	1.96	4.44
120.000	2.00	4.34

wideband

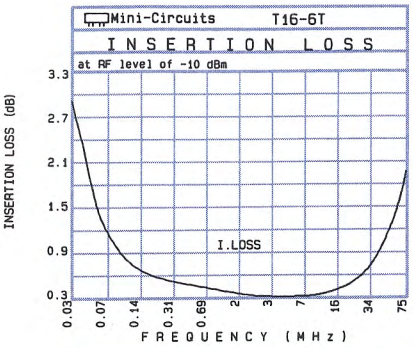
RF Transformers

Configuration A



T16-6T

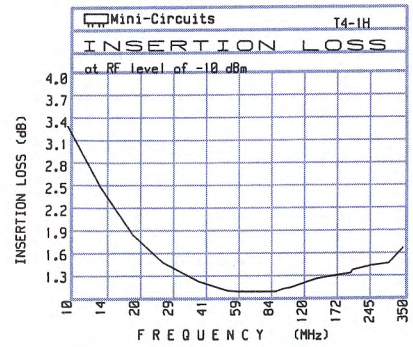
.03 TO 75 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.030	2.98	1.55
0.050	1.66	3.37
0.060	1.33	4.30
0.100	0.78	7.70
0.201	0.56	12.89
20.000	0.49	11.81
30.000	0.70	8.64
38.744	0.90	6.92
72.335	1.93	3.49
75.000	2.03	3.32

T4-1H

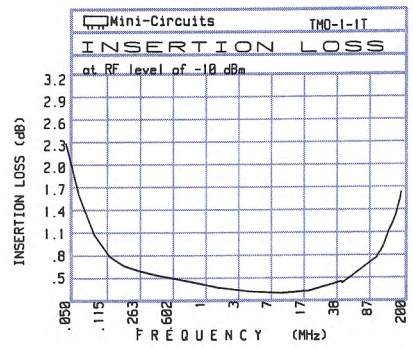
10 TO 350 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
10.000	3.33	4.05
20.000	1.85	8.95
40.311	1.22	16.05
54.149	1.10	18.56
90.756	1.09	15.02
99.524	1.13	13.84
138.711	1.26	9.87
200.594	1.34	6.03
250.289	1.44	4.15
350.000	1.68	2.29

TMO-1-1T

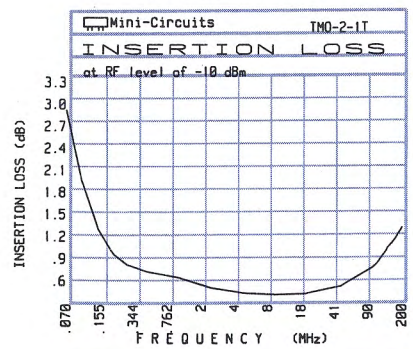
.05 TO 200 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.050	2.30	5.27
.149	.76	12.39
.468	.51	19.78
4.663	.29	27.23
45.277	.43	18.89
100.506	.72	12.67
125.317	.88	10.94
142.439	1.06	9.93
173.682	1.32	8.40
200.000	1.64	7.32

TMO-2-1T

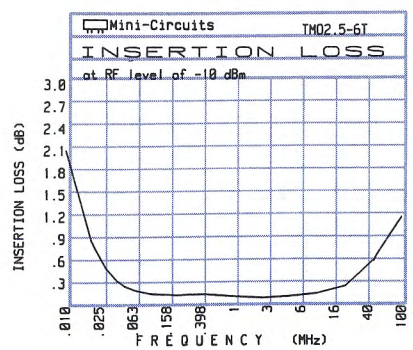
.07 TO 200 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.070	2.89	4.80
.201	.99	11.79
1.007	.62	18.05
10.025	.39	20.81
45.277	.50	20.35
108.526	.80	17.28
125.317	.91	16.24
142.439	1.02	15.20
173.682	1.16	13.29
200.000	1.30	11.75

TMO2.5-6T

.01 TO 100 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.010	2.16	6.47
.030	.56	14.16
.047	.34	17.71
.101	.21	24.25
.201	.19	29.71
.468	.20	34.17
2.168	.15	33.65
20.125	.30	21.48
45.277	.65	14.84
100.000	1.25	7.02

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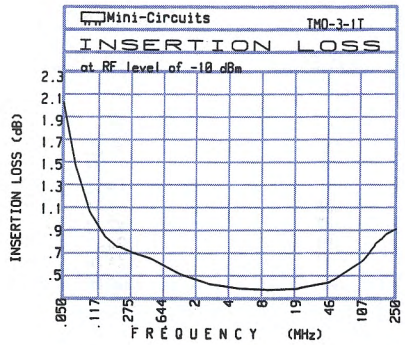
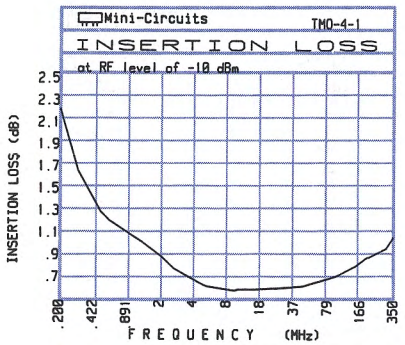


TMO-3-1T

.05 TO 250 MHz

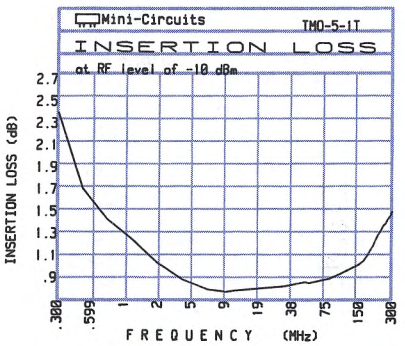
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.050	2.12	6.80
.201	.81	15.48
.468	.71	18.20
10.025	.43	23.28
45.277	.50	21.93
108.526	.70	15.96
125.317	.76	14.37
149.288	.85	12.26
173.682	.89	10.40
250.000	.98	7.10



TMO-4-1

.2 TO 350 MHz

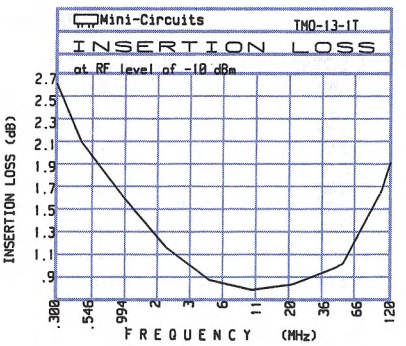
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.200	2.20	7.00
.610	1.19	13.99
1.266	1.00	16.82
5.034	.61	22.86
10.039	.56	24.46
22.534	.58	22.32
45.833	.60	17.98
100.873	.70	11.84
193.382	.86	6.33
350.000	1.04	2.27



TMO-5-1T

.3 TO 300 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.300	2.36	7.17
1.420	1.21	13.79
6.716	.76	17.23
18.929	.77	16.75
53.348	.82	13.20
150.356	.99	6.60
188.201	1.11	5.13
223.677	1.26	4.13
261.289	1.36	3.25
300.000	1.47	2.63



TMO-13-1T

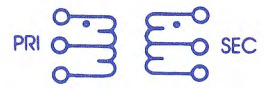
.3 TO 120 MHz

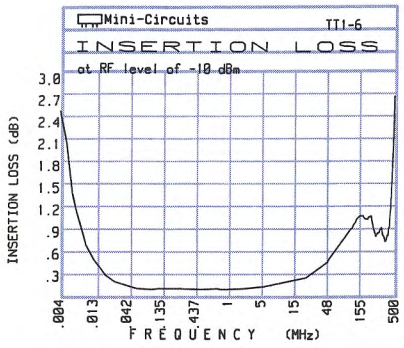
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.300	2.63	6.95
1.007	1.59	11.16
2.168	1.14	13.24
10.025	.76	14.21
20.125	.81	11.28
45.277	.97	6.32
46.549	.98	6.21
100.506	1.65	2.51
108.526	1.77	2.25
120.000	1.92	1.97

wideband

RF Transformers

Configuration B

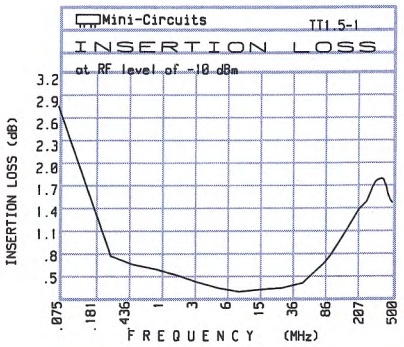




TT1-6

.004 to 500 MHz

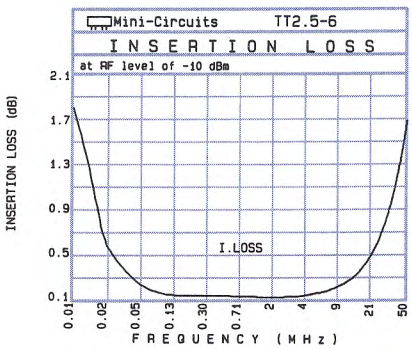
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.004	2.53	4.71
.020	.29	15.34
1.153	.10	37.84
100.858	.89	10.71
151.507	1.10	9.32
200.000	1.08	9.41
280.250	.87	12.74
350.000	.81	24.39
430.250	1.11	11.24
500.000	2.74	6.16



TT1.5-1

.075 to 500 MHz

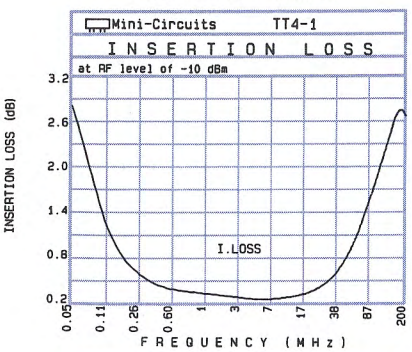
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.075	2.88	4.70
.913	.67	19.36
4.936	.41	23.51
19.837	.40	23.36
81.211	.75	16.19
201.509	1.47	8.72
297.468	1.80	5.38
351.506	1.89	4.13
439.125	1.70	2.79
500.000	1.57	2.35



TT2.5-6

.01 to 50 MHz

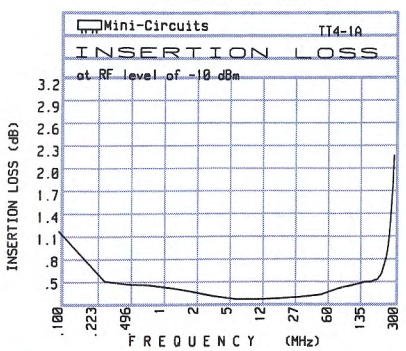
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	1.85	2.83
0.020	0.74	6.20
0.025	0.52	7.77
0.050	0.22	12.98
0.100	0.15	19.05
10.000	0.26	14.59
25.000	0.67	8.03
25.890	0.71	7.73
48.082	1.65	3.91
50.000	1.74	3.73



TT4-1

.05 to 200 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.050	2.88	1.46
0.100	1.29	4.13
0.200	0.58	8.81
0.501	0.39	15.77
1.000	0.36	19.03
30.000	0.51	11.31
50.000	0.91	7.28
100.860	1.96	3.92
195.150	2.78	3.87
200.000	2.76	4.08



TT4-1A

0.1 to 300 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	1.17	10.70
.846	.44	23.68
4.001	.29	30.12
18.929	.26	27.31
53.348	.32	17.29
99.339	.43	10.23
175.639	.49	3.69
223.677	.60	1.96
261.289	.99	1.36
300.000	2.21	1.09

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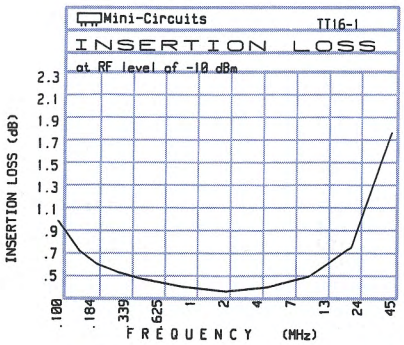
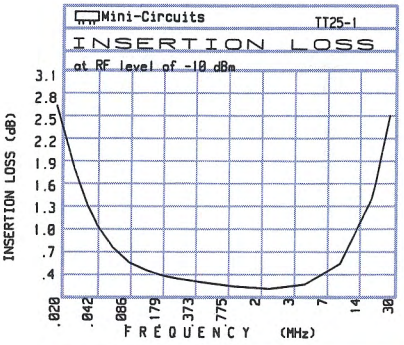


TT16-1

0.1 to 45 MHz

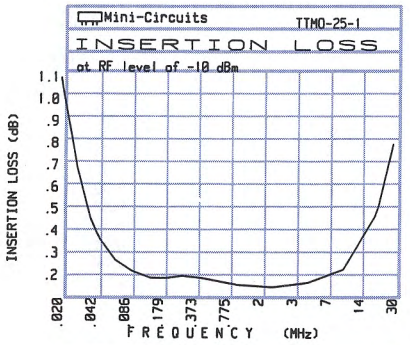
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	1.03	11.30
.149	.76	14.27
.217	.63	17.22
.299	.57	19.65
.468	.51	23.01
2.168	.40	33.97
4.663	.44	46.27
10.025	.54	25.12
21.543	.80	10.53
45.000	1.84	2.08



TT25-1

.02 to 30 MHz

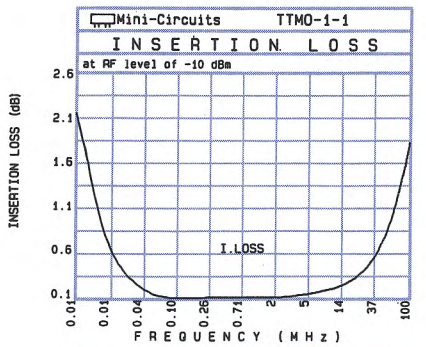
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.020	2.72	6.13
.030	1.86	7.95
.047	1.18	10.45
.069	.80	13.16
.149	.48	19.05
.299	.37	25.11
1.007	.27	28.34
4.663	.30	12.69
20.125	1.46	2.94
30.000	2.60	2.00



TTMO-25-1

.02 to 30 MHz

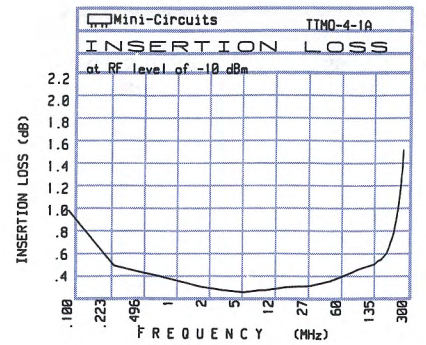
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.020	1.15	6.87
.030	.69	8.06
.047	.39	8.87
.069	.27	9.34
.149	.19	9.76
.299	.20	9.91
1.007	.16	9.66
4.663	.17	9.20
20.125	.47	6.09
30.000	.80	4.20



TTMO-1-1

.005 to 100 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.005	2.20	2.65
0.010	0.84	6.23
0.020	0.30	11.73
0.050	0.11	21.19
0.101	0.10	33.49
1.000	0.11	35.59
40.000	0.65	9.49
49.699	0.83	7.84
75.000	1.38	4.96
100.000	1.87	3.51



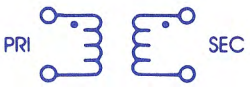
TTMO-4-1A

0.1 to 300 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	1.00	10.00
.846	.41	24.31
4.001	.28	32.42
18.929	.31	32.56
53.348	.37	22.30
99.339	.47	14.66
175.639	.56	6.89
223.677	.73	4.12
261.289	1.00	2.74
300.000	1.56	1.90

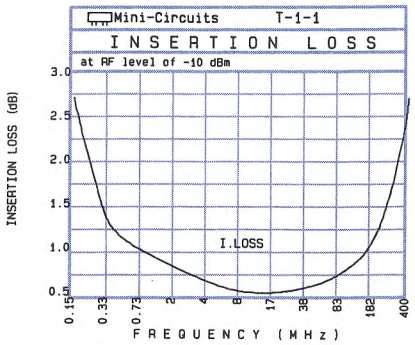
RF Transformers

Configuration C



T-1-1

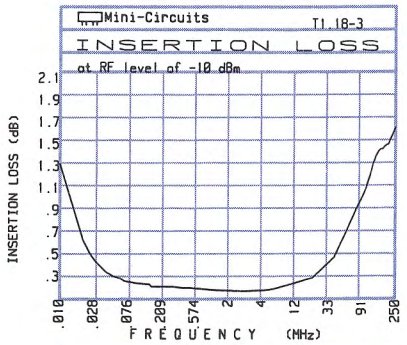
.15 to 400 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.150	2.75	1.98
0.200	2.10	3.10
0.300	1.44	9.92
0.350	1.29	11.10
1.001	0.92	16.82
2.000	0.75	19.24
50.000	0.64	20.06
191.320	1.23	10.15
200.000	1.26	9.90
400.000	2.75	4.79

T1.18-3

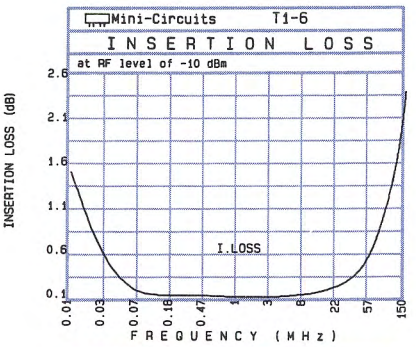
0.01 to 250 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.010	1.28	9.92
.040	.30	19.95
.101	.20	26.49
.401	.16	31.57
5.014	.14	28.04
20.125	.25	21.52
74.289	.86	11.69
128.742	1.30	6.88
169.296	1.42	4.22
250.000	1.62	1.40

T1-6

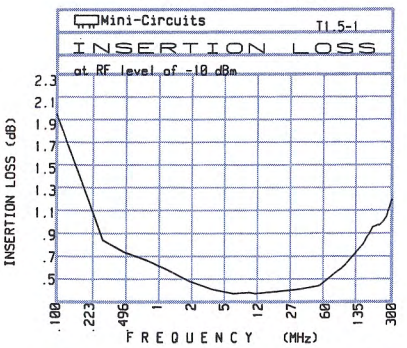
.01 to 150 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	1.53	3.51
0.020	0.58	7.36
0.050	0.18	14.35
0.099	0.13	20.32
0.198	0.13	26.00
50.000	0.54	9.38
76.890	0.97	6.19
100.000	1.37	4.61
143.590	2.26	2.79
150.000	2.43	2.57

T1.5-1

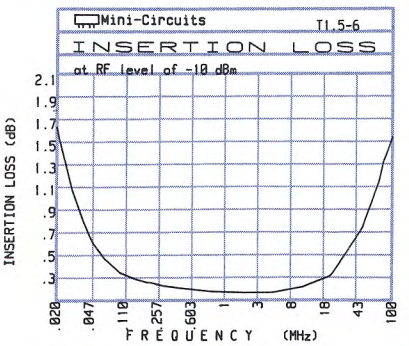
.1 to 300 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	1.96	6.70
.846	.64	19.19
4.001	.38	23.71
18.929	.36	24.68
53.348	.42	22.20
99.339	.61	18.74
175.639	.89	14.16
223.677	.96	11.88
261.289	1.03	10.26
300.000	1.19	8.75

T1.5-6

.02 to 100 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.020	1.66	10.04
.040	.79	14.25
.050	.61	15.84
.149	.28	24.00
.299	.22	28.68
1.007	.17	33.51
10.025	.21	25.00
45.277	.73	13.42
50.365	.83	12.65
100.000	1.57	6.99

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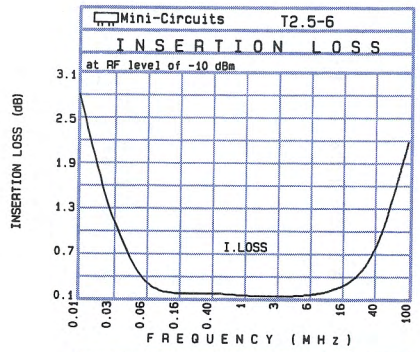
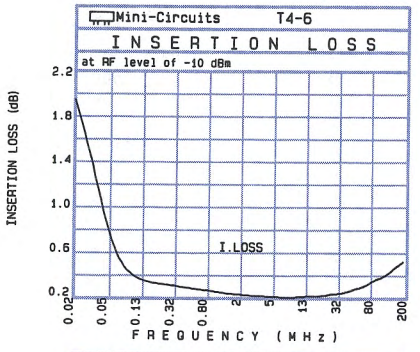


T2.5-6

.01 to 100 MHz

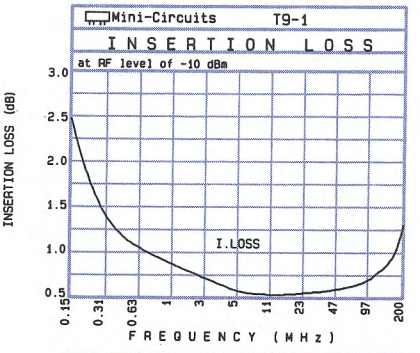
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	2.90	1.61
0.020	1.26	4.15
0.050	0.35	10.11
0.099	0.20	15.86
0.198	0.19	21.42
20.000	0.40	11.56
50.000	1.18	5.42
53.667	1.30	5.02
95.264	2.30	3.06
100.000	2.38	3.00



T4-6

.02 to 200 MHz

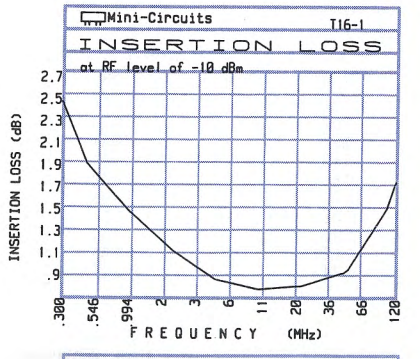
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.020	1.99	2.65
0.050	0.61	7.84
0.100	0.35	13.54
0.199	0.32	18.56
0.501	0.28	23.01
100.000	0.39	16.74
106.420	0.40	16.67
150.000	0.49	16.25
190.300	0.54	21.29
200.000	0.57	25.21



T9-1

.02 to 200 MHz

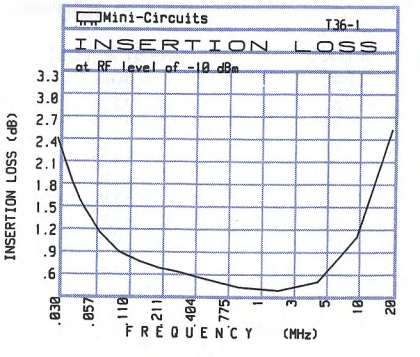
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.150	2.54	2.35
0.199	1.95	3.59
0.300	1.40	6.00
0.998	0.95	11.90
2.000	0.77	14.45
40.000	0.60	17.64
100.860	0.74	14.07
150.000	0.95	10.48
190.300	1.23	8.18
200.000	1.34	7.50



T16-1

.3 to 120 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.300	2.48	6.85
1.007	1.48	13.30
2.168	1.13	16.98
10.025	.78	16.23
20.125	.81	10.21
45.277	.93	4.59
46.549	.93	4.49
100.506	1.51	1.58
108.526	1.62	1.41
120.000	1.76	1.24



T36-1

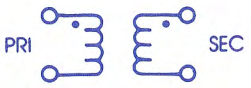
.03 to 20 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.030	2.44	6.98
.047	1.60	9.75
.050	1.50	10.28
.101	.89	15.22
.201	.69	19.88
.217	.67	20.32
.468	.55	24.87
2.168	.38	16.92
4.663	.50	10.04
20.000	2.58	1.81

wideband

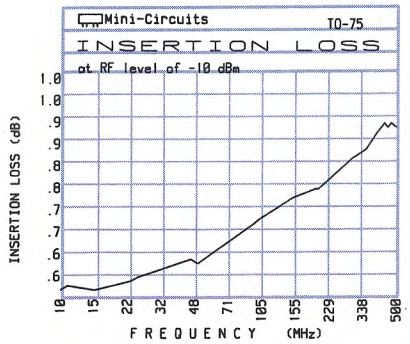
RF Transformers

Configuration C



TO-75

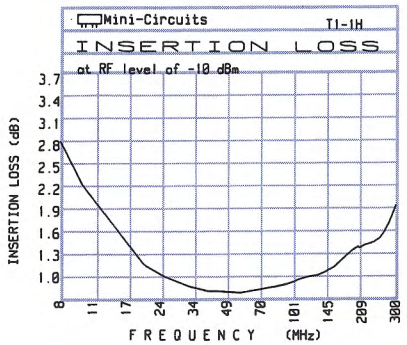
10 to 500 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
10.000	.53	24.68
14.893	.53	25.54
24.869	.56	26.08
49.595	.59	26.40
100.873	.69	25.11
193.382	.76	22.22
298.431	.83	19.48
401.160	.89	17.42
451.552	.90	16.74
500.000	.90	16.24

T1-1H

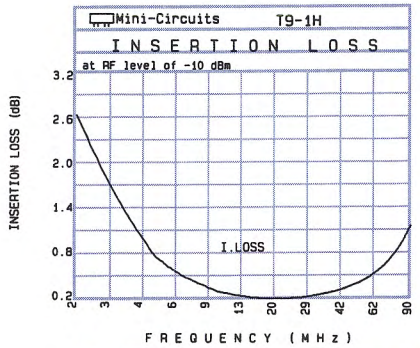
8 to 300 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
8.000	2.89	3.88
20.410	1.19	9.28
44.500	.85	13.20
81.000	.91	14.00
105.090	1.01	13.59
154.000	1.18	12.25
190.500	1.42	11.04
214.590	1.48	10.32
263.500	1.65	8.87
300.000	2.02	7.84

T9-1H

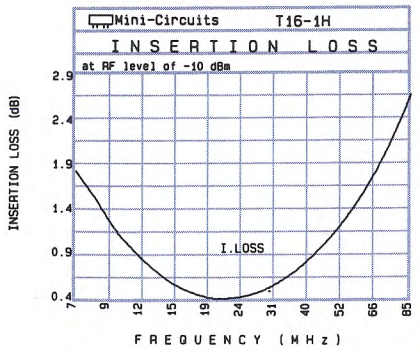
2 to 90 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
2.000	2.72	1.84
3.000	1.56	3.66
4.783	0.83	6.45
6.000	0.62	8.05
19.913	0.23	32.98
45.945	0.40	12.78
50.000	0.44	11.83
75.000	0.84	7.53
87.330	1.14	6.02
90.000	1.21	5.74

T16-1H

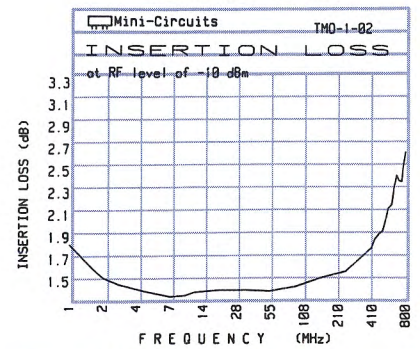
7 to 85 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
7.000	1.87	3.19
10.000	1.09	5.78
14.110	0.62	10.41
15.000	0.57	11.67
40.000	0.88	7.47
42.328	0.95	6.90
65.000	1.85	3.53
70.622	2.09	3.09
82.506	2.62	2.36
85.000	2.74	2.25

TMO-1-02

1 to 800 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
1.000	1.80	12.31
2.726	1.44	15.92
7.429	1.33	17.22
19.913	1.39	17.37
89.604	1.42	17.23
403.203	1.77	12.96
501.042	1.92	11.59
602.156	2.16	10.32
699.887	2.38	9.22
800.000	2.64	8.24

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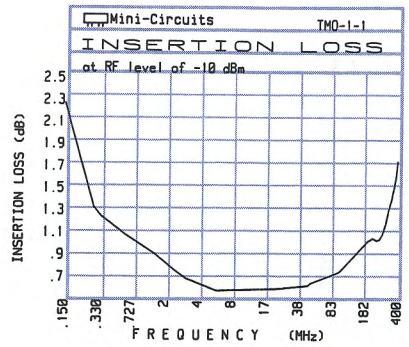
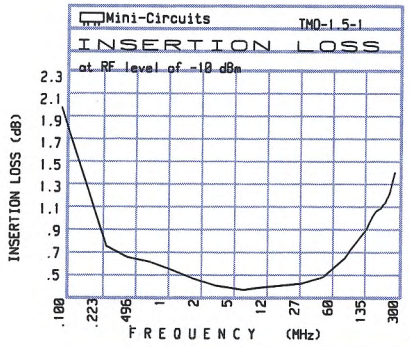


TMO-1-1

15 to 400 MHz

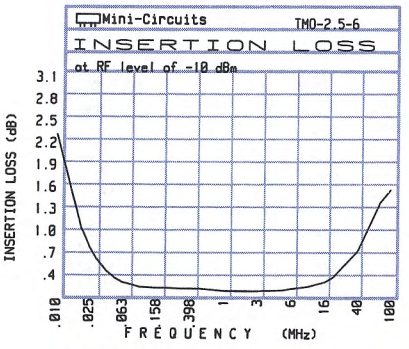
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.150	2.31	6.40
.616	1.13	14.47
2.645	.73	20.39
11.153	.63	24.24
49.640	.69	22.54
198.326	1.08	14.12
241.721	1.08	12.56
279.134	1.14	11.40
340.211	1.43	9.80
400.000	1.80	8.46



TMO-1.5-1

1 to 300 MHz

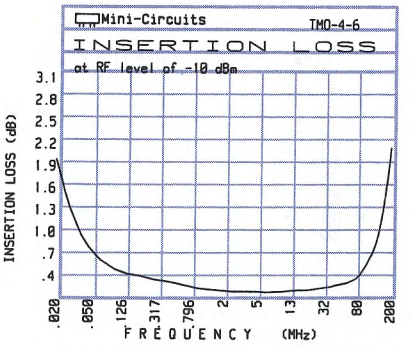
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	2.00	7.10
.846	.60	15.20
4.001	.39	20.76
11.275	.37	22.45
49.788	.46	17.20
150.356	.90	9.84
188.201	1.06	8.59
223.677	1.12	7.77
261.289	1.22	7.17
300.000	1.42	6.79



TMO-2.5-6

.01 to 100 MHz

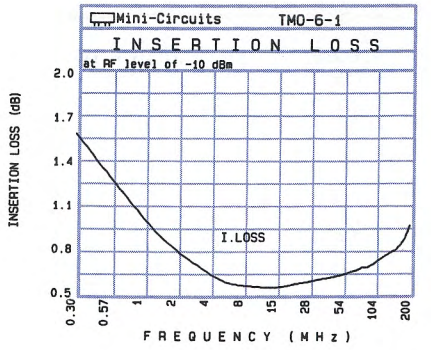
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.010	2.29	5.62
.030	.61	12.84
.063	.28	18.83
.149	.21	26.07
.299	.20	31.31
1.007	.17	33.88
6.247	.20	27.27
20.125	.36	19.19
59.626	1.14	9.98
100.000	1.55	5.13



TMO-4-6

.02 to 200 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.020	2.02	7.83
.050	.82	13.85
.149	.46	21.21
.401	.37	25.45
5.014	.23	34.23
20.125	.25	29.15
74.289	.40	16.60
119.220	.75	11.27
160.523	1.33	7.63
200.000	2.19	4.98



TMO-6-1

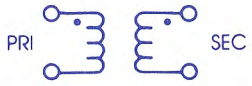
.3 to 200 MHz

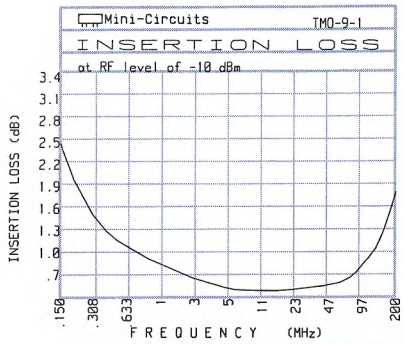
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.300	1.62	6.65
0.500	1.37	8.91
1.000	1.06	11.59
2.003	0.79	14.70
5.000	0.61	18.64
50.000	0.66	18.68
100.070	0.74	17.44
150.000	0.83	14.84
194.740	0.98	12.66
200.000	1.00	12.04

wideband

RF Transformers

Configuration C

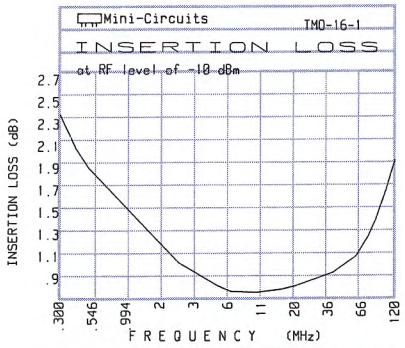




TMO-9-1

.15 to 200 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.150	2.49	7.48
.299	1.53	12.47
1.007	.92	19.11
6.247	.51	24.11
20.125	.51	13.21
74.289	.68	3.93
111.200	.95	2.35
139.015	1.17	1.74
169.296	1.50	1.34
200.000	1.84	1.09

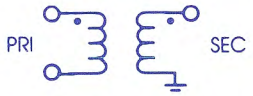


TMO-16-1

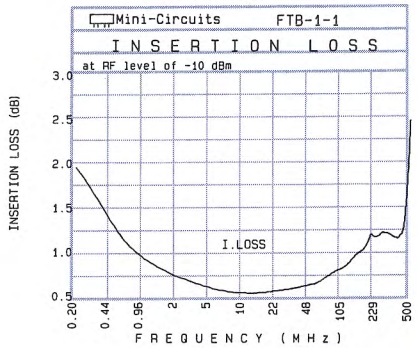
.3 to 120 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.300	2.37	7.37
.502	1.89	10.14
2.516	1.03	17.74
6.247	.77	21.40
15.711	.79	14.20
20.125	.82	12.18
40.312	.95	6.96
74.289	1.27	3.41
100.506	1.67	2.28
120.000	1.96	1.78

Configuration E

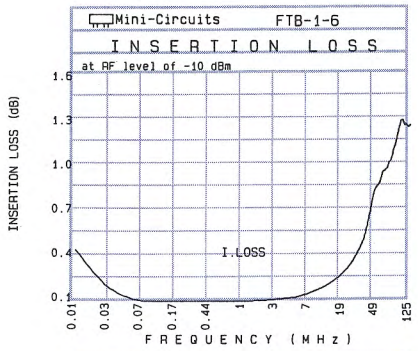


balance to unbalance



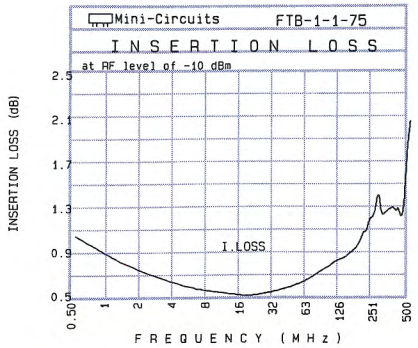
FTB-1-1, .2 to 500 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.200	2.00	6.79
0.500	1.19	13.47
1.000	0.94	16.19
2.000	0.75	18.70
5.000	0.61	22.34
10.000	0.58	23.84
100.000	0.86	17.64
241.480	1.23	11.38
300.000	1.26	10.05
500.000	2.53	6.59



FTB-1-6, .01 to 125 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	0.45	9.03
0.020	0.19	14.65
0.050	0.10	22.68
0.100	0.10	29.17
0.199	0.10	34.28
25.000	0.38	12.89
50.000	0.89	8.56
62.669	0.97	7.71
118.440	1.28	6.04
125.000	1.29	6.02



FTB-1-1-75, .5 to 500 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.500	1.08	8.63
1.000	0.88	11.46
2.000	0.74	13.95
5.000	0.60	17.18
10.000	0.57	18.35
20.000	0.55	18.21
100.000	0.84	13.46
242.190	1.29	9.95
300.000	1.34	10.43
500.000	2.12	9.11

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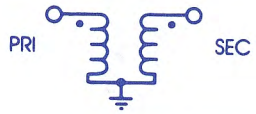
Configuration D



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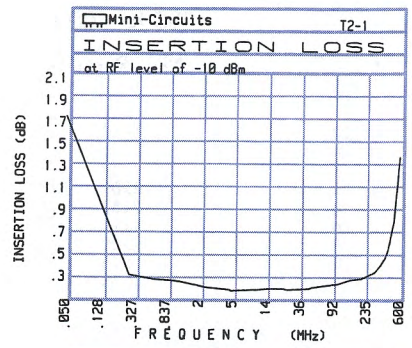
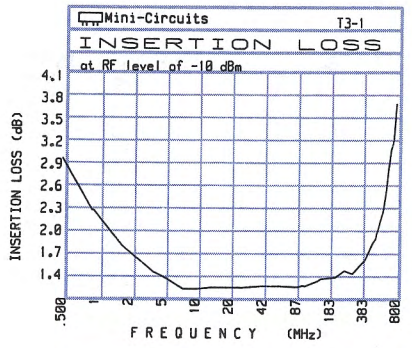


T2-1

.050 to 600 MHz

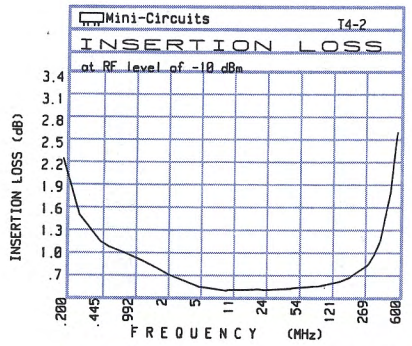
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.050	1.72	7.90
.999	.23	21.60
2.575	.17	22.56
10.863	.15	22.77
24.869	.15	21.86
100.873	.20	15.04
201.162	.25	9.94
434.088	.51	4.99
498.347	.73	4.46
600.000	1.36	3.99



T3-1

.5 to 800 MHz

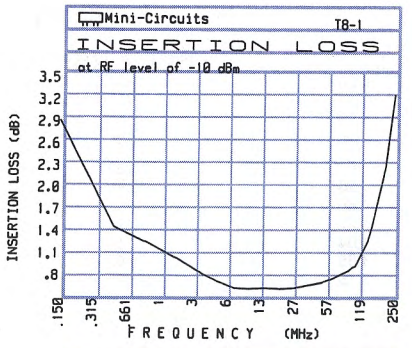
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.500	2.94	7.21
1.994	1.73	10.66
9.923	1.18	12.30
50.297	1.22	11.12
99.524	1.23	8.97
200.594	1.34	5.44
348.840	1.49	2.96
523.423	1.95	1.94
677.637	2.84	1.72
800.000	3.70	1.83



T4-2

.2 to 600 MHz

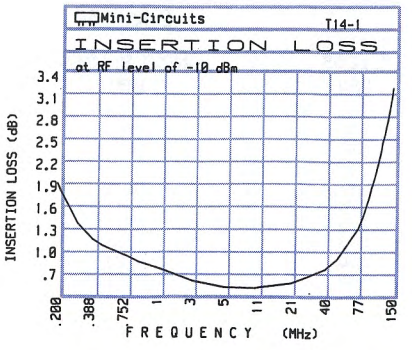
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.200	2.30	6.00
.999	.99	12.85
2.575	.72	13.02
10.863	.52	12.53
24.869	.52	12.18
100.873	.59	8.39
201.162	.72	4.85
434.088	1.40	2.06
498.347	1.79	1.85
600.000	2.68	1.66



T8-1

.15 to 250 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.150	2.88	5.70
1.008	1.23	14.01
1.994	1.01	15.74
7.252	.60	19.04
20.000	.59	15.65
40.311	.65	10.88
60.485	.72	8.00
105.186	.90	4.54
149.332	1.40	2.92
250.000	3.25	1.41



T14-1

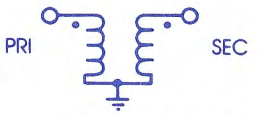
.2 to 150 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.200	1.96	8.58
.405	1.20	12.75
1.484	.81	16.38
10.088	.54	13.93
39.401	.80	4.69
86.706	1.63	1.60
104.956	2.08	1.21
118.907	2.44	1.01
138.493	2.95	.83
150.000	3.28	.76

wideband

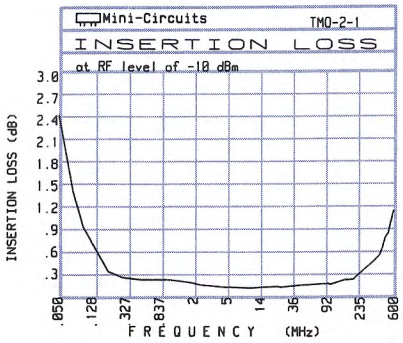
RF Transformers

Configuration D



TMO-2-1

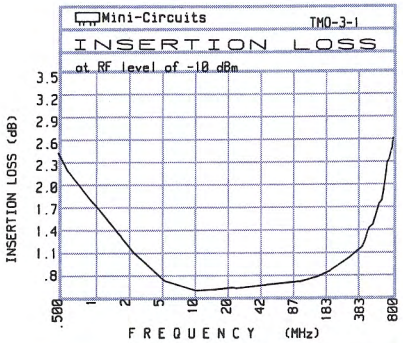
.050 to 600 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.050	2.50	6.00
.300	.28	17.65
1.266	.24	21.54
5.341	.15	23.03
22.534	.16	23.09
49.595	.18	21.63
193.382	.26	13.91
401.160	.59	8.29
498.347	.88	6.75
600.000	1.20	5.65

TMO-3-1

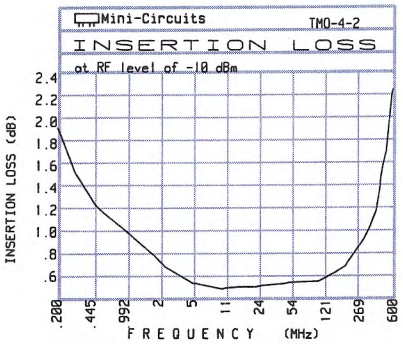
.5 to 800 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.500	2.52	7.01
1.992	1.37	10.31
10.039	.65	12.79
24.869	.68	12.70
100.873	.77	11.07
298.431	1.09	6.42
451.552	1.44	4.22
549.992	1.70	3.32
656.812	2.10	2.68
800.000	2.73	2.18

TMO-4-2

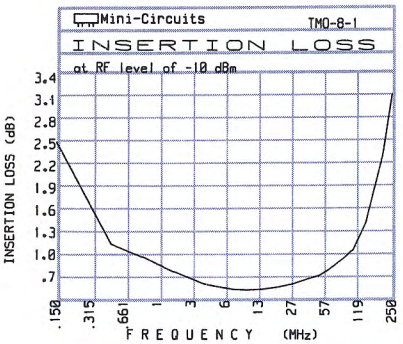
.2 to 600 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.200	2.00	7.70
.999	1.07	15.63
2.575	.74	19.54
10.863	.55	24.29
24.869	.57	19.63
100.873	.61	8.87
201.162	.78	4.44
434.088	1.43	1.73
498.347	1.75	1.54
600.000	2.35	1.35

TMO-8-1

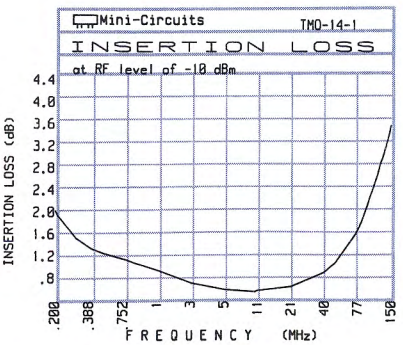
.15 to 250 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.150	2.50	5.90
1.008	.95	15.49
1.994	.75	17.53
7.252	.51	18.62
20.000	.54	12.81
40.311	.66	7.84
60.485	.77	5.23
105.186	1.04	2.68
149.332	1.58	1.66
250.000	3.15	.90

TMO-14-1

.2 to 150 MHz



FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.200	2.06	7.95
.405	1.37	11.80
1.484	.97	15.30
10.088	.58	16.70
39.401	.93	8.24
86.706	1.95	3.61
104.956	2.45	2.81
118.907	2.83	2.38
138.493	3.30	1.93
150.000	3.60	1.73

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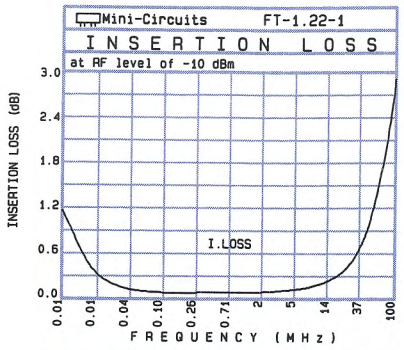
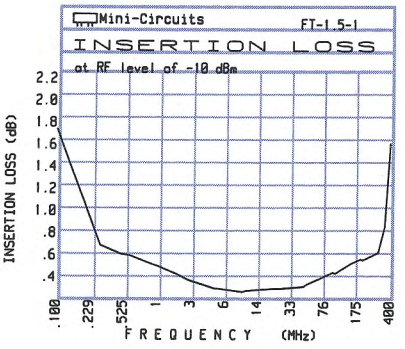


FT-1.22-1

.005 to 100 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.005	1.20	4.31
0.010	0.42	8.44
0.020	0.16	13.97
0.050	0.09	21.75
0.100	0.08	27.89
25.000	0.46	10.22
46.536	1.03	5.94
50.000	1.14	5.51
95.614	2.76	4.00
100.000	2.99	4.74



FT-1.5-1

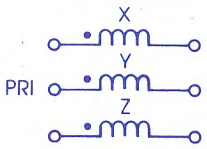
.1 to 400 MHz

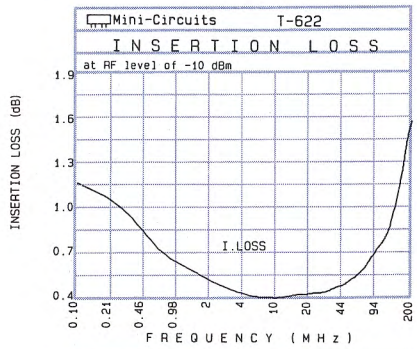
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.100	1.79	7.10
.610	.65	18.61
1.266	.55	20.63
5.034	.35	24.38
10.863	.33	25.10
22.534	.35	24.87
49.595	.39	22.83
149.648	.58	15.96
201.162	.61	13.38
400.000	1.67	6.07

wideband

RF Transformers

Configuration F

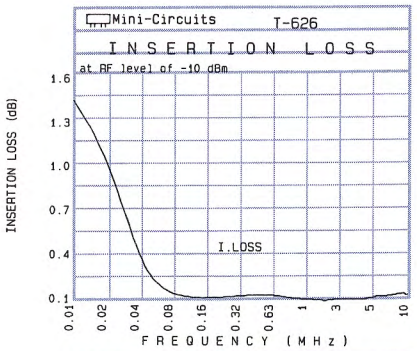




T-622

0.1 to 200 MHz

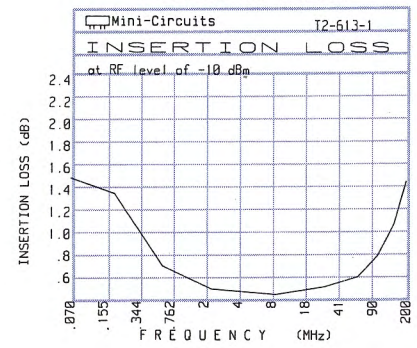
FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.100	1.19	7.87
0.500	0.70	17.40
1.100	0.64	20.99
2.099	0.50	24.10
5.000	0.42	26.99
80.000	0.69	14.78
93.054	0.76	13.92
100.000	0.78	13.50
193.000	1.58	8.19
200.000	1.62	8.08



T-626

0.01 to 10 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
0.010	1.48	6.06
0.035	0.41	12.04
0.110	0.13	24.10
0.200	0.14	30.00
0.400	0.15	33.34
2.000	0.12	33.19
4.680	0.14	29.13
5.000	0.14	28.47
9.675	0.16	25.30
10.000	0.16	24.75



T2-613-1

0.07 to 200 MHz

FREQ. (MHz)	I. LOSS (dB)	INPUT R. LOSS (dB)
.070	1.48	8.88
.200	1.34	15.76
.633	.68	20.56
2.000	.47	25.22
9.199	.42	27.19
29.090	.49	23.67
63.246	.58	18.52
100.238	.77	15.39
149.063	1.06	13.44
200.000	1.45	13.77

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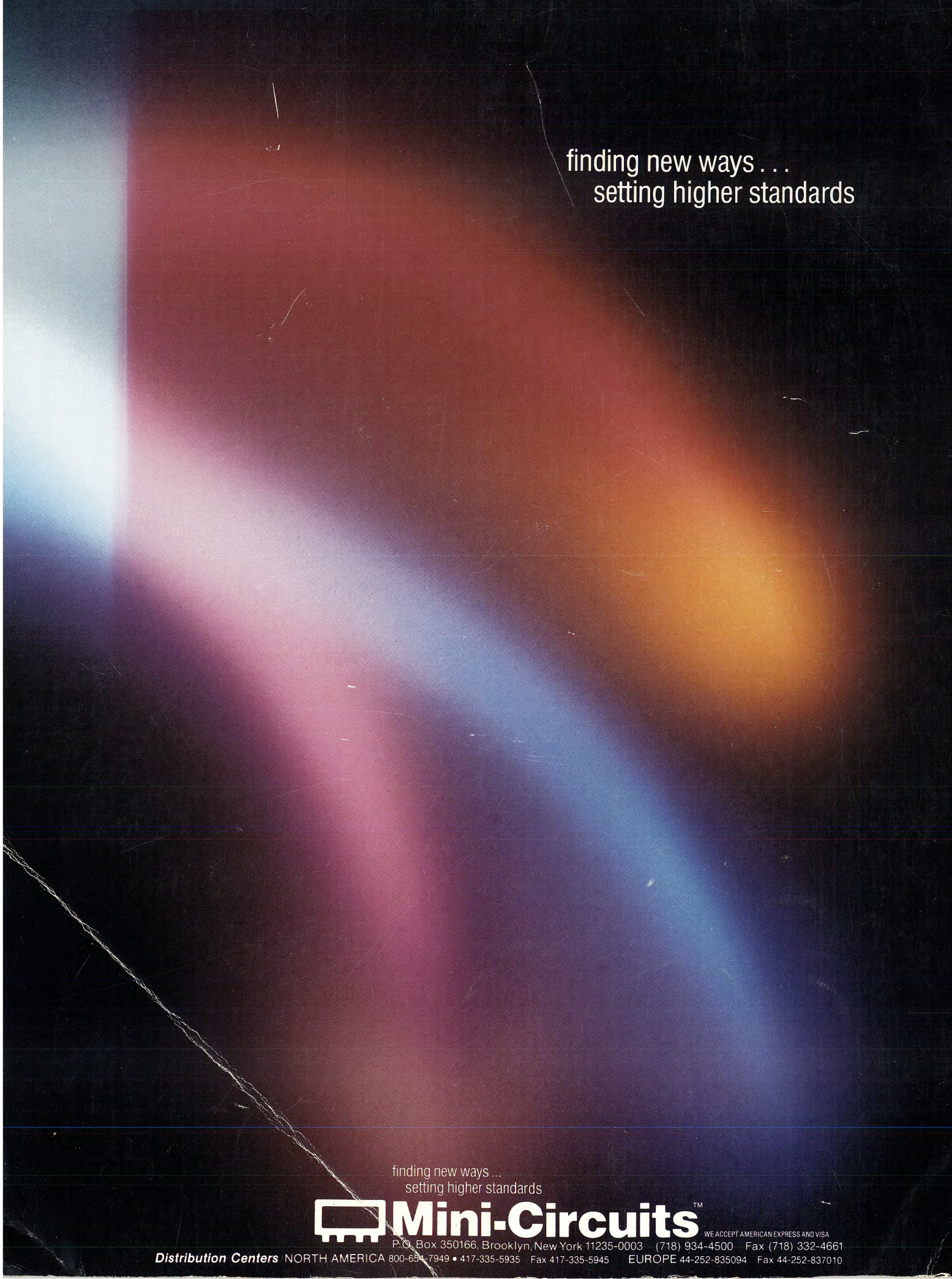

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