



Agilent Technologies

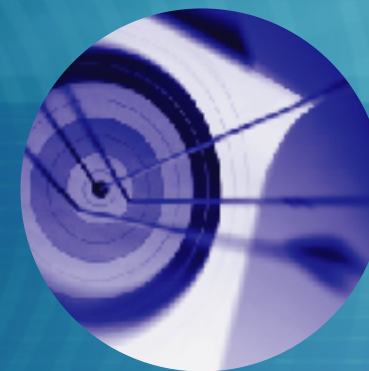
Test & Measurement

Catalog 2003/04

Products, Systems, Services

Test & Measurement

Catalog 2003/04



Technical information in this document is subject to change without notice.

© Agilent Technologies, Inc. 2003
Printed in China 6/03



Agilent Technologies

About Test and Measurement

Catalog 2003/04

The Agilent Technologies 2003/04 Test and Measurement Catalog brings you a tremendous range of high quality technology products, as well as many advances in measurement and test technology that provide optimized solutions. This includes the basic tools of test and measurement all the way to complete systems that focus on emerging electronic and communications fields. For over sixty years we have developed products and services that are unequalled in their ability to help you improve your engineering results and contribute to your business and personal success.

In response to your comments and suggestions, we have expanded our World Wide Web site (www.agilent.com/find/products) to meet your requests for more information about Agilent Technologies products and services. We encourage you to visit the site, where you can obtain updated technical information and download application notes, interactive selection guides and free demonstration software. The site gives you quick access to the latest news and training course schedules.



Agilent Technologies

1 Introduction, Table of Contents, Web Site Highlights and Index

2 New Products

New Product Highlights 2

3 Support and Services

1 Support Services 22

2 Education and Consulting Services 30

3 Channel Partners 34

4 General Purpose Instruments

4 Oscilloscopes 38

5 Oscilloscope Probes & Accessories 57

6 Modulation Domain Analyzers 67

7 Electronic Counters 69

8 Digital Multimeters 76

9 Data Acquisition & Switching 85

10 Function/Arbitrary Waveform Generators 89

9 DC Electronic Loads 96

10 Power Supplies 100

11 AC Source/Analyzers 126

5 RF & Microwave Instruments

12 Signal Generators 130

13 Signal Analyzers 167

14 EMI/EMC Test Systems 200

15 Cable TV Regulatory Test Equipment 203

16 Network Analyzers 205

Power Meters 242

Noise Figure Analyzers 247

Impedance Measuring Instruments 256

Materials Test Equipment 258

LCR & Resistance Meters 262

VCO/PLL Signal System 269

RF & Microwave Test Accessories 272

6 Digital Design and Test

Logic Analyzers and Accessories 290

Pulse/Pattern Generators 302

Data Generators/Analyzers 307

PCI/PCI-X Exerciser and Analyzers 309

7 Software and Connectivity

Software and Connectivity 312

8 RF Design Software

RF Design Software 320

9 Test Systems

Electronic Functional Test System 328

Phase Noise Test System 333

Satellite Payload Test Solutions 334

VXIbus Products 335

Cabinets & Cabinet Accessories 345

10 Lightwave Test

Lightwave Test Solutions 354

Tunable Lasers Modules 361

Lightwave Test Modules 365

Loss and Dispersion Test Solutions 371

Optical Spectrum Analyzer 376

Error Performance Analyzer 382

Optical Wavelength Meter 383

Lightwave Test System 388

11 Wireless Communications

One Box Test Sets and Test Applications 392

Wireless Test Manager Software 401

Lab Applications 402

Wireless Protocol Test Set and Software 408

Bluetooth Test Set 411

Base Station Test Set 413

Wireless Network Optimization Platform 416

Air Interface Remote Monitoring System 417

Wireless Network Planning and Design Software 418

Wireless Test Systems and Solutions 419

12 Wireline Communications

Wireline Network Analyzer	426
Network Advisor and Modules	429
IP Telephony Products	431
Optical Time Domain Reflectometer	433
Optical Hand Held Testers	434
Modular Network Tester	435
Transmission Test Sets	436
Optical/Transmission Tester	438
Serial BERT, ParBERT, OmniBER	448
Signaling Advisor	457
Router Tester	459
Storage Area Network Tester	460

13 Frequency & Time Standards

Frequency & Time Standards	464
Laser Interferometers & Calibration Systems	467

14 Automated Test Equipment

Printed Circuit Board Test and Inspection Systems	472
Automated Semiconductor Test Systems	473
Semiconductor Parameter Analyzer	474

15 Purchasing Alternatives

Refurbished Equipment, Trade Up, Leasing & Finance	476
---	-----

16 Ordering Information and Local Assistance

Ordering Information and Local Assistance	480
---	-----

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

Agilent Technologies: An Overview

Agilent Technologies' Test & Measurement Organization



1

Agilent Technologies is on the leading edge of nearly every major trend in communications and life sciences. From optical and wireless communications to disease discovery and drug development research, Agilent delivers product and technology innovations that benefit millions of people around the world. Leading companies – communications equipment manufacturers, Internet service providers, biopharmaceutical companies and more – depend on Agilent's more than 20,000 test, measurement and monitoring devices, semiconductor products and chemical analysis tools to help drive the communications and life sciences revolutions that are transforming the modern world.

Communications and Electronics

The convergence of Internet, video, voice and computing technologies is accelerating. Agilent is helping leading companies bring new capabilities in wireless, optical and network management to rapidly growing global markets. Our customers include Nokia, Lucent Technologies, Cisco, Juniper, Samsung and IBM, among others.

The communications and electronics industries are Agilent's largest strategic markets. We offer a broad product portfolio for all the high-growth segments: optical, wireless, broadband, data networking and the Internet Protocol (IP) world. Our customers – industry innovators – rely on Agilent's technology, expertise, complete solutions and services that help them push boundaries, seize opportunities and successfully compete in demanding business and consumer markets.

Communications and electronics equipment manufacturers find that Agilent's test and measurement tools

add value at all stages of a product's life cycle, from research and design to high-volume manufacturing to installation and maintenance.

Agilent's Intelligent Test strategy enables manufacturers to leverage the power of information to ensure that the right test is performed at the right time for the right cost.

Agilent Labs

The innovations that set Agilent apart begin in Agilent Laboratories, one of the world's leading industrial research centers. The human talent here has helped propel a space launch and shrink a lab onto a chip. A breakthrough from Agilent Labs helped engineer an optical mouse that is now marketed by the major computer mouse manufacturers.

Researchers at Agilent Labs look out over the horizon three to five years, and sometimes even farther, to enable advances that, someday, no one will live without.

Right now, Labs scientists are conducting research to advance high-speed telecommunications and data communications. They're working on fiber-optic telecommunications, high-speed computer interconnects, broadband wireless communications and video- and image-processing technologies. They're developing new ways to use fiber-optic cables within buildings and new kinds of Internet-backbone hardware that can send data faster to those buildings.

Researchers at our Labs are also collaborating with the National Human Genome Research Institute, part of the National Institutes of Health, to help scientists improve diagnosis and treatment capabilities for various types of cancer. And they're working with leading university medical researchers to help

develop an understanding of disease that will lead to new, life-saving treatments.

History and Culture

Agilent's pioneering spirit was kindled more than 60 years ago, when two engineers – Bill Hewlett and Dave Packard – invented the future in their garage. In 1999, Agilent was spun off from Hewlett-Packard Company, and we have continued to support the values so important to the two visionary founders – uncompromising integrity; trust, respect and teamwork; and innovation that makes a difference. We also continue to innovate in territory that matters, blazing trails in the fields that are shaping the modern world.

Our products and technologies enable real breakthroughs in communications and life sciences, and our ways of doing business challenge traditional thinking about how to successfully run a high-performance technology company in today's dynamic, global economy. We continually seek – and find – creative ways to contribute to communities we serve around the world.

Agilent Around the World

Agilent has facilities in more than 40 countries. We have manufacturing sites in the U.S., China, Germany, Japan, Malaysia, Singapore, Australia and the U.K. Agilent Labs has its headquarters in Palo Alto, California, with additional sites in Misonkuchi, Japan; South Queensferry, Scotland; and Beijing, China.

Our worldwide headquarters is in Palo Alto, California, on the site of Hewlett-Packard's first owned and operated R&D and manufacturing facility.

Introduction and Index 1

→	Introduction, Table of Contents, Web Site Highlights and Index	1
	New Products	2
	Support and Services	3
	General Purpose Instruments	4
	RF & Microwave Instruments	5
	Digital Design and Test	6
	Software and Connectivity	7
	RF Design Software	8
	Test Systems	9
	Lightwave Test	10
	Wireless Communications	11
	Wireline Communications	12
	Frequency & Time Standards	13
	Automated Test Equipment	14
	Purchasing Alternatives	15
	Ordering Information and Local Assistance	16

Table of Contents

Agilent Technologies Test & Measurement Catalog 2003/04

1 Introduction, Table of Contents, Web Site Highlights and Index

2 New Products

New Products Highlights

Services and Support	2
General Purpose Instruments	3
RF and Microwave Instruments	5
Digital Design and Test	9
Software and Connectivity	12
Wireless Communications	13
Wireline and Optical Communications	15
Lightwave Measurements	18

3 Support and Services

Support Services

Fitness Program	22
Calibration	23
Volume On-site Calibration	26
Equipment Management Solution	27
Repair and Warranty	28
Advantage System Uptime Solutions	29

Education and Consulting Services

Engineering Services	30
Accelerated Education Curriculum	31
Professional Consulting Solutions	33

Channel Partners

Partnering for Success	34
------------------------	----

4 General Purpose Instruments

Oscilloscopes

Overview	38
MegaZoom Deep Memory	39
Mixed Signal Oscilloscopes	40
General-Purpose Infiniium Oscilloscopes	45
54600 Series Portable Oscilloscopes	48
High-Performance Infiniium Oscilloscopes	51
Infiniium DCA	54

Oscilloscope Probes & Accessories

High Impedance Passive Probes	57
117x Low Mass Passive Probe Family	60
Surface-Mount Probing Accessories	61
Differential Probes	62
Active Probes	63
High-Voltage, Resistive Divider and Current Probes	65

Modulation Domain Analyzers

Overview	67
Modulation Domain Analyzers	68

Electronic Counters

Overview	69
Counter Product Families	70
Frequency and Time Interval Counters	71
CW Microwave Frequency Counters	73
Microwave Counter/Power Meter/DVM	75

Digital Multimeters

Overview	76
Low-Cost 6½ Digit Multimeter	77
Nanovolt/Micro-ohm Meter	79
8½ Digit Multimeter	81
Accessories	83

Data Acquisition & Switching

Low-Cost Data Acquisition/Switch Unit	85
---------------------------------------	----

Function/Arbitrary Waveform Generators

Overview	89
Function/Arbitrary Waveform Generators	90

DC Electronic Loads

Single Input Loads	96
High Performance Electronic Load Family	97

Power Supplies

Selection Index	100
Modular Power System	102
Mobile Communication dc Source	104
Telecommunication dc Source	106
Solar Array Simulators	107
Dynamic Measurement Single-Output System	108
Precision Measurement Single-Output System	109, 111

Table of Contents

Agilent Technologies Test & Measurement Catalog 2003/04

Multiple-Output System	110
Single-Output System and Manually Controlled	112
Single-Output Autoranging	117
AC Line Cord Options	118
E3640A to E3649A, Single and Dual Output	119
Single- and Multiple-Output	121
Laboratory: Multiple Output	122
Laboratory: Single Output	123
N3280A Component Test dc Source	124
Multi-Cell Charger/Discharger (MCCD)	125

AC Source/Analyzers

AC Power Solutions	126
--------------------	-----

5 RF & Microwave Instruments

Signal Generators

Overview	130
Vector Signal Generators	131
Analog & CW Signal Generators	151
Millimeter-Wave Source Modules	166

Signal Analyzers

Overview	167
Basic Performance Spectrum Analyzers, ESA-L Series	171
Mid-Performance Spectrum Analyzers, ESA-E Series	174
Measurement Personalities for the ESA-E Series	179
High-Performance Spectrum Analyzers, 8560EC Series	180
Highest Performance Spectrum Analyzer, PSA Series	185
VSA Transmitter Tester	192
Vector Signal Analyzers	195
Millimeter Mixers	198
Amplifiers	199

EMI/EMC Test Systems

EMI Receivers	200
EMC Development Products and Accessories	202

Regulatory Test Equipment

Cable TV Analyzers, Accessories	203
---------------------------------	-----

Network Analyzers

Complete Characterization of Linear Networks	205
ENA Series RF Network Analyzers	208
PNA Series RF and MW Network Analyzers	210
High-Speed Network Analyzers	214

Network/Spectrum Analyzers

Baseband, IF Network/Spectrum/Impedance Analyzer	216
RF Network/Spectrum/Impedance Analyzers	218
Test Kits, Active Probe	220

Network Analyzers

8712 Series RF Network Analyzers	221
8753ET and 8753ES RF Network Analyzers	225
8720 Series Microwave Network Analyzers	229
8757 Scalar Network Analyzer	232
Custom Test Sets	237
Analyzer Accessories	238

Power Meters

Peak and Average Power Meters	242
Single- and Dual-Channel Power Meters	244
E-Series and 8480 Series Power Sensors	245
Power Sensor Selection Guide	246

Noise Figure Analyzers

Noise Figure Analyzers	247
Agilent Noise Sources	250

Component Test Instruments

Overview	253
----------	-----

Impedance Measuring Instruments

RF Impedance/Material Analyzer	256
--------------------------------	-----

Materials Test Equipment

Dielectric and Magnetic Material Test Solutions	258
---	-----

Impedance Measuring Instruments

Precision Impedance Analyzer	260
------------------------------	-----

LCR & Resistance Meters

Capacitance Meter	262
RF LCR Meter	263
LCR Meter	264
High-Resistance Meter	265
Precision LCR Meters	266
Milliohmeter	268

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

Table of Contents

Agilent Technologies Test & Measurement Catalog 2003/04

RF & Microwave Components Measurement Systems

VCO/PLL Signal Test System 269

RF & Microwave Test Accessories

Amplifiers 272
Custom Switch Interfaces 273
Switching Solutions/Coaxial Switches 274
High-Performance Programmable Step Attenuators 279
Coaxial Step Attenuators 282
Coaxial Fixed Attenuators 284
Coaxial Detectors 285
Coaxial Single- and Dual-Directional Couplers 287

6 Digital Design and Test

Digital Design and Test

Logic Analyzers 290
Modular Logic Analysis Systems 291
Measurement Modules 292
Post-Processing Tool Sets 294
Application-Specific Protocol Tools 295
Standalone Logic Analyzers 296
PC-Hosted Logic Analyzers 297
Processor, Bus, and FPGA Support 298
Trace Port Analyzers and Emulation 299
Logic Analyzer Probing Solutions 300
N1900A Series Physical-Layer Test Systems 301
Pulse and Pulse/Pattern Generators 302

Characterization Tools & Solutions

81200 Data Generator/Analyzer Platform 307

Verification Tools & Solutions

E2920 Exerciser and Analyzer, PCI/PCI-X Series 309

7 Software and Connectivity

Software and Connectivity

Test and Measurement Software and Connectivity 312
GPIB Cards and Converters 317
Agilent Developer Network – ADN 318

8 RF Design Software

RF Design Software

EDA Software 320
RF Design Environment 323
RF Design Environment Bundles 325

9 Test Systems

Electronic Functional Test System

TS-5400 Series II Automotive Electronics Functional Test System 328
Switch Matrices 329

Test Systems

Test Solutions 330
Functional Electronic Test: RF and Microwave 332
Phase Noise Measurement Solutions 333
Satellite Payload Test Solutions 334

VXIbus Products

75000 VXIbus Family 335
75000 VXI Products 337
System Switches 339
Dynamic Signal Analyzer 344

Cabinets & Cabinet Accessories

Rack Cabinets 345, 351
Rack Accessories 348
Testmobiles & Accessories 349

10 Lightwave Test

Lightwave Test

Agilent Lightwave Solution Platform 354
8163B Lightwave Multimeter 358
8166B Lightwave Multichannel System 359
8164B Lightwave Measurement System 360

Tunable Lasers Modules

Agilent 814xxB and 816xxB Tunable Laser Modules 361
Agilent 8198xA and 8194xA Compact Tunable Laser Source 363

Table of Contents

Agilent Technologies Test & Measurement Catalog 2003/04

Lightwave Modules

81662A and 81663A DFB Laser Modules	365
Agilent Optical Power and Return Loss Modules	368
8157xA High-Power Optical Attenuators	369

Loss and Dispersion Test Solution

Agilent 81910A Photonic All-Parameter Analyzer	371
Agilent N4155A/N4156A High-Speed Spectral-Loss Measurement Solutions	374
86038A Optical Dispersion Analyzer	375

Optical Spectrum Analyzer

8614xB Family of Optical Spectrum Analyzer	376
Agilent 86146B Option DPC Optical Spectrum Analyzer	381

Error Performance Analyzer

Agilent BERT and Bathbub Jitter Software 71612C	382
---	-----

Optical Wavelength Meter

86120B/C and 86122A Multi-Wavelength Meters	383
---	-----

Lightwave Test System

JS-1000 Performance Jitter Solution	388
Optical Amplifier (XOA) Test Solution	389

11 Wireless Communications

One Box Test Sets

8960 Series 10 Wireless Communications Test Set, model E5515C	392
---	-----

Test Applications

GSM/GPRS/EGPRS Mobile Test Application	393
W-CDMA Mobile Test Application	394
1xEV-DO Terminal Test Application	395
cdma2000/IS-95/AMPS Mobile Test Application	396
AMPS/136 Mobile Test Application	397
8960 Series 10 Test Application Suite	399
GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, IS-95/cdma2000 Mobile Test Application (fast switching)	400

Wireless Test Manager Software

Wireless Test Manager Products	401
--------------------------------	-----

Lab Applications

GSM/GPRS Lab Application	402
EGPRS Lab Application	403
W-CDMA Lab Application	404
cdma2000 Lab Application	405
Lab Application Suite	406
GSM/GPRS_W-CDMA Lab Application (fast switching)	407

Wireless Protocol Test Set

Wireless Protocol Test Set	408
----------------------------	-----

Protocol Applications

GSM/GPRS Protocol Application	409
-------------------------------	-----

Wireless Protocol Advisor Software

Wireless Protocol Advisor Products	410
------------------------------------	-----

Bluetooth Test Set

Bluetooth Test Set	411
--------------------	-----

Wireless Test Manager Software

Bluetooth Wireless Test Manager	412
---------------------------------	-----

Agilent Base Station Test Set

2G, 2.5G and 3G Base Station Test Tool	413
--	-----

Wireless Network Optimization Platform

2G, 2.5G and 3G Drive Test System	416
-----------------------------------	-----

Agilent Air Interface Remote Monitoring System

Remote Monitoring Drive Test System	417
-------------------------------------	-----

Wizard Wireless Network Planning and Design Software

2G, 2.5G and 3G Network Planning and Design Software	418
--	-----

Wireless Test Systems and Solutions

GS-8000 Functional Test Solution	419
GS8300 WLAN Manufacturing System	420
GS-8800 RF Design Verification System	421
GS-9200 Base Station Test	423

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

Table of Contents

Agilent Technologies Test & Measurement Catalog 2003/04

12 Wireline Communications

Multi-Services/Access (The Agilent Network Analyzer Product Portfolio)

A Centralized Troubleshooting Solution 426

Agilent Advisor, Advisor Modules and Undercradle

Layer 1 to Layer 3 Protocol Analyzer for BERT, ATM QoS & Policing and Frame Relay SLA & CIR 429

IP Telephony Products

Voice Quality Tester (VQT), IP Telephony Analyzer, Telephone Network Analyzer 431

Optical Time Domain Reflectometer

E6000C Mini-OTDR Family 433

Optical Hand Held Testers

Hand Held Optical Loss Test Set 434

Modular Network Tester

N3900A Modular Network Tester 435

Transmission Test Sets

Multi-rate Transmission Test Set, 56/64 k/bs to 10 Gb/s 436

Optical/Transmission

86100B Infiniium DCA 438

N4906A Serial BERT 448

Digital Transmission Testers

ParBERT 81250 Parallel Bit Error Ratio Tester 449

Serial Bit Error Ratio Tester

Serial BERT 13.5 Gb/s (N4901A) and 7 Gb/s (N4902A) 452

Industry-Best Jitter and Wander Testing to 10.7 Gb/s

Agilent J7231B OmniBER OTN Jitter Analyzer 453

Data Over SONET/SDH Ethernet Payload, GFP and Laps Analysis

Agilent J7232A OmniBER OTN 2.5 Gb/s Performance Analyzer 454

Fast and Accurate Analysis of Data Over SONET/SDH Equipment

Agilent OmniBER XM Network Simulator 455

Single-Box, Structure Testing of SONET/SDH and OTN to 43 Gb/s

Agilent J7230C OmniBER OTN 40 Gb/s Performance Analyzer 456

Signaling Advisor

2/2.5/3G Mobile and SS7 Test Equipment 457

RouterTester 900

RouterTester 900 459

SAN Tester

Storage Area Network (SAN) Test Solutions 460

13 Frequency & Time Standards

Frequency & Time Standards

Standards Labs and Communication Networks 464

Primary Frequency Standard 465

Laser Interferometers & Laser-Based Calibration Systems

Laser Interferometer Positioning Systems 467

Laser-Based Machine Tool Calibration System 470

14 Automated Test Equipment

Automated Test Equipment

Printed Circuit Board Test and Inspection Systems 472

Automated Semiconductor Test Systems 473

Semiconductor Parameter Analyzer 474

15 Purchasing Alternatives

Refurbished Equipment, Trade Up, Leasing & Finance

Financial Solutions 476

16 Ordering Information and Local Assistance

Ordering Information and Local Assistance

Ordering Information 480

Local Assistance 481

Agilent's Web Site: Get News, Updated Product and Support Information, and More, 24 Hours a Day

1

The screenshot displays the Agilent Technologies website interface. At the top, there is a search bar and navigation links for 'Products & Services', 'Industries', 'Online Stores', and 'About Agilent'. Below this, a breadcrumb trail shows 'Worldwide Home > Products & Services > Test & Measurement'. The main content area is titled 'Test & Measurement' and includes a 'Contact Us' button. A 'What's New' section highlights a 'New T&M Order Status Tool' for checking order status. The 'Products & Services' section lists categories like 'Basic & General Purpose Instruments', 'Oscilloscopes, Logic Analyzers & Digital Test', and 'RF & Microwave Instruments & Systems'. A 'More Details' sidebar offers links for 'Technical Support', 'Library', 'Education & Training', 'Events', and 'Alliances & Channel Partners'. A 'Highlights' section is also visible. An inset window shows a detailed view of a 'New Oscilloscope' product, featuring an image of the device and descriptive text about its capabilities.

Resources Available Online

- Product and support information with helpful navigation aids and improved web pages that make it easier to access application notes, product overviews, technical details, frequently asked questions, manuals, software, news releases, education course descriptions and schedules, and much more
- Updated comparison data and evaluation guides/tools that facilitate product selections
- Helpful application notes, downloadable interactive application notes, tutorials, online models, and other learning and problem-solving material

- Quick access to customer support services
- Information on recommended replacements for discontinued products
- The latest information on the status of your Agilent test and measurement order

Use our online test and measurement resources and services often

www.agilent.com/find/products (English)
www.agilent.com.cn/find/products (Simplified Chinese)
www.agilent.co.kr/find/products (Korean)
www.agilent.com.tw/find/products (Traditional Chinese)

Product Number Index

Model Index 10070 – 4396B

1

10070	Passive Divider Probes Family	57
10072A	Probe Family SMT Kit	57, 61
10076A	High Voltage Probe	57, 65-66
10077A	Accessory Kit for High Voltage Probe	65-66
10400	Passive Divider Probes Family	58
10450A	Probe Family SMT Kit	61
10467-68701	IC Clip Accessory Kit	59-61
1070x A/B	Interferometers	468
1071x A	Differential Interferometers	468
1072x A	Differential Interferometers	468
10737 L/R	Compact Three-Axis Interferometers	468
10885A	PC-Compatible Laser Axis Board	469
10886A	PC Compensation Board	468-470
10887B	PC Calibrator Board	469-470
10887P	Programmable PC Calibrator Board	469
10889B	PC Servo-Axis Board	469
10895A	VMEbus Laser Interferometer	469
10896B	VMEbus Compensation Board	468-469
10897B	VME Laser Axis Board	467, 469
11059A	Kelvin Probe Set	83
11060A	SMD Test Probe	83
11062A	Kelvin Clip	83
1141A	Differential Probe	57, 62
1142A	Power Supply for Active Probe	62-64
1143A	Probe Offset and Power Module	63-64
1144A	Active Probe	57, 63-64
1145A	Active Probe	57, 63-64
1146A	Oscilloscope ac/dc Current Probe	57, 65-66
1152A	Active Probe	57, 63-64
1153A	Differential Probe	44, 47, 57, 62
1154A	Differential Probe	44, 47, 57, 62
1155A	Low Mass Active Probe	44, 47, 57, 63-64
11581A	Coaxial Attenuator Set	284
11582A	Coaxial Attenuator Set	284
11583C	Coaxial Attenuator Set	284
1159A	Differential Probe	44, 47, 57, 62
1160A	Family Miniature Passive Probe	57-59, 61
11636A	Power Dividers	235-236
11636B	Power Divider	235-236
11667A	Power Splitter	235-236
11667B	Power Splitter	56, 235-236, 447
11667C	Power Splitter	56, 235-236, 447
11679A	Extension Cable	235-236
11679B	Extension Cable	235-236
11691D	Coaxial Directional Coupler	287
11692D	Coaxial Directional Coupler	287
11693A	Limiter	178, 199
11694A	Matching Transformer	199
11713A	Attenuator/Switch Driver	273, 275, 279, 282, 329, 420
11716 Series	Attenuator Interconnect Kits	282
1171A	Low Mass Passive Probe	60
1173A	Low Mass Passive Probe	60
1180C	Testmobile Scope Cart	349-350, 352
1181B	Testmobile System Cart	349-350, 352

11850C/D	Three-Way Power Splitters	241
11852B	Minimum Loss Pad	235-236, 241
11867A	RF Limiter	199
11930A/B	Power Limiters	241
11940A	Close Field Probe	168, 200-202
11941A	Close Field Probe	168, 200-202
11945A	Close Field Probe Set	201-202
11970x Series	Harmonic Mixers	198
11974x Series	Preselected Millimeter Mixers	198
11975A	Power Amplifier	198
16196A/B/C	Parallel Electrode SMD Test Fixtures	217, 219-220, 255, 257
16197A	Bottom Electrode SMD Test Fixture	217, 219-220, 255-257
16451B	Dielectric Material Test Fixture	254-255, 259, 261
16452A	Liquid Test Fixture	254-255, 259
16453A	Dielectric Material Test Fixture	254-255, 257-258
16454A	Magnetic Material Test Fixture	254-255, 257-258, 261
16534A	Digitizing Oscilloscope Card	293
1670 Series	Logic Analyzer Standalone	290
16700	Logic Analyzer in Modular Systems	9, 290, 299
16700B	Logic Analysis System Frame	291
16701B	Logic Analysis Expansion Frame	291
16702B	Logic Analysis System Frame	291
1670G	Standalone Logic Analyzers	296
1671G	Standalone Logic Analyzers	296
1671xA	Logic Analysis Modules	292
16720A	Pattern Generator Module	293
1672G	Standalone Logic Analyzers	296
1673G	Standalone Logic Analyzers	296
1674xA	Logic Analysis Modules	292
1675xA	Logic Analysis Modules	292
1675xB	Logic Analysis Modules	292
16760A	Logic Analysis Module	292, 300
1680 Series	Logic Analyzer Standalone	290, 296
1680A/1680AD	Standalone Logic Analyzers	296
1681A/1681AD	Standalone Logic Analyzers	296
1682A/1682AD	Standalone Logic Analyzers	296
1683A/1683AD	Standalone Logic Analyzers	296
1690 Series	Logic Analyzer PC-Hosted	290
1690A/1690AD	PC-Hosted Logic Analyzers	297
1691A/1691AD	PC-Hosted Logic Analyzers	297
1692A/1692AD	PC-Hosted Logic Analyzers	297
1693A/1693AD	PC-Hosted Logic Analyzers	297
1730B	Fiber Channel Test Module	460-461

3

3070 Family	In-Circuit Test (ICT) System	472
33120A	Function/Arbitrary Waveform Generator	84, 89-91

33220A	Function/Arbitrary Waveform Generator	3, 89, 92-93, 316
33250A	Function/Arbitrary Waveform Generator	84, 89, 92, 94-95
34132A/B	Deluxe Test Lead Kits	83
34133A	Precision electronic DMM test lead	83
34134A	DMM dc/ac Current Probe	83-84
34135A	DMM dc/ac Current Probe	83-84
34161A	Accessory Pouch	72, 78, 80, 83-84, 88, 91, 93, 95, 242
34171A	DMM Terminal Connector	78, 83-84
34172A	DMM Calibration Short	78, 83-84
34330A	30A Current Shunt	83-84
34401A	Digital Multimeter	76-78, 83-84, 420
34420A	Nanovolt/micro-ohm Meter	76, 79-80, 83-84
3458A	Digital Multimeter	76, 81-83
346 Series	Noise Sources	250-252
34970A	Data Acquisition/Switch Unit	76, 85-88, 339
3499A	System Switch Mainframe	339-343
3499B	System Switch Mainframe	339-343
3499C	System Switch Mainframe	339-343
355 Series	Step Attenuators	282-283
35670A	Dynamic Signal Analyzer	170, 344
37907A	Signaling Advisor Mainframe	457-458

4

40653B	Thermistor Surface Assembly	83-84
4070 Family	Semiconductor Test System	473
4155C	Precision Semiconductor Parameter Analyzer	474
4156C	Precision Semiconductor Parameter Analyzer	474
4157A	Precision Semiconductor Parameter Analyzer	474
41800A	Active Probe	173, 178, 215, 220
423B	Low-barrier Schottky Diode Detector	285-286
4263B	LCR Meter	254-255, 264
4268A	Capacitance Meter	254-255, 262
4284A	Precision LCR Meter	254-255, 266-267
4285A	Precision LCR Meter	254-255, 266-267
4287A	RF LCR Meter	254-255, 263
4288A	Capacitance Meter	254-255, 262
4294A	Precision Impedance Analyzer	253, 255, 259-261
4338B	Milliohmeter	254, 268
4339B	High Resistance Meter	254, 265
43521A	Downconverter Unit	269-271
4352B	VCO/PLL Signal Analyzer	269-271
4352S	VCO/PLL Signal Test System	170, 269-271
4395A	Network/Spectrum/Impedance Analyzer	207, 216-217, 219-220, 253, 255
43961A	RF Impedance Test Kit	216-220, 255
4396B	RF Network/Spectrum/Impedance Analyzer	207, 218-220, 253, 255

Product Number Index

5071A – 8490D Model Index

5

5071A Primary frequency standard	464-466
53131A Universal Counter	69-72
53132A Universal Counter	69-72
53147A Microwave Counter/ Power Meter/DVM	69-70, 75
53148A Microwave Counter/ Power Meter/DVM	69-70, 75
53149A Microwave Counter/ Power Meter/DVM	69-70, 75
53150A Microwave Frequency Counter	69-70, 73-74
53151A Microwave Frequency Counter	69-70, 73-74
53152A Microwave Frequency Counter	69-70, 73-74
53181A RF Counter	69-72
53305A Phase Analysis Software	67-68
53310A Modulation Domain Analyzer	67-69, 170
54006A Resistive Divider Probe Kit	56-57, 65-66, 447
54600 Series Portable Oscilloscopes	40, 44, 48-50, 62, 66
5462xD Series Mixed Signal Oscilloscope	40-44
5464xD Series Mixed Signal Oscilloscope	40-44
54754A Differential TDR module	54-56, 440, 445-446
54800 Series General-Purpose Infiniium Oscilloscopes	45-47, 59, 63, 66, 293, 296-297
5483xD Series Infiniium Mixed Signal Oscilloscope	40-44
54850 Series High-Performance Infiniium Oscilloscopes	9, 51-53, 60, 66
5507B Laser position transducer electronics	469
55292A Calibrator USB expansion module	470
5529A Dynamic Calibrator	469-470
5DX Series Automatic X-Ray Inspection (AXI) System	472

6

601xA DC Power Supply	101, 117-118
602xA DC Power Supply	117
603xA DC Power Supply	100, 117-118
6060B Electronic Load	96
6063B Electronic Load	96
654xA DC Power Supply	101, 112
655xA DC Power Supply	101, 113
657xA DC Power Supply	101, 114
66000A Modular Power System Mainframe	102-103, 118
66001A Modular Power System Keyboard	102-103
661xC DC Power Supply	100, 109
662xA DC Power Supply	100, 110
66309B Mobile Communication dc Source	100, 104-105
66309D Mobile Communication dc Source	104-105

66311B Mobile Communication dc Source	100, 104-105
66311D Mobile Communication dc Source	104-105
66319B Mobile Communication dc Source	100, 104-105
66319D Mobile Communication dc Source	104-105, 421
66321B Mobile Communication dc Source	100, 104-105
66321D Mobile Communication dc Source	104-105
66332A Dynamic Measurement dc source	100, 108
663xB DC Power Supply	100, 111
664xA DC Power Supply	112
665xA DC Power Supply	100, 113
667xA DC Power Supply	100, 114
668xA DC Power Supply	100, 115
669xA DC Power Supply	100, 116
6800 Series AC Power Solutions	126-127
6811B AC Source/Analyzer	126-127
6812B AC Source/Analyzer	126-127
6813B AC Source/Analyzer	126-127

7

70611A Attenuator/Switch driver	273, 282, 329
71612C Bit Error Rate Tester (BERT)	382, 388
75000 VXI Bus Family	337-338
770 Series Directional Couplers	287

8

81101A Pulse Generator	302-306
81104A with 81105A Pulse Generator	302-306
81110A with 81111A Pulse Generator	302-306
81110A with 81112A Pulse Generator	302-306
81130A with 81131A Pulse Generator	302-306
81130A with 81132A Pulse Generator	302-306
81133A Pulse-/Pattern Generator	4, 302-306
81134A Pulse-/Pattern Generator	4, 53, 302-306
8114A Programmable Pulse Generator	302-306
81200 Data Generator/Analyzer Platform	307-308
81250A Parallel Bit Error Ratio Tester	308, 449-451
8133A Pulse Generator	302-306
814xxB Series Tunable Laser Source	361-362
8156xA Optical Attenuators	355
8157xA High Power Optical Attenuators	355-356, 369-370
8161xx Return Loss Modules	368
8162xx Optical Heads Modules	368
8163B Lightwave Multimeter	355-358
8163xx Power Sensor Modules	368
8164B Lightwave Measurement System	354-357, 360-362, 373
81662A DFB Source Module	355-357, 365-367
81663A DFB Laser Source Module	355-357, 365-367

8166B Lightwave Multichannel System	355-357, 359
816xxB Series Tunable Laser Source	361-362
81910A Photonic All-Parameter Analyzer	17, 371-373
8194xA Series Tunable Laser Source	363-364
8198xA Series Tunable Laser Source	363-364
82341C ISA High-Performance GPIB Card	317
82350B PCI High-Performance GPIB Card	314, 316-317
82357A USB/GPIB Interface	88, 213, 314, 316-317
83036C Broadband Directional Detector	285-287
83484A Dual Electrical Channel Modules	444
83491A Electrical Clock Recovery Plug-in	56, 445-446
83492A Multi-Mode Clock Recovery Plug-in	56, 445-446
83493A Single-Mode Clock Recovery Plug-in	56, 445-446
83494A Single-Mode Clock Recovery Plug-in	56, 445-446
83554A mm-Wave Source Module	130, 166
83555A mm-Wave Source Module	166
83556A mm-Wave Source Module	166
83557A mm-Wave Source Module	166
83558A mm-Wave Source Module	130, 166
83650B/L Synthesized Swept Signal and CW Generator	164-165
84000RF Semiconductor Test System	473
84105EM Design Development System	201-202
84115EM Pre-Production Evaluation System	201-202
8447A Amplifier	199
8447D Amplifier	199
8449B Microwave Preamplifier	183, 199, 202
8470 Series Planar-Doped Barrier Detectors	285-286
8481A Power Sensor	246
8481B Power Sensor	246
8481D Power Sensor	246
8481H Power Sensor	246
8482A Power Sensor	246, 414-415
8482B Power Sensor	246
8482H Power Sensor	246
8483A Power Sensor	246
8485A Power Sensor	246
8485D Power Sensor	246
8487A Power Sensor	246
8487D Power Sensor	246
84904K Programmable Step Attenuator	279-281
84904L Programmable Step Attenuator	279-281
84904M Programmable Step Attenuator	279-281
84905M Programmable Step Attenuator	279-281
84906K Programmable Step Attenuator	279-281
84906L Programmable Step Attenuator	279-281
84907K Programmable Step Attenuator	279-281
84907L Programmable Step Attenuator	279-281
84908M Programmable Step Attenuator	279-281
8490D Coaxial Fixed Attenuator	56, 284, 447

Product Number Index

Model Index 8493 Series – E1962B

8493 Series Coaxial Fixed Attenuator	284
8494 Series Step Attenuators	273, 277, 282-283
84940A Switch Driver	273, 329
84941A Distribution Card	273
8495 Series Step Attenuators	273, 277, 282-283
8496 Series Step Attenuators	273, 277, 282-283
8497 Series Step Attenuators	273, 277, 282-283
8498A High Power Attenuator	284
85022A System Cable Kit	235-236
85024A High Frequency Probe	173, 178, 241
85025A Coaxial Detector	233, 236
85025B Coaxial Detector	233, 236
85025C Detector adapter	233-234, 236
85025D Coaxial Detector	233, 236
85025E Return Loss Detector	233-234, 236
85027A Directional Bridge	234, 236
85027B Directional Bridge	234, 236
85027C Directional Bridge	234, 236
85027D Directional Bridge	234, 236
85027E Directional Bridge	234, 236
85037A Precision Detector	233
85037B Precision Detector	233-234, 236
85046A/B S-Parameter Test Set	225, 227-228
85047A S-Parameter Test Set	225, 227-228
85121A Satellite Payload Test Solutions	334
8560EC High Performance Portable Spectrum Analyzer	180-183
8561EC High Performance Portable Spectrum Analyzer	180-183
8562EC High Performance Portable Spectrum Analyzer	180-183
8563EC High Performance Portable Spectrum Analyzer	180-183, 199
8564EC High Performance Portable Spectrum Analyzer	180-183
8565EC High Performance Portable Spectrum Analyzer	180-183
85901A Portable AC Power Source	183, 203-204
85905A 75 ohm Preamplifier	173, 203-204
8591C Cable TV Analyzer	169, 203-204
86038A Optical Dispersion Analyzer	375
86100B Infiniium Digital Communications Analyzer (DCA)	54-56, 66, 377, 438-447
86101A Optical/Electrical Modules	55, 440-441, 446
86102A Optical/Electrical Modules	55, 440-441, 446
86102U Optical/Electrical Modules	55, 440-441, 446
86103A Optical/Electrical Modules	55, 440, 442, 446
86103B Optical/Electrical Modules	55, 440, 442, 446
86106B Optical/Electrical Modules	55, 440, 442, 446
86109A Optical/Electrical Modules	55, 440, 443, 446
86109B Optical/Electrical Modules	55, 440, 443, 446
86111A Dual Optical Channel Modules	55, 440, 444, 446
86111U Dual Optical Channel Modules	55, 440, 444, 446
86112A Dual Electrical Channel Modules	55, 440, 444, 446
86113A Dual Optical Channel Modules	55, 440, 444, 446

86115B Dual Optical Channel Modules	55, 440, 444, 446
86120B/C Multi-Wavelength Meter	383-387
86122A Multi-Wavelength Meter	375, 383-387
86146B Optical Spectrum Analyzer	376-377, 379-381
8614xB Optical Spectrum Analyzer	376-380
86205A 50 ohm RF Bridge	241
86207A 75 ohm RF Bridge	241
8644B Synthesized Signal Generator	130, 160-161, 270
8645A Frequency-agile generator	130, 162-163
8648A Synthesized RF Signal Generator	130, 158-159
8648B Synthesized RF Signal Generator	158-159
8648C Synthesized RF Signal Generator	158-159
8648D Synthesized RF Signal Generator	158-159
8664A Synthesized Signal Generator	160-161, 270-271, 421
8665B Synthesized Signal Generator	160-161, 271
87050B Opt H37 Duplexer Test Set	237
87050E "Multiport Test Set, 50 ohm"	222-224
87075C "Multiport Test Set, 75 ohm"	222-224
87104 Series Multiport Switches	277-278
87106 Series Multiport Switches	277-278
8712ES RF Vector Network Analyzer	207, 221-224
8712ET RF Vector Network Analyzer	221-224
87130A Attenuator/Switch Driver	273, 275, 277, 279, 282, 329
8714ES RF Vector Network Analyzer	207, 221-224
8714ET RF Vector Network Analyzer	221-224
8719ES Microwave Vector Network Analyzer	207, 229-231
8719ET Microwave Vector Network Analyzer	229-231
87204 Series Multiport Switches	277-278
87206 Series Multiport Switches	277-278
8720D Opt K22 Multiple Port Test Set	237
8720ES Microwave Vector Network Analyzer	207, 229-231
8720ET Microwave Vector Network Analyzer	207, 229-231
87222 Coaxial Transfer Switches	277-278
8722ES Microwave Vector Network Analyzer	207, 229-231
8722ET Microwave Vector Network Analyzer	229-231
87300 Series Hybrid Power Dividers	287
87406B Coaxial Matrix Switch	277
87511A S Parameter Test Set	216-217, 220
87511B S Parameter Test Set	217, 220
87512A Transmission/Reflection Test Kit	215, 217, 219-220
87512B Transmission/Reflection Test Kit	217, 219-220
8753ES RF Network Analyzer	207, 225-228, 237
8753ES Opt H85 High Power Test Set	237
8753ET RF Network Analyzer	225-226, 228, 241

8757D Scalar Network Analyzer	8, 142, 146, 154-155, 157, 207, 232-236
8757XC Coaxial Scalar System	236
8760 Series Custom Switch Matrices	329
87606B Coaxial Matrix Switch	277
8761 Series Coaxial Switches	275-276
8762 Series Coaxial Switches	273, 275-276
8763 Series Coaxial Switches	273, 275-276
8764 Series Coaxial Switches	273, 275-276
8765 Series Coaxial Switches	275-276
8766 Multiport Switch	273, 277-278
8767 Multiport Switch	277-278
8768 Multiport Switch	277-278
8769 Series Multiport Switches	277-278
89410A Vector Signal Analyzer	170, 197
89441A Vector Signal Analyzer	170, 197
89441V VSB/QAM Vector Signal Analyzer	170, 197
8960 Series Wireless Communication Test Set	392-408, 419
89610 Baseband Vector Signal Analyzer	196
89611 IF Vector Signal Analyzer	196
89640 RF Vector Signal Analyzer	196
89641 RF Vector Signal Analyzer	196

9

93000 SOC Semiconductor Test System	473
-------------------------------------	-----

A

ADN Agilent Developer Network	12, 318
-------------------------------	---------

B

B4600B System Performance Analysis Tool	294
B4601B Serial Analysis Tool	294
B4605B Tool Development Kit	294
B4620B Source Correlation Tool Set	294
B4640B Data Communication Toolset	295
B4645B MPEG Analysis Tool	295

E

E1368A Microwave Switch	273, 338-339
E1369A Microwave Switch Driver	273, 338-339
E1370A Microwave Switch/Step Attenuator Driver	273, 338-339
E1371B DOCSIS Design Verification Test System	331
E1852B Bluetooth Test Set	411-412
E1961A AMPS/136 Mobile Test Application	392, 397-400
E1962B cdma2000/IS-95/AMPS Mobile Test Application	392, 395-396, 399-400, 405

Product Number Index

E1963A – E6562A Model Index

E1963A W-CDMA Mobile Test Application 392, 394, 399-400, 404	E4416A Peak and Average Power Meter 242-243, 245	E4862A Data Generator Front End Module 307-308, 449-450
E1966A 1xEV-DO Terminal Test Application 15, 392, 395, 399	E4417A Peak and Average Power Meter 242-243, 245	E4862B Generator Front End Module 449-451
E1968A GSM/GPRS Mobile Test Application 392-393, 399-400, 402	E4418B Single Channel EPM Series Power Meter 225, 244, 420-421	E4863A Data Analyzer Front End Module 307-308, 449-450
E1985D Mobile Test Applications Fast Switching 392-394, 398-400	E4419B Dual Channel EPM Series Power Meter 225, 244	E4863B Analyzer Front End Module 449-451
E1991B Mobile Test Application Suite 392, 399-400	E4420B ESG-A Analog Series RF Signal Generator 151-153	E4864A Data Generator Front End Module 307-308, 449-450
E2156A Optical Amplifier Test Solution 389	E4421B ESG-A Analog Series RF Signal Generator 151-153	E4865A Data Analyzer Front End Module 307-308, 449-450
E2158A Optical Amplifier Test Solution 389	E4422B ESG-A Analog Series RF Signal Generator 151-153, 448	E4868B 43G Multiplexer Module 11, 449-451
E2307A Thermocouple Bead Temperature Probe 83-84	E4423B ESG-AP Analog Series RF Signal Generator 130, 151-153	E4869B 43G Demultiplexer Module 11, 449-451
E2308A Thermistor Temperature Probe 83-84	E4424B ESG-AP Analog Series RF Signal Generator 151-153	E4875A ParBERT User Software 449-451
E2613A Wedge Probe Adapter 60-61	E4425B ESG-AP Analog Series RF Signal Generator 151-153	E4991A RF Impedance/Material Analyzer 253, 255-258
E2613B Wedge Probe Adapter 58-61	E4426B ESG-AP Analog Series RF Signal Generator 151-153	E4991A-002 Material Measurement Firmware 257-258
E2614A Wedge Probe Adapter 58-61	E4430B ESG-D Series RF Signal Generator 130, 147-150	E5070B ENA Series Network Analyzer 207-209
E2615A Wedge Probe Adapter 60-61	E4431B ESG-D Series RF Signal Generator 147-150	E5071B ENA Series Network Analyzer 207-209
E2615B Wedge Probe Adapter 58-61	E4432B ESG-D Series RF Signal Generator 147-150	E5091A Multiple Port Test Set 208-209
E2616A Wedge Probe Adapter 58-61	E4433B ESG-D Series RF Signal Generator 147-150	E5100A Network Analyzer 207, 214-215, 254
E2643A Wedge Probe Adapter 58-61	E4434B ESG-DP Series RF Signal Generator 130, 147-150	E5270A Precision Semiconductor Parameter Analyzer 474
E2644A Wedge Probe Adapter 58-61	E4435B ESG-DP Series RF Signal Generator 147-150	E5272A/73A Precision Semiconductor Parameter Analyzer 474
E2925B PCI Analyzer 309-310	E4436B ESG-DP Series RF Signal Generator 147-150	E5378A Single Ended Probe for Logic Analyzer 300
E2928A PCI Analyzer 309-310	E4437B ESG-DP Series RF Signal Generator 147-150	E5379A Differential Probe for Logic Analyzer 300
E2929B PCI-X Protocol Checker 309-310	E4438C ESG Vector Signal Generator 130-139, 421	E5380A Single Ended Probe for Logic Analyzer 300
E2930A PCI Analyzer 309-310	E4440A PSA Spectrum Analyzer 140, 169, 185-191	E5381A Differential Flying Lead Probe Set 300
E2940A PCI Analyzer 309-310	E4443A PSA Spectrum Analyzer 169, 185-191	E5382A Single-Ended Flying Lead Probe Set 300
E361xA dc Power Supply 101, 123	E4444A BenchLink Spectrum Analyzer PC Software 173	E5387A Differential Soft Touch Probe 10, 300
E3620A Laboratory dc Power Supply 101, 122	E4445A PSA Spectrum Analyzer 169, 185-191, 421	E5390A Single-Ended Soft Touch Probe 10, 300
E3630A Laboratory dc Power Supply 101, 122	E4446A PSA Spectrum Analyzer 169, 185-191	E5500 Series Phase Noise System 332-333, 388
E363xA DC Power Supply 100, 121, 420	E4448A PSA Spectrum Analyzer 185-191	E5501A Phase Noise Measurement Solution 333
E364xA DC Power Supply 100, 119-120	E4805A Clock Module 307-308	E5501B Phase Noise Measurement Solution 333
E3661B Rack Cabinet 345-347	E4810A Optical-Electrical Generator Module 449-451	E5502B Phase Noise Measurement Solution 333
E3662B Rack Cabinet 345-347, 351	E4811A Optical-Electrical Analyzer Module 449-451	E5503A Phase Noise Measurement Solution 333
E4350B Solar Array Simulator 100, 107	E4832A Data Generator/Analyzer Module 307-308, 449-451	E5503B Phase Noise Measurement Solution 333
E4351B Solar Array Simulator 100, 107	E4835A Data Analyzer Front End Module 307-308, 449-451	E5504A Phase Noise Measurement Solution 333
E4356A Telecom dc Power Supply 100, 106	E4838A Data Generator Front End Module 307-308, 449-451	E5504B Phase Noise Measurement Solution 333
E4370A Multi-Cell Charger/Discharger 125	E4841A Data Generator/Analyzer Module 307-308	E5515C Wireless Communication Test Set 15, 392-395, 399, 402, 404-410, 421
E4400B ESG-A Analog Series RF Signal Generator 130, 151-153	E4846A Dual 200 Mbit/s Generator Module 307-308	E5810A LAN/GPIB Gateway 88, 314, 316-317
E4401B ESA-E Series Spectrum Analyzer 169, 176-178	E4847A Dual 200 Msa/s Analyzers Module 307-308	E5900B Emulation Probe Products 299
E4402B ESA-E Series Spectrum Analyzer 169, 176-179	E4848B Expander Frame for 81200 307-308	E5901B Emulation Module Products 299
E4403B ESA-L Series Spectrum Analyzer 169, 171-173	E4849C Data Generator and Analyzer Mainframe 307-308	E5904B Trace Port Analyzer 290, 299
E4404B ESA-E Series Spectrum Analyzer 169, 176-179	E4861A Data Generator/Analyzer Module 307-308, 449-450	E6000C Mini OTDR Mainframe 433
E4405B ESA-E Series Spectrum Analyzer 169, 176-179, 420	E4861B Generator/Analyzer Module 449-451	E60xyA/B OTDR Modules 433
E4406A VSA Transmitter Tester 192-194		E6473B Network Optimization Solution Hardware 416
E4407B ESA-E Series Spectrum Analyzer 169, 176-179, 420		E6474A Network Optimization Solution Software 416
E4408B ESA-L Series Spectrum Analyzer 169, 171-173		E6476A Air Interface Remote Monitoring System 417
E4411B ESA-L Series Spectrum Analyzer 169, 171-173		E6478A Wireless Remote Monitoring System Software 417
E4412A CW Power Sensor 245		E6482A Wizard RF Network Planning Software 418
E4413A CW Power Sensor 245		E6560A cdma2000/IS-95 Wireless Test Manager 392, 396, 400-401, 405

Product Number Index

Model Index E6563A – JS1000

E6563A AMPS/136 Wireless Test Manager	392, 398, 401
E6564A 1xEV-DO Wireless Test Manager	15, 392, 395, 401
E6566A GSM/GPRS Wireless Test Manager	392-393, 400-402, 407
E6568B Wireless Test Manager Suite	392, 401, 407
E6569B Wireless Test Manager Suite	392, 399, 401
E6571A Wireless Test Manager Run-Time License	393-396, 398-401
E6581A GPRS Wireless Protocol Advisor	409-410
E6582A CDMA Wireless Protocol Advisor	410
E6583A W-CDMA Wireless Protocol Advisor	410
E6701C GSM/GPRS Lab Application	392, 402-403, 406-407, 409-410
E6702A cdma2000 Lab Application	392, 405-406, 410
E6703A W-CDMA Lab Application	392, 404, 406-407, 410
E6704A EGPRS Lab Application	392, 402-403, 407
E6719A Lab Application Suite	392, 406
E6785A GSM/GPRS_W-CDMA Lab Application	392, 402, 404, 406-407
E6900A Wireless Protocol Test Set	408-410
E6910A GSM/GPRS Protocol Application	408-410
E7317B RouterTester Routing Test Card	459
E7318B RouterTester Routing Test Card	459
E7333A DOCSIS Protocol Analyzer	331
E740xA Series EMC Analyzers	200
E7415A EMI Measurement Software	201-202
E7495A Base Station Test Set	14, 413-415
E7571A E1 Balanced Link Interface Module	457-458
E7572A E1 Unbalanced Link Interface Module	457-458
E7573A T1 Link Interface Module	457-458
E7574A V.35 Link Interface Module	457-458
E7575A DSO/DSOA Link Interface Module	457-458
E7577A Link Expansion Undercradle for Signaling Advisor	457-458
E7578A Fast Ethernet Undercradle	457-458
E7590A Rack Cabinet	345-347, 351
E7849A RouterTester Software	459
E7900A RouterTester Chassis	459, 461
E7906A RouterTester Ethernet Routing Test Card	459
E7907A RouterTester Routing Test Card	459
E7909A RouterTester Routing Test Card	459
E7912A RouterTester Portable Chassis	459
E7917A RouterTester Routing Test Card	459
E7919A RouterTester Routing Test Card	459
E7920A RouterTester Routing Test Card	459
E7922A RouterTester Ethernet Routing Test Card	459
E8247C PSG CW Signal Generator	8, 130, 154-157, 166, 236, 270-271, 421
E8257C PSG Analog Signal Generator	8, 130, 154-157, 270-271
E8267C PSG Vector Signal Generator	8, 130, 140-146, 270-271
E8311A VXI Pulse-/Pattern Generator	302-306, 337

E8312A VXI Pulse-/Pattern Generator	302-306, 337
E8356/7/8A PNA Series RF Network Analyzer	207, 210-213
E8361A PNA Series Microwave Network Analyzer	5, 207, 210-213
E8362/3/4B PNA Series Microwave Network Analyzer	207, 210-213
E8770A TS5402 Automotive Electronics Functional Test System	328
E8780A TS5401 Automotive Electronics Functional Test System	328
E8786A TS5400 Automotive Electronics Functional Test System	328
E8801/2/3A PNA Series RF Network Analyzer	207, 210-213, 301
E9300A Average Power Sensor	245
E9300B Average Power Sensor	245
E9300H Average Power Sensor	245
E9301A Average Power Sensor	245
E9301B Average Power Sensor	245
E9301H Average Power Sensor	245
E9304A Average Power Sensor	245
E9321A Peak and Average Power Sensor	243
E9322A Peak and Average Power Sensor	243
E9323A Peak and Average Power Sensor	243
E9325A Peak and Average Power Sensor	243
E9326A Peak and Average Power Sensor	243
E9327A Peak and Average Power Sensor	243
E9340A Logic Analyzer PC-Hosted	290, 297
E9340A/LOGICWAVE PC-Hosted Logic Analyzers	297

G

GS8300 WLAN Manufacturing System	420
GS8800 RF Design Verification System	421-422

I

IntuiLink Connectivity Software	3, 41, 44, 50, 71-72, 76-77, 79, 89-90, 92, 94, 131, 171, 174, 178, 185, 191, 200, 202, 312, 316, 318
--	---

J

J1981B VQT Portable Analyzer Mainframe	431-432
J2126A Transmission Test Set	436-437
J2127A Transmission Test Set	436-437
J2286B DB-9 to Dual Siemens Cable Set	429-430
J2294D E1/T1 DB-9/RJ-45 Interface Module	429-430
J2296D E1 Interface Module	429-430
J2298D E1/T1 RJ-45/RJ-48C/Mini-bantam Interface	429-430
J2300E WAN Protocol Analyzer	429-430

J2307A Advisor LAN-token Ring Undercradle	429-430
J2524A Advisor LAN – FDDI Undercradle	429-430
J2900A Advisor High Speed Acquisition Undercradle	429-430
J2901A Advisor LAN – Gigabit Ethernet Undercradle	429-430
J2905B ISDN BRI S/T and U Interface Module	429-430
J2908A Advisor-DDS Module	429-430
J2911A J2 (6.13 MBs) ATM Interface Module	429-430
J2912B Advisor OC-3/STM-1 Module	429-430
J2913B UTP155 interface Module	429-430
J2914A Advisor STM-1e/EC-3 Module	429-430
J3444A Advisor LAN – Fast Ethernet Undercradle	429-430
J3445A Advisor LAN – 100Base-FX Interface	429-430
J3446E Advisor LAN Protocol Analyzer	429-430
J3447A 100 Base FX Interface Module	429-430
J3759B Advisor WAN-DS3/E3 Cells and Frames Module	429-430
J3762B Advisor WAN – HSSI Module	429-430
J3763A OC-12/STM-4 Undercradle	429-430
J3764A 622 Mbs Single Mode Interface Module	429-430
J3766A Advisor ATM25 Module	429-430
J4618C IP Telephony Analyzer	431-432
J4646A Unbalanced E1 Primary Rate ISDN PRI I/F Module	429-430
J4647A Balanced E1 Primary Rate ISDN PRI I/F Module	429-430
J4648A Balanced T1 Primary Rate ISDN I/F Module	429-430
J4649A Balanced T1 Primary Rate ISDN I/F Module	429-430
J5425A Switch Advisor Software – RMON License	429-430
J5457A High-speed V-series Interface	429-430
J5492A LX GBIC Modules	429-430
J6753A Additional Combo 56k Modem	428-430
J6781A Network Troubleshooting Center	426-428
J6800A Network Analyzer	16, 426-428
J6801A Distributed Network Analyzer	426-428
J6802A Distributed Network Analyzer	426-428
J6805A Distributed Network Analyzer	426-428
J6835A Network Analyzer Software Edition Agent	426-428
J6840A Network Analyzer Software	426-428
J6844A Telephony Network Analyzer	428, 431-432
J6848A Report Center	426-428
J7230C OmniBER OTN Communications Performance Analyzer	456
J7231B OmniBER OTN Jitter Analyzer	453
J7232A OmniBER OTN Communications Performance Analyzer	454
JS1000 Performance Jitter Solution	388

Product Number Index

N1810TL – Trademark Information

Model Index

N

N1810TL Terminated Latching SPDT	274
N1810UL Unterminated Latching SPDT	274
N1811TL Terminated Latching Bypass	274
N1812UL Unterminated Latching 5-Port	274
N1886A GS-9200 MCPA Test System	423
N1891A Digital Communication Measurement System	332, 334
N1900A Physical Layer Test Systems	7, 301
N1930A Physical Layer Test System Software	301
N1947A Physical Layer Test System	301
N1948A Physical Layer Test System	301
N1951A Physical Layer Test System	301
N1953A Physical Layer Test System	301
N1957A Physical Layer Test System	301
N2002A Noise Source Test Set	5, 250-252
N2771A High Voltage Probe	57, 65-66
N2772A Differential Probe	57, 62
N2773A Universal Power Supply for Differential Probe	62
N3280A Component Test dc Power Supply	100, 124
N3300A Electronic Load Mainframe	97-98
N3301A Electronic Load Mainframe	98
N3302A Electronic Load Module	98
N3303A Electronic Load Module	98
N3304A Electronic Load Module	98-99
N3305A Electronic Load Module	98
N3306A Electronic Load Module	97-99
N3307A Electronic Load Module	98-99
N3381/2/3A PNA Series RF Network Analyzer	207, 210-213
N3900A Modular Network Tester	435
N3970A Optical Power Meter	434
N3974A Dual Laser Source	434
N3977A Automated Optical Attenuator	434
N4000A SNS Series Noise Sources	247, 250-252
N4018A Bluetooth Wireless Test Manager Run-Time License	401, 411-412
N4019A Bluetooth Wireless Test Manager	401, 411-412
N4041A GS-8000 Functional Test System	419
N4042A GS-8000 Functional Test System	419
N415xA Spectral-Loss Measurement Solutions	374
N4206A Protocol Analysis Tool for InfiniBand	295
N421xA Gigabit Ethernet Protocol Analysis Tool Set	295
N4220A PCI-Express Packet Analysis Probe	11, 295
N4430B RF Ecal Module	301
N4872A 13.5 Gb/s Generator	11, 449-451
N4873A 13.5 Gb/s Analyzer Module	11, 449-451
N4901A Serial BERT	12, 452
N4902A Serial BERT	12, 452
N4906A Serial BERT	12, 448
N5101A Baseband Studio	7, 131, 139-140, 146
N8972A NFA Series Noise Figure Analyzer	247-249
N8973A NFA Series Noise Figure Analyzer	247-249

N8974A NFA Series Noise Figure Analyzer	247-249
N8975A NFA Series Noise Figure Analyzer	5, 247-249, 252

O

OmniBER XM Network Simulator	15, 455
------------------------------	---------

Q

Q8486A Waveguide Power Sensor	246
Q8486D Waveguide Power Sensor	246
Q85026A Waveguide Detector	234, 236

R

R8486A Waveguide Power Sensor	246
R8486D Waveguide Power Sensor	246
R85026A Waveguide Detector	234, 236

S

SJ Series Automatic Optical Inspection (AOI) System	472
---	-----

T

TS5400 Automotive Electronics Functional Test System	331
--	-----

U

U85026A Waveguide Detector	234, 236
----------------------------	----------

V

V8486A Waveguide Power Sensor	246
VEE Graphical Programming Environment	77, 86, 119, 242, 312, 314-316, 318, 330, 335, 337, 374, 378
Versatest Series Semiconductor Test System	473
Visual Studio .NET Test & Measurement Programmers Toolkit	312-314, 316, 318
VXI Modular Test System	339

W

W8486A Waveguide Power Sensor	245-246
-------------------------------	---------

Z

Z2049A Wireless Device Test Fixture	422
Z2090A Component Test System	332
Z5621A Opt H36 Duplexer Test Set Adapter	237

Trademark Information

BitAlyzer® is a registered trademark of SyntheSys Research Inc.

Bluetooth and the Bluetooth logos are trademarks owned by Bluetooth SIG, Inc., U.S.A. and licensed to Agilent Technologies, Inc.

Cadence and Cadence product names are registered trademarks of Cadence Design Systems, Inc.

cdma2000 is a registered trademark of the Telecommunications Industry Association (TIA-USA).

MATLAB® is a U.S. registered trademark of the MathWorks, Inc.

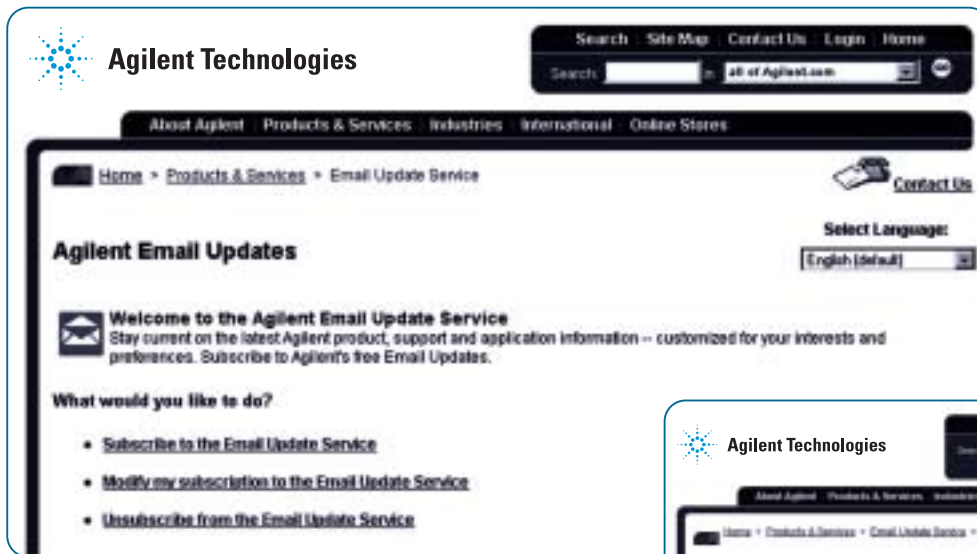
Microsoft, Windows, and Visual Basic are U.S. registered trademarks of Microsoft Corporation.

Third-party product information is included for informational purposes only and does not constitute an endorsement or recommendation by Agilent Technologies, Inc. Third-party product providers are solely responsible for their products and services. Agilent Technologies, Inc. makes no warranties of any kind, express or implied, including the warranties of merchantability, fitness for a particular purpose, and non-infringement of intellectual property regarding third-party product providers, their products, or services. In no event will Agilent Technologies, Inc. be liable for any direct, indirect, special, consequential, or other damages, including but not limited to loss of profits, in connection with third-party product providers, their products, or services.

Agilent Email Update Service

Get the Latest Information and Newest Test Skills

1



Cut through the clutter with timely updates on the test and measurement topics most important to you. The Agilent Email Update Service ensures that you get the latest information for making better use of Agilent equipment and helps keep your technical skills up-to-date with information on the latest technology advances.

Only the information you want, when you want it

Easily identify your specific interests from a selection of more than 100 product and application areas and specify the types of information you would like to receive:

- **Support information** (such as new products and enhancements information/specifications, application information and technical notes on technologies and standards, tradeshow, events, and live/virtual seminars)
- **What's New** (including education/training and consulting services, firmware/software upgrades, and warranty, calibration and repair)

Total commitment to privacy

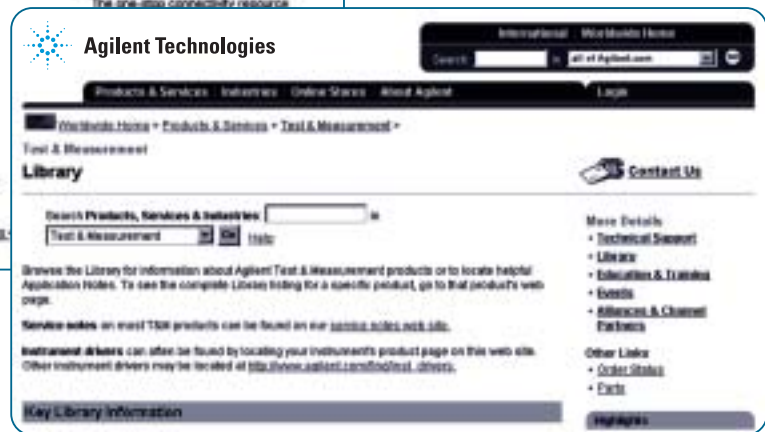
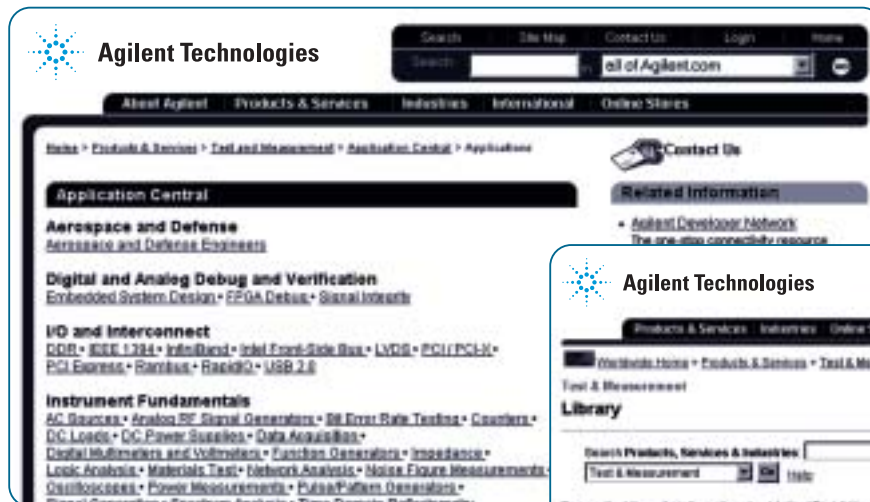
Agilent is proud to participate in the Better Business Bureau On-Line Privacy Program, and we adhere to all of the program's standards. We will never sell or rent your email address, nor will we share it with anyone without your consent. If you have any questions, please contact our privacy advocate via email at privacy_advocate@agilent.com

Agilent Email Updates

www.agilent.com/find/emailupdates

Get the latest information on the products and applications you select

Instant Access to Application Resources and Information



1

With increasing demands on your time and the expectation to get more done with less, the right information can often make all the difference. Agilent offers a wide array of print, online and webcast resources to help you accelerate design verification, debugging and testing.

Application Resources

- **Application Central:** The place to start, whether you want to brush up on the basics or explore advanced technologies and applications.
www.agilent.com/find/appcentral
- **Wireless Central:** The latest on wireless standards, applications and products.
www.agilent.com/find/wireless
- **Bluetooth™ & Wireless LAN:** From design tips to industry news.
www.agilent.com/find/wireless
- **Aerospace/Defense:** Applications, technologies and new developments in security, surveillance and design.
www.agilent.com/find/ad
- **Application Note Library:** Hundreds of application notes and technical papers covering virtually every test and measurement subject area.
www.agilent.com/find/apps
- **Educator's Corner:** A unique site that helps instructors expose their students to contemporary engineering challenges.
www.educatorscorner.com
- **Back to Basics:** Free training programs and resources covering RF, microwave, lightwave and digital.
www.agilent.com/find/backtobasics
- **Agilent Measurement Solutions Newsletter:** Keep up-to-date on the latest in measurement applications, new products, training, events and seminars.
www.agilent.com/find/solutions

Visit Application Central for quick access to print, online and multimedia resources that help with today's hottest technologies.

New! Check the Status of your Agilent Orders Online

1

The screenshot shows the Agilent Order Status tool interface. At the top, there is a navigation bar with the Agilent logo and the text "Agilent Technologies". Below this, there is a search bar and a "Contact Us" button. The main heading is "Order Status". A paragraph explains that users can check the status of their orders at any time, with status information available worldwide for all Test & Measurement, Communications, and Automated Test products. Below this, there is a form with two sections: "Order Identification" and "Verification Information". The "Order Identification" section has a dropdown menu for "Agilent Order Number" and a text input field. The "Verification Information" section has a dropdown menu for "Customer Number" and a text input field. There are "Find" and "Clear" buttons below the form. Below the form, there is a section titled "Order Status: Details" with a "Contact Us" button. This section contains the following information:

For help, see the [Customer-Order Status/FAQ](#).

Agilent Order Number: 1100000
 Customer PO Number: 11000000
 Customer Number: 101000
 Delivery Method: DDP Out/Post

The order status data is provided on a real-time information basis and is not guaranteed. All times are based on the US Pacific Time Zone.

Line #	Item Number	Item Description	Line Status	Qty Ordered	Qty Shipped	Est. Ship Date	Customer Order Date
1	1100000	Agilent Order Number	Open	1	0	01 Feb 2001	01 Feb 2001
2	1100000	Customer PO Number	Open	1	0	01 Feb 2001	01 Feb 2001
3	1100000	Customer Number	Open	1	0	01 Feb 2001	01 Feb 2001

Agilent's new Order Status Tool gives you a quick, easy and secure way to check the status of your orders, at any time, on our web site: www.agilent.com/find/orders

Real-time status information is available worldwide for all Test & Measurement and Communications products.

The Order Status tool is secure, and it's easy to use:

- You enter only two data items for identification and verification (for example, your purchase order number and Agilent order number) and then you can view real-time status information about the order
- You will find these data items on documents you receive from Agilent
- If you would like assistance identifying this information, please feel free to contact us www.agilent.com/find/contactus

New Product Highlights

2

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

Agilent Calibration Services



The uncompromising quality of Agilent calibration with greater flexibility and lower prices.

- Comprehensive services that match the quality of Agilent products
- Modular approach lets you pay only for what you need
- Available worldwide for both Agilent and non-Agilent products

Agilent's new suite of calibration services was designed with a modular approach to help you decrease instrument maintenance cost without sacrificing quality or comprehensive coverage.

You can now order calibration and adjustments separately, paying only for the individual testing, adjustments and compliance levels

you need. You'll have the flexibility to pre-approve adjustments, receive notification before approving adjustments, and the option to order no adjustments at all.

And with new lower prices, you'll be able to apply these services to a wider array of test and measurement instruments, too. Agilent is the only company to offer this level of affordable and comprehensive calibration services for all of your sites worldwide.

See page 23.
www.agilent.com/find/calibration

Agilent Advantage System Uptime Solutions



System uptime you can count on with a new and flexible approach to test system support.

- Greater flexibility in balancing uptime requirements and system support costs
- Choose response times to meet your unique business needs
- Quality service from the world leader in test and measurement

Make sure your test systems stay up and running at peak performance with the new Agilent Advantage System Uptime Solutions. These comprehensive support packages balance your uptime and budgetary requirements and help maximize the value of your equipment purchase with ensured levels of system performance.

Choose from three different service levels with a range of coverage options, response time guarantees, system restoration goals and onsite or remote delivery models. The 3-Star, 4-Star and 5-Star System Uptime Solutions will help ensure peak performance and operational efficiency.

See page 29.
www.agilent.com/find/system_uptime

33220A Function/Arb Generator



Cost-effective custom waveforms for unique measurement needs.

- Sine, square, ramp, pulse, noise, dc and arbitrary waveforms up to 20 MHz
- AM, FM, PM, FSK, and PWM modulation, sweep, and burst
- PC connection via USB, GPIB and LAN

The new Agilent 33220A function/arbitrary waveform generator provides waveforms up to 20 MHz with the lowest distortion of any function generator in its class. It provides all the basic waveforms for your general-purpose needs and a 14-bit, 64 K-point arbitrary waveform capability to create custom waveforms for special applications. The 33220A's pulse function enables variable edge-time pulses with PWM for electronic control and other digital applications.

The graphical front panel provides direct access to all major waveforms, multiple modulation types, and sweep and burst modes. Standard USB, GPIB, and LAN interfaces let you easily connect your PC to create complex arbitrary waveforms with Agilent's IntuiLink Waveform Editor software.

See page 92.
www.agilent.com/find/33220A

54850 Infiniium Oscilloscopes



True 6 GHz bandwidth across the entire measurement system.

- Bandwidths to 6 GHz with 20 GSa/s sampling rate on all four channels simultaneously
- 7 GHz InfiniiMax active probes for differential and single-ended measurements
- MegaZoom deep memory with up to 1 M points on all sample rates and 32 M points ≤ 2 GSa/s

Experienced scope users know that your measurements are only as good as your probing system.

The newest Infiniium scopes and the breakthrough InfiniiMax high-performance probing systems combine to offer an end-to-end measurement system with unmatched performance, accuracy and connectivity. The result is measurements you can trust and better insight into circuit behavior. The 54855A (6 GHz), 54854A (4 GHz) and 54853A (2.5 GHz) offer 20 GSa/s sampling on all four channels to significantly reduce the chances of aliasing.

The InfiniiMax 113X system delivers the highest-performance differential and single-ended probes available today, with flexible connectivity solutions for browsing, solder-in and socketed connections to high density ICs and circuit boards.

See page 51.
www.agilent.com/find/infiniimax

54640 Series Oscilloscopes



High-performance measurements for DSP and 16-bit mixed-signal designs.

- Troubleshoot mixed analog and digital designs with responsive MegaZoom deep memory
- Up to 18 time-aligned analog and digital channels, 350 or 500 MHz

With simultaneous measurements on 2 analog and 16 digital channels, Agilent MegaZoom deep memory and nearly twice the horizontal resolution of any digital scope on the market, the 54640 series scopes open a new window inside your circuits. Patented high-definition displays show subtle details you couldn't see before, from narrow transients to distorted edges to intermittent defects.

See page 40.
www.agilent.com/find/MSO

Infiniium 54830 Series MSO



2

Measurement power for advanced digital system debug.

- First mixed signal scope with Infiniium power and ease of use
- Up to 20 time-aligned analog and digital channels, 600 MHz or 1 GHz

With either 2 or 4 analog and 16 digital channels seamlessly integrated in the powerful Infiniium measurement system, you now have the most powerful MSO available to debug advanced digital systems. The Infiniium MSO helps you isolate design problems quickly, complementing your logic analyzer to save time, cost and trouble.

See page 40.
www.agilent.com/find/MSO

81133/34A Pulse/Pattern Generators



Generate the unique signals you need to test innovative digital designs.

- Jitter modulation for jitter tolerance and stressed eye tests
- Low jitter for high performance clock generation
- Differential signals and voltage levels for LVDS testing

When timing and performance are critical, the fast rise times and low jitter of the new Agilent 81133A and 81134A 3.35 GHz pulse/pattern generators enable precise characterization of devices and minimize the influence of jitter injection by the source.

With 8 kB memory and hardware PRBS generation that supports the most common industry standards, the 81133/34A are ideal data and pattern sources in particular for eye diagram measurements.

Add any kind of deterministic or random jitter to your clock and data signals with the delay control input for jitter tolerance and stressed eye tests or use the direct mode to simulate wander or spread spectrum clocks.

See page 304.
www.agilent.com/find/pulse_generator

N2022A Noise Source Test Set



Reduce downtime with the convenience and confidence of in-house noise source calibration.

- Simple calibration of noise sources with reduced uncertainty
- Traceable results to a national standard
- Start in-house calibration or complement an existing installation

The N2002A noise source test set gives you the opportunity to calibrate your own noise sources with minimal levels of uncertainty. With simple straightforward operation and equipment low cost, it's now feasible to bring this process in-house and dramatically reduce downtime.

For engineers that currently run their own noise source calibration service, the N2002A noise source test set is an ideal addition to their test equipment. By incorporating this low-cost, self-contained unit into a wider noise source calibration system, high quality calibrations of noise sources can be made. When used within a noise source calibration system the N2002A and Agilent N8975A NFA series noise figure analyzer can also drastically reduce the calibration time.

See page 252.

www.agilent.com/find/nsts

PNA Series Network Analyzers



Precision network analysis with electronic calibration, now up to 67 GHz.

- Test over a 10 MHz to 67 GHz range with a single vector network analyzer
- Improve calibration accuracy with a minimum of connections using electronic calibration
- Characterize a variety of mixer/converter types with conversion loss and absolute group delay measurements

The Agilent Microwave PNA series now includes the 67 GHz E8361A, adding to the current portfolio of 20, 40, and 50 GHz high-performance network analyzers. All provide the dynamic range and measurement speed needed to develop accurate designs and deliver better margins and higher yields in manufacturing.

The microwave models now offer the option of frequency-offset measurements to characterize mixers/converters and amplifiers.

In addition, electronic calibration (ECal) modules are now available to cover 10 MHz to 67 GHz. ECal is an ideal solution for calibrating network analyzers with faster and more repeatable results. Performing a full two-port calibration with ECal takes less than half the time and half the number of connections compared to using a mechanical calibration kit.

See page 210.

www.agilent.com/find/pna

ENA Series Network Analyzers



Enhancing ENA network analyzers for today's advanced component tests.

- Enhanced electronic calibration function increases calibration reliability
- 4-port embedding/de-embedding capability for multiport/balanced measurements
- Convenient one-key access to start your application programs

The new Revision 3.5 firmware for Agilent's ENA series network analyzers meet the advanced measurement requirements for today's RF components. It offers enhanced electronic calibration functions, such as user-characterized ECal, for accurate calibration with different connector types, and ECal confidence check when you want to verify the performance of ECal calibration data.

Other new functions include 4-port embedding/de-embedding and an application program quick start function. These functions allow you to quickly make reliable evaluations and increase your overall engineering efficiency.

See page 208.
www.agilent.com/find/ena

PSA Series Spectrum Analyzers



High-performance spectrum analysis with an expanded array of analysis tools.

- Frequency coverage from 3 Hz to 6.7, 13.2, 26.5, 44 or 50 GHz
- New noise figure measurement personality
- Expanded modulation analysis capability with links to the Agilent 89601A vector signal analysis software

New higher frequency models and expanded functionality enhance the power of Agilent PSA Series high-performance spectrum analyzers, known for their powerful one-button measurements, versatile feature set, and leading-edge combination of flexibility, speed, accuracy, and dynamic range.

Now you can make noise figure and gain measurements with the same instrument you use to make spectrum analysis, phase noise, and modulation measurements. The new built-in noise figure measurement personality (Option 219) provides fast, one-button noise figure and gain measurements from 200 kHz to 26.5 GHz with ± 0.5 dB instrument uncertainty up to 3 GHz (using the internal preamplifier, Option 1DS).

See page 185.
www.agilent.com/find/psa

89600 Vector Signal Analyzers



Powerful new analysis features for 89600 series vector signal analyzers.

- Enhanced WLAN tests include 802.11g analysis, 802.11a/b/g one-button test suite and expanded 802.11b analysis
- Wideband complex-stimulus-based multi-channel power amplifier distortion measurements
- TD-SCDMA and 1xEV-DO modulation analysis

New WLAN capabilities for the 89600 series include the 802.11g standard, both the DSSS/CCK/PBCC and the OFDM modes, and one-button standards-based testing of 802.11a/b/g signals.

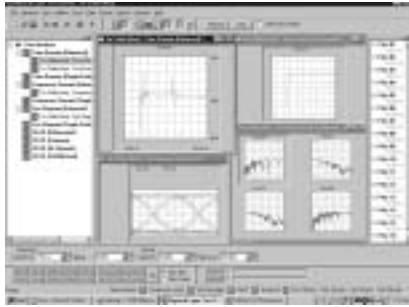
The powerful 3G capability now offers analysis of TD-SCDMA signals, version TSM (V3.0.0), and 1xEV-DO signals, both forward and reverse links.

The 89604A distortion test suite is a new software application for the 89600 series, as well as the ESA and PSA series spectrum analyzers. Use this software to measure AM/AM and AM/PM distortion of MCPAs using complex modulated stimulus signals, a technique that helps ensure even subtle distortion mechanisms are stimulated and measured.

Available as an upgrade to most 89600 VSAs.

See page 195.
www.agilent.com/find/89600

N1900A Physical Layer Test Systems



Accurate model extraction and complete characterization of differential interconnects.

- Completely characterize single-ended, differential, common-mode, and mode-conversion
- Improve signal integrity insights with accurate device models based on real measurements
- Powerful tools include time-domain reflectometry, time-domain transmission, frequency domain, and eye diagram

Get complete and accurate insights into signal integrity issues in differential high-speed interconnects with the new Agilent N1900A series physical-layer test systems. The combination of frequency domain, time domain and eye diagram analysis provides the most comprehensive view of device performance now available.

Accurate models are critical for signal integrity analysis, and measurement-based model extraction provides the most-accurate models for addressing problems in printed circuit boards, connectors, backplanes, IC packages, cables and flexible interconnects.

See page 301.
www.agilent.com/find/plts

N5101A Baseband Studio



Advanced baseband capabilities for fading or infinite waveform length applications.

- Full-featured channel simulation for W-CDMA, WLAN, GSM and other communication formats
- Allows up to hours of unique RF or analog I/Q signals by streaming complex waveforms from a PC
- Reconfigurable design is prepared for your future applications, too

The Agilent N5101A Baseband Studio offers a new approach to baseband signal processing, combining hardware and software components in a PC. Working with a vector signal

generator, you can perform traditional receiver tests such as channel simulation with fading and noise impairments or use new capabilities such as streaming very long waveforms from the PC hard drive. Plus, the reconfigurable FPGA design will support a host of future applications to address emerging signal generation needs.

www.agilent.com/find/basebandstudio

PSG Series Microwave Signal Generators up to 40 GHz



Develop complex test signals at microwave frequency, quickly and easily.

- The first microwave signal generator to provide vector modulation in a single integrated instrument
- Optional analog (ramp) sweep provides continuous sweeps and fully automated use with the 8757D scalar network analyzer

The new E8247C, E8257C, and E8267C PSG signal generators combine the best performance parameters in the industry with the only integrated vector (complex) modulation capability in a microwave signal generator. Whether you're working in satellite, radar, broadband wireless or other advanced communications, you can now test your components and systems with realistic signals, early in the design process.

The E8267C vector signal generator features an internal baseband generator and I/Q modulation capability to simulate wideband complex waveforms for a variety of microwave applications. The complex signal generation capability and versatility lets you download custom waveform files from PC-based signal development software to create radar chirps, barker codes and any other complex signal.

See page 140, 154.
www.agilent.com/find/psg

HP 8566B/68B Code Compatibility Option



HP 8566B/68B code compatibility for PSA and ESA-E spectrum analyzers.

- Programming code compatibility with HP 8566B and HP 8568B spectrum analyzers
- Provides 173 of the most highly used HP 8566/68B commands
- Easy switching between SCPI and HP 8566/68B remote languages via front panel and remote control

Agilent PSA and ESA-E series spectrum analyzers now offer programming code compatibility with HP 8566/68B spectrum analyzers. Option 266 lets you upgrade legacy ATE systems with modern and supportable ESA-E or PSA Series spectrum analyzers as the HP instruments reach the end of their formal support lives.

Option 266 is offered free of charge when ordered with new PSA and ESA-E Series analyzers and is also available as a free download from the Web. The option provides 100% code compatibility in most cases; refer to the product literature to learn more about specific implementations that may require modifications.

See page 185.
www.agilent.com/find/psa

E4438C-414, Signal Studio for 1xEV-DV and cdma2000

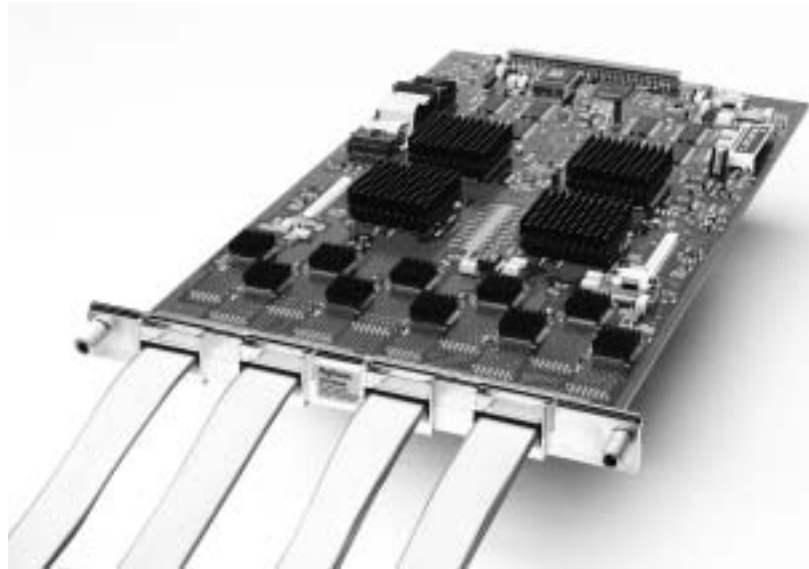


E4438C-414, Signal Studio for 1xEV-DV and cdma2000.

This software provides the first 1xEvolution – Data and Voice (1xEV-DV) forward link test signals in industry, along with cdma2000 forward and reverse link signal generation. With the user-friendly interface, you can configure standards-based and custom test signals for mobile receiver and ASIC verification. The 1xEV-DV packet data and control channels (PDCH, PDCCH) contain the full signal coding needed to demodulate packets for packet error rate (PER) and block error rate (BLER) testing. For interference and sensitivity testing, you can add a noise (AWGN) interferer, and adjust channel parameters to simulate varying real-world conditions.

See page 136.
www.agilent.com/find/signalstudio

600 MHz Logic Analysis Modules



Debug digital system behavior through a single connection with enhanced logic analysis.

- Simultaneous 4 GHz timing and 600 MHz state analysis on all channels using soft touch probing
- Comprehensive signal integrity validation across hundreds of signals simultaneously with eye scan technology
- Integrated display of time-correlated 6 GHz oscilloscope signals with logic analyzer traces

The 16753/54/55/56A state and timing modules for the Agilent 16700 Series logic analysis systems deliver the performance and capabilities needed to debug and validate today's high-speed digital systems. Together with soft touch connectorless probing solutions these modules let

you validate signal integrity, circuit functionality and timing relationships through the same probe, on both differential and single-ended signals.

Use Agilent's exclusive eye scan feature to capture, display and analyze eye diagrams (similar to an oscilloscope) on hundreds of signals simultaneously.

Then view problem signals in more detail by time-correlating your logic analysis traces with measurements from an Infiniium 54850 Series 6-GHz oscilloscope.

See page 292.
www.agilent.com/find/600_mhz_logic

Soft Touch Connectorless Probes

2



Maximize reliability, minimize intrusion with connectorless logic analyzer probes.

- **<0.7 pF loading and >2.5 Gb/s data rate acquire fast signals without impacting system performance**
- **Small footprint, low profile and high density help you access signals, even in the tightest conditions**
- **Direct signal routing retains differential-pair spacing and maintains tight timing margins**

Accurate, easy logic analyzer measurements start at the probe tips. The Agilent E5387A differential and E5390A single-ended soft touch probes meet the demand for accuracy and reliability while providing a connectorless attachment to your device.

From basic state and timing analysis to signal integrity problems in high-speed, low-amplitude signals, these low-intrusion probes simplify all your debug challenges. Get quick,

easy and repeatable signal access without designing in a connector. Micro-spring pin technology provides reliable contact to signal pads, even on uneven boards or contaminated surfaces. Plus, soft touch probes eliminate the need for gold plating or special board processes, stiffeners, handling and cleaning.

See page 300.
www.agilent.com/find/logic_analyzer_probes

N4220A Logic Analysis Probe for PCI Express



Quickly validate PCI Express designs with low-intrusion, logic analyzer solutions.

- Easily access PCI Express slots or chip-to-chip links at 2.5+ Gb/s with ultra-dense connectorless probing
- Gain quick insight with intuitive triggering and data analysis at the packet level
- Supports squelch, link training, TLP, DLLP, 10b, 8b, spread spectrum clock, and scrambled data

Combine the new N4220A Series analysis probes with the 16753/54/55/56A logic analyzer modules for a complete and powerful debug solution for PC Express system hardware and software. Quickly capture PCI Express bus traffic and get triggering, cross-correlation, and detailed measurements.

Intuitive packet analysis software makes it easy to trigger on different types of PCI Express packets, and Agilent's new soft touch probing technology enables high-fidelity physical access to chip-to-chip signals.

The N4220A also performs software packet decoding that handles lane deskew, data scrambling and data format and provides the ability to view raw 8b and/or 10b codes.

See page 295.

www.agilent.com/find/pci_express

E2960 Exercisers/Analyzers for PCI Express



Test and validate PCI Express designs with modular flexibility.

- Exerciser and protocol analyzer for PCI Express x1 and x8
- Protocol analyzer GUI with trigger, search, filter and performance capabilities
- Exerciser generates and receives all variations of PCI Express packets with error insertion capability

Debug and validate today's PCI Express designs and easily accommodate future technologies and standards with the Agilent E2960 Series protocol analyzers/exercisers. Housed in Agilent's new multi-port system tester platform, the E2960 is the industry's most scalable solution for realistic multi-port traffic generation, response, protocol analysis, emulation and performance analysis.

The protocol analyzer's tools for root cause analysis, troubleshooting and optimization accelerate debug and bring-up, while the exerciser validates designs by stressing all data paths, testing corner cases, inserting error conditions and protocol violations, and verifying compliance.

www.agilent.com/find/pci_express_e2960_series

ParBERT 81250 13.5 Gb/s and 45 Gb/s Optical Modules



Expanding the power of the 81250 ParBERT platform with new 13.5 and 45 Gb/s modules.

- 13.5 Gb/s modules for 10GbE, jitter and general purpose high sensitivity, differential measurements; with CDR
- 45 Gb/s optical modules provide NRZ, RZ and RZ-CS data for SDH/SONET OC-768 and STM-256; with CDR

Tackle the toughest problems in high-speed BER testing on digital transmission lines, modules, communication ports, chips and components. The Agilent 81250 ParBERT addresses a wide variety of parallel-to-serial, serial-to-parallel, serial and multiple serial applications, including mux/demux, TIA, FEC and 10GbE device test.

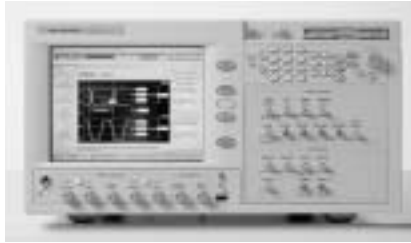
New 13.5 Gb/s modules: generator (N4872A), analyzer (N4873A) and clock (E4809A).

45 Gb/s modules and bundles: 16:1 multiplexer (E4868B), 1:16 demultiplexer (E4869B), pattern generator bundle (E4896A), error detector bundle (E4897A), lightwave receiver (E4882A), lightwave transmitter (E4883A) and high-performance option for E4883A (E4884A).

See page 449.

www.agilent.com/find/parbert

N4900 Serial BERT Series Agilent Developers Network



2

Test and characterize serial interfaces for a wide range of technologies and applications.

- Industry leading signal-integrity and waveform quality ensures patterns will be delivered with the highest possible fidelity
- World class intuitive user interface allows concentration on the problem, not the test equipment

The Agilent N4900 Serial BERT Series provides industry-leading parametric test capabilities for design verification and characterization of devices at frequency ranges from 50 Mb/s up to 13.5 Gb/s. The instruments of the N4900 Serial BERT Series provide industry leading signal integrity and analysis capabilities addressing a wide range of applications and technologies in the semiconductor and communication industry.

The new N4901A Serial BERT 13.5 Gb/s is the successor of the famous Agilent 71612 High-Speed BERT. The Serial BERT 13.5 Gb/s covers frequency ranges from 150 Mb/s to 13.5 Gb/s providing unmatched signal integrity and analysis capabilities.

The new N4902A Serial BERT 7 Gb/s is the industry-first product to specifically address the upcoming needs in the semiconductor and data communication industry.

The N4906A Serial BERT is a 3.6 Gb/s general-purpose bit error ratio tester designed for high-speed digital components and systems.

See page 448.

www.agilent.com/find/N4900_Series



A one-stop resource for a wide range of instrument connectivity needs.

- Drivers, I/O software, example code, and application information
- Get time-saving information about your connectivity questions, 24 hours a day, 7 days a week

The Agilent Developer Network provides fast, convenient access to the information, tools and support that solve connectivity challenges. Whether it's a driver problem, a test programming question, or an I/O compatibility issue, ADN will help.

Access the ADN Web site by simply registering at www.agilent.com/find/ADN. You'll find information to get started with test code development, PC connectivity, demos, documentation, instrument drivers and discussion forums.

See page 318.

www.agilent.com/find/adn

T&M Programmers GPIB, USB and LAN Interfaces Toolkit



Spend more time engineering and less time programming.

- Save time at every step, from initial connections to data analysis
- Create and modify tests quickly and easily
- Fully integrated with Microsoft® Visual Studio.NET

The Agilent T&M Programmers Toolkit for Visual Studio.NET extends the Microsoft® Visual Studio.NET platform with easy-to-use software tools. Because the T&M Toolkit is integrated into Microsoft's open-standard development environment, you'll be free to focus your attention where it matters most, on your solutions and designs, ultimately saving time and money.

The Toolkit makes it easy for you to get started, with Project Wizards that provide instrument and system control program building blocks. The Toolkit then helps with every phase of connectivity: configuring the interface, communicating with instruments and acquiring and analyzing data. The I/O Monitor gives you the insight to quickly debug instrument control applications, too.

Agilent Developer Network is included as a standard feature of the T&M Toolkit so that you are always current with the latest updates and upgrades.

See page 313.
www.agilent.com/find/toolkit



Simplified connections for test and measurement instruments.

- USB/GPIB interface connects directly to the USB port on your laptop or desktop computer
- LAN/GPIB gateway provides remote access and control of GPIB instruments
- GPIB card offers high throughput via your computer backplane

Now you can connect your test instruments to your PC or network using today's standard I/O that's already built into your computer. For the fastest and easiest connections, choose Agilent converters that connect your GPIB instruments to the USB or LAN. Or if you prefer,

the high performance GPIB card plugs into the backplane of your computer and provides high system throughput.

These products come with the standard VISA and SICL software for Windows, which simplifies connectivity between different instrument and software vendors. Using the standard VISA software offers backwards compatibility, too – your existing VISA programs work with a simple re-configuration.

See page 317
www.agilent.com/find/GPIB

E7495A Base Station Test Set



Perform all your critical base station tests with a single rugged instrument.

- Performs more wireless and wireline measurements than any other test set
- Stands up to rough field use and all weather conditions
- Costs far less to own and operate than all the tools it replaces

The Agilent E7495A base station test set combines the most frequently used BTS tools in one lightweight test set for everyday 2G, 2.5G and 3G base station maintenance. As the most functional one-box tool on the market, the E7495A eliminates the need to carry, manage and learn multiple test tools.

Incorporating your most frequently used tools into a single instrument dramatically increases productivity for both administrators and technicians, reducing your asset costs, tracking costs, calibration and maintenance costs, and the training costs associated with learning specifics of separate instruments.

See page 413.
www.agilent.com/find/basestations

E6900 Wireless Protocol Family



Simplify design software verification with a live network simulation at your fingertips.

- Emulate a wireless network on your bench
- Connect your device to the Internet
- Wireless protocol advisor software provides logging and protocol analysis

Accelerate design and integration of new data-oriented wireless devices with the Agilent E6900 wireless protocol analysis platform and protocol application signaling tester. Live network simulation at your bench quickly delivers the insights that help with ever-evolving standards, increasingly complex protocol stacks, and sophisticated embedded applications.

Protocol applications for key 2.5G and 2.5G (in future, 3G) speed design cycles while giving you confidence in your protocol design and data performance.

Test SMS and IP data with GSM circuit switched and GPRS packet switched data channels. Wireless protocol analysis software adds capability with advanced logging and filtering.

See page 408.
www.agilent.com/find/e6900

E1966A 1xEV-DO Test Application



The first one-box manufacturing solution for testing 1xEV-DO at high data rates.

- Supports all modulation modes with packet data rates up to 2.4 Mbps
- Supports Test Application Protocol (TAP) for RF test interface
- Easy firmware upgrade for existing CDMA-capable 5515C test sets

Working in conjunction with the E5515C wireless test set, the E1966A 1xEV-DO test application provides complete testing of all 1xEV-DO high data rates – ideal for mobile manufacturers and developers and designers of leading edge 1xEV-DO wireless access terminals.

The E1966A supports call connection through the standardized FTAP/RTAP over-the-air protocols; at high data rates, these protocols allow quick and efficient control of the forward and reverse operation, producing accurate parametric test results.

Plus, new packet error rate (PER) measurements provide decreased test times, as much as 12 times faster than traditional frame-based receiver quality measurements.

Add test automation with the E6564A Wireless Test Manager software.

See page 395.
www.agilent.com/find/e1966a

OmniBER XM Network Simulator



Fast, accurate and thorough simulation and testing of next generation SONET/SDH.

- Comprehensive testing on all channels, on all ports, simultaneously
- Measure BER and inject error/alarm bursts
- Stimulate and measure switch times and verify correct path connectivity

The Agilent OmniBER XM network simulator replicates real network conditions to truly stress next generation SONET/SDH network equipment, increasing the effectiveness of system verification tests. It uses multi-channel, multi-port, parallel testing to validate existing and new products to international standards quickly and thoroughly.

Use the OmniBER XM to generate a wide variety of real-life network signals, incorporating mixed payloads, errors and alarms, simultaneously on up to 192 channels in each single OC-192/STM-64 port, or on more channels spread across multiple ports and test modules.

See page 455.
www.agilent.com/find/omniberxm

OmnIBER OTN Comm Analyzer



2

Test next generation SONET/SDH/OTN devices and equipment quickly and accurately.

- Fully-integrated SONET/SDH and OTN testing at all standard rates from 1.5 Mb/s to 43 Gb/s
- High-accuracy jitter tester for SONET/SDH and ITU-T G.709 optical channel rates up to 10.7 Gb/s
- Configurations to meet your specific data rates and test requirements

The OmniBER OTN communications performance analyzer offers a powerful set of tools for testing SONET/SDH/OTN at all SONET/SDH line rates from 52 Mb/s to OC-768c/STM-256c, plus the ITU-T G.709 optical channel rates OTU1/OTU2/OTU3 (2.66/10.71/43 Gb/s).

With comprehensive error and alarm generation, overhead access with sequence generation and capture, and jitter generation and measurement, the OmniBER OTN is particularly well suited to design and verification test applications for next generation SONET/SDH and G.709 OTN designs.

The system's advances include the ability to identify defects when encapsulating Ethernet client signals within GFP/LAPS and transporting virtually concatenated payloads over SONET/SDH.

See page 456.
www.agilent.com/comms/otn

Network Analyzers



Complete tool sets for local and remote network troubleshooting.

- Comprehensive tools for data, mobile and VoIP network maintenance and troubleshooting
- Centralized troubleshooting of LAN and WAN/ATM networks using Distributed Network Analyzers and Network Troubleshooting Center
- Dispatched troubleshooting of LAN and WAN/ATM networks using the "all under one handle" J6800A Network Analyzer

The Agilent Network Analyzer family lets you test all access technologies with a single architecture. The key benefit is full and uniform testing of network and higher layers over any supported LAN or WAN/ATM technology up to 1 Gb/s, plus analysis of technology-specific lower layers.

These systems are designed for both dispatched and distributed testing. Time synchronization of local and remote analyzers provides the means to deliver advanced quality of service measurements, essential for testing multi-service networks.

The Network Analyzer family offers a variety of form factors, including software only, single port and dual port options.

See page 427.
www.agilent.com/comms/XPL

Storage Area Network Tester



Quickly and easily characterize the performance of complex SAN equipment.

- Modular, scalable, multi-user system architecture
- Multi-port wire speed Fibre Channel traffic generation and real time measurement
- Comprehensive tools for SAN fabric performance, conformance and stress testing

Whether you need to characterize the performance of Fibre Channel SAN switch fabrics and SAN extenders or integrate Fibre Channel storage solutions, the Agilent SAN test system provides the controlled Fibre Channel traffic generation and measurement environment necessary for measuring the performance, conformance and robustness of your equipment.

The 1 or 2 Gb/s Fibre Channel configurable ports can stimulate and measure your system with a wide range of traffic conditions, including line speed data traffics, errors conditions and disruptive port state events. Simultaneous test of the data plane, control plane and fabric services help you analyze your system under realistic traffic conditions.

See page 460.

www.agilent.com/find/santester

81910A Photonic All-Parameter Analyzer



Analyze components with the most-accurate, high-speed all-parameter test solution.

- Simultaneous measurement of insertion loss, polarization dependent loss, group delay and differential group delay
- Now 10 times faster with real-time display of all four parameters
- New Jones Matrix function for more comprehensive photonic vector analysis

The original Agilent 81910A photonic all-parameter analyzer introduced thorough and instantaneous measurements of all device properties relevant to DWDM, simultaneously in transmission and reflection.

For its newest release, the Agilent 81910A offers higher measurement speeds and more functionality, including a new real-time mode that lets you observe all four device parameters while adjusting or processing the device. The 10x speed improvement help cut design cycles and boost manufacturing throughput.

The new Jones Matrix export function enables in-depth analysis of device properties by calculating Eigenstates, 2nd order PMD, polarization dependent wavelength shift, impulse response and other advanced parameters.

See page 371.

www.agilent.com/comms/allparameter

86116B Optical/ Electrical Module



The widest optical and electrical bandwidths available in a single module.

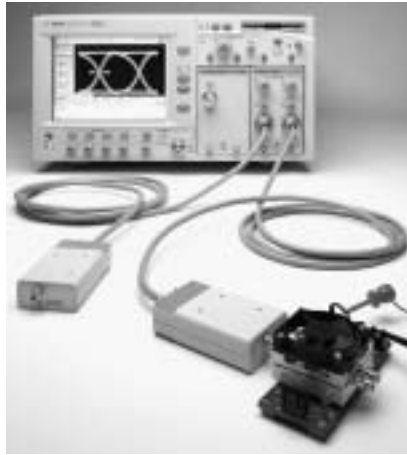
- Accurate analysis of 40 Gb/s waveforms
- Two measurement channels with user-selectable bandwidths
- Optical FWHM of <7.4 ps, electrical risetime of <4.4 ps

The Agilent 86116B module for the Infiniium DCA represents one of the fastest solutions available for measuring high-speed communication signals. With 65 GHz optical and 80 GHz electrical bandwidth, the 86116B gives optical/electrical designers accurate view of signals in devices under test.

The Infiniium DCA combines the capabilities of a general-purpose oscilloscope, a digital communications analyzer and a time domain reflectometer. Its extensive modularity lets you configure a solution to your specific application needs.

www.agilent.com/comms/dca

86118A & 86105B DCA Modules



Precision high-speed waveform analysis in a compact, lightweight package.

- 86118A: More than 70 GHz of electrical bandwidth with high fidelity time-domain response in a small lightweight housing
- 86105B: Optical filter rate coverage for multiple SONET/SDH/Fibre Channel and Ethernet rates to 10 Gb/s

With over 70 GHz of electrical bandwidth, the 86118A module for the 86100 Infiniium DCA provides the fastest channel performance available today to minimize attenuation of the signal spectrum and maintain fast edge speeds. The module's sampling electronics are located in a small, lightweight housing that can be placed up to 2 meters away from the mainframe.

The Agilent 86105B lets you perform transmitter compliance tests of multiple technologies and line rates with a single module. It's now possible to characterize optical transmission performance of all SONET, Ethernet, and Fibre Channel technologies, from 155 Mb/s through to 10 Gb/s.

www.agilent.com/comms/dca

N1022A Probe Adapter



Use the industry's fastest high-speed probes with the Agilent 86100 Infiniium DCA.

- Easy-to-use high-performance adapter enables wide bandwidth probing with the Infiniium DCA
- Works with Agilent 1130 or 1150 probe series

Agilent InfiniiMax 1130 series of high-performance active probes simplify and significantly improve the accuracy of waveform analysis of high-speed electrical circuits. Now you can use these probes, as well as the Agilent 115x probe family, with the 86100 Infiniium DCA series sampling oscilloscopes.

The N1022A probe adapter provides power, identification/calibration, and a high-integrity signal path between the DCA plug-in module and the probe. The N1022A is directly compatible with any of the 861xx, 8348x, and 5475x DCA plug-in modules with electrical channel bandwidths of 20 GHz or less and a 3.5 mm connector.

www.agilent.com/comms/dca

3 Support and Services

20 Support Services, Education and Consulting Services, Channel Partners



Support and Services 3

Support Services, Education and Consulting Services, Channel Partners 21

Support Services 22

Education and Consulting
Services 30

Channel Partners 34

The Agilent Fitness Program – Dedicated to Keeping your Equipment in Peak Condition

Agilent provides a complete range of services to ensure your instruments perform precisely to their original design and purpose. Much like exercise and routine check-ups keep your body healthy, our Equipment Fitness program includes regular calibration and maintenance that keep your equipment reliable and accurate. While you focus on your business, Agilent concentrates on maintaining the strength of your instruments.

From start to finish, the Agilent Fitness Program will ensure your equipment is in peak condition.



3 Agilent Equipment Fitness Program Elements

<p>Calibration Services (page 23) – Measurement confidence is assured with our Fast-Track, Selective and Inclusive Agilent Calibration services. On-site services, such as VOSCAL, are provided for added convenience.</p>	<ul style="list-style-type: none"> • Measurement accuracy • Successful audits • Assured performance
<p>Warranty & Repair Services (page 28) – With our expertise and worldwide capability, Agilent can ensure your equipment is in the game at all times.</p>	<ul style="list-style-type: none"> • Peace-of-mind • Ongoing performance • Reduced risk
<p>System Uptime Solutions (page 29) – Agilent Advantage System Uptime Solutions provides test systems with peak levels of endurance and uptime.</p>	<ul style="list-style-type: none"> • Uptime assurance • Proactive coverage • Balance uptime & cost
<p>Equipment Management Solution (page 27) – Understand your equipment pools with our suite of asset management tools and services.</p>	<ul style="list-style-type: none"> • Reduced downtime • Higher production • Decreased cost of ownership
<p>Professional Consulting Solutions (page 33) – Customized solutions designed and delivered by experts that know what it takes to win.</p>	<ul style="list-style-type: none"> • Expert knowledge • Tailored solution • Partner in success
<p>Engineering Services (page 30) – Develop your team into star performers with the utmost in equipment knowledge and utilization.</p>	<ul style="list-style-type: none"> • Optimized equipment utilization • Efficiency • Quick start

Service and Support on the Web:

Web Tools for Services:

Access the most up-to-date information on services and support online: www.agilent.com/find/tm_services

- Warranty status
- Calibration and repair service status
- Calibration due dates
- Electronic calibration certificates
- Log instrument service requests

New in Support Services for 2003

Re-energizing Calibration:

Agilent’s new portfolio of calibration services provides a flexible, more affordable approach while still offering the quality, depth and thoroughness you are accustomed to receiving from Agilent. These calibration services are designed to help equipment managers and coordinators lower instrument maintenance costs with a modular ordering structure. Calibration and adjustments can now be ordered and purchased separately. You only pay for the individual testing, adjustments and compliance levels you need. The new calibration pricing lowers the entry price and makes our high quality calibration services available to a wider market. Agilent is the only company to offer this level of affordable and comprehensive, calibration services on a worldwide scale.

Agilent Calibration – the New Flexible Calibration Service for your Electronic Equipment

- Cost-effective, affordable route to peak performance
- New modular approach addresses your calibration needs
- Thorough calibration services with a range of options
- Highest level of accreditations available
- Services offered for Agilent and other vendors' equipment

Why Calibrate?

In today's competitive environment, confidence that your test and measurement equipment is producing accurate results is of the utmost importance. An effective calibration ensures that instruments are in-specification, and can therefore reduce cost-per-device and improve return-on-assets. Poorly calibrated instruments may give incorrect information about tested products, and could lead to the belief that either bad products are passing the tests (potentially increasing warranty costs) or that good products are failing (which will incur unnecessary rework and "no fault found costs").

Choosing a Calibration Provider:

Suddenly, the calibration of equipment is no longer a simple engineering issue, left to the decision of the technicians. Finance and procurement personnel are understandably becoming involved in the decisions of "who" and "how much"? This choice needs to be based on capability, experience, accuracy and service and not just price – a cheaper supplier may not be able to meet your requirements, costing you more in the long run. Quite simply, if you rely on the results of your test and measurement equipment, you have to have complete confidence that they are true and accurate. And who better to



ensure that your test and measurement instruments are accurate and in "peak fitness" than the world's leading manufacturer.

Trust Agilent to get your equipment in peak condition and put you in a winning position

Agilent Calibration combines the rigor and thoroughness of our high quality calibration process with the flexibility of a modular approach – enabling cost savings while ensuring equipment is maintained at the highest level. With Agilent Calibration you can choose the package that best meets your needs and be confident in your testing quality.

Calibration Services at a Glance:

Calibration Services	Description	Key Benefit	Advantages
Fast-Track	You pre-approve charges for adjustments, if they're required	Speed	<ul style="list-style-type: none"> • Fast Service with no approval delays • Adjustments only charged when instrument is out of specification
Selective	You select whether to have adjustments performed	Flexibility	<ul style="list-style-type: none"> • Full control over adjustments • Adjust or no adjust choices made by you, if and when instrument is out of specification
Inclusive	One single price for calibration, all necessary adjustments included. (Includes our ISO 17025, Z540, Accredited Cal Services)	Peace of mind	<ul style="list-style-type: none"> • Inclusive price means no extra costs for adjustments • Good value if a lot of equipment will require adjustment
On-site: VOSCAL	A fully operational, high quality calibration laboratory on your site	Minimal downtime	<ul style="list-style-type: none"> • Reduces the need for spares or rental equipment • Reduced risk – no shipping damage
Non-Agilent Instruments	Reliable, quality calibration for your non-Agilent instruments	Convenience	<ul style="list-style-type: none"> • One stop shop, without compromising quality • Simplify vendor management, reduce admin costs

Fast-Track

Agilent Fast-Track Calibration is the right choice for equipment that is in generally good condition (eg calibrated consistently by Agilent in the past). In these instances, Fast-Track is the lowest cost calibration option. It also gives you a faster turnaround time than calibrations requiring notification.

Fast-Track Benefits

- Time and money savings – most economical price with all decisions made upfront

- Allows you to select the specific service you need upfront
- Minimal hassle, interaction and turn-around-time

Fast-Track Features

- Instruments received in specification will be shipped with full data
- Pre-select how you would like us to handle instruments that are received out-of-specification
- Pre-approve adjustment costs to enable fast processing and return of your instrument



Fast-Track Options:

Service	What you Receive	Key Differences
Fast-Track	<ul style="list-style-type: none"> • Agilent Calibration Certificate • As-received data report • Calibration labels and seals 	This instrument will be returned in the as-received condition with this service
Fast-Track with Adjust Option	<ul style="list-style-type: none"> • Agilent Calibration Certificate • Calibration labels and seals • Adjustments to return this instrument to within specification • Post-adjustment data report 	Post-adjustment data only with this service
Fast-Track with Adjust Plus Option	<ul style="list-style-type: none"> • Agilent Calibration Certificate • Calibration labels and seals • As-received data report • Adjustments to return this instrument to within specification • Post-adjustment data report 	Pre and post-adjustment data only with this service

Be Aware of your Calibration Interval

Most reputable test & measurement equipment manufacturers provide a recommended calibration interval for their applicable test equipment. This interval is usually provided in the calibration section of the owners manual or other documentation. Calibration intervals are typically based on such things as mean drift rates for the various components within the instrument. Great emphasis is placed on developing designs that demonstrate minimal drift; however, drift is a factor that can't be eliminated altogether, which is the reason that periodic calibration is necessary.

Selective:

Agilent selective calibration is our most flexible service. You select whether to have adjustments performed after the out-of-specification condition has been identified. You can save money if the failed parameter is not one that is critical to your testing needs.

Selective Benefits

- Control – you decide what parameters are adjusted or repaired
- Scalability – you pay only for the service you need
- Savings – If you decide the adjustment is not critical to your testing needs

Selective Features

- Instruments received in-specification will be shipped with full data
- Decide case-by-case whether you want adjustments carried out for instruments not in-specification
- Approve adjustment costs for those items you want adjusted. Others will be returned still out-of-specification

Selective Options:

Service	What you Receive	Key Differences
Selective	<ul style="list-style-type: none"> • Agilent Calibration Certificate • As-received data report • Calibration labels and seals 	You decide to not adjust equipment – instrument is returned in the as-received condition
Selective with Adjust Plus Option	<ul style="list-style-type: none"> • Agilent Calibration Certificate • As-received data report • Calibration labels and seals • Adjustments to return this instrument to within specification • Post-adjustment data report 	Post-adjustment data report included in this service

Inclusive:

Agilent Inclusive Calibration is a fixed price calibration service. This choice may be ideal if your equipment is worse than average. The pricing for Inclusive includes an “average” adjustment cost in the per unit price. The Agilent Inclusive option also includes our advanced standards compliant services – 17025, Z540 and Accredited Calibration.

Inclusive Calibration Benefits

- Certainty – inclusive price means no extra costs (unless repairs are required)
- Ease of doing business – no expertise or ordering criteria necessary
- Custom calibration – receive the level of cal your business needs (ie 17025 etc)

Inclusive Calibration Features

- Instruments received in-specification will be shipped with full data
- Instruments received out of specification will be adjusted and shipped with post-adjustment data

Inclusive Calibration Options:

Service	What you Receive	Key Differences
Inclusive	<ul style="list-style-type: none"> • Agilent Calibration Certificate • Calibration labels and seals No Adjustment required: • As-received data report Adjustment required: • As shipped data report 	One data report only
Agilent Calibration Plus	<ul style="list-style-type: none"> • Agilent Calibration Certificate • Calibration labels and seals • As-received data report • As shipped data report 	Both as received and as shipped data reports included
Z540 Calibration	<ul style="list-style-type: none"> • ANSI/NCSL Z540 compliant Calibration Certificate • As-received data report • Calibration labels and seals • ANXI NCSL Z540 compliant measurement uncertainty and/or Test Accuracy Ratio report • Post-adjustment data report (if required) 	Meets Z540 standards
17025 Calibration	<ul style="list-style-type: none"> • ISO 17025 compliant Calibration Certificate • As-received data report • Calibration labels and seals • ISO 17025 compliant full measurement uncertainty report If adjustments required: • Notification of adjustment of parameters within guardbands • Adjustments to return the instruments to within guardbanded specification • Post-adjustment data report 	Meets 17025 standards
Accredited Calibration		Meets accrediting agency standards

Calibration Hot Tip:

Adjustment – Only for the Qualified Technician!

Adjustments made to an instrument to rectify an out-of-tolerance situation and allow a successful calibration need to be done by qualified, technical personnel. Adjustments are often made to a single element of the instrument’s design, but may affect other elements as well. A qualified calibration expert not only knows how to properly adjust a test point, but also knows that thorough testing before and after any adjustments is critical to ensure the measurement integrity of the instrument.



Why Send your Equipment Away for Calibration – When Calibration can Come to You?



3

Agilent's Volume On-site Calibration (VOSCAL)

Agilent's Volume On-site Calibration (VOSCAL) service offers a fully operational, high quality calibration laboratory on your site, complete with high-specification systems and automation. VOSCAL keeps your equipment operating at optimum performance levels and accuracy while ensuring it is available for use virtually 100% of the time. With VOSCAL, some or all of your test equipment can be calibrated at your site at the time most convenient for you. Depending upon the size of your instrument base and other constraints, calibration can be performed in a single visit or over several. VOSCAL is ideal for companies with several hundred electronic test instruments from a wide variety of technologies, tight production schedules and very little time available to utilize typical return-to-bench services for calibration.

An Agilent VOSCAL Project Manager will plan the entire event, meeting with your representatives to gain an understanding of which test systems are most critical to your production or development processes and build a project calibration schedule to suit. VOSCAL teams use the same automated testing procedures and equipment as Agilent Service

Centers. This ensures there is no difference in the quality of calibration. A VOSCAL team leader will be on-site each day for the duration of the VOSCAL service. This level of planning and management ensures that most instruments are calibrated within four hours.

Benefits:

- Improved production – maximize uptime
- Convenience – calibrate your entire inventory at a single or multiple visits
- Reduced risk – eliminate shipping damage
- Lower costs – reduce cost of logistics, transport and rental and/or purchase of spares

Features:

- A fully operational, high quality calibration laboratory on your site, complete with high-specification systems and automation
- Calibration performed by a team of specialist engineers, using industry standard tools and processes
- Your project management throughout the operation
- Reduced equipment downtimes
- Convenience of a single supplier reduces the need for spares or rental equipment
- Expert calibration delivered by the world's Test & Measurement market leader

Calibration Services for Non-Agilent Products

Single Vendor Solutions:

Agilent provides expert calibration for all of your equipment – Agilent and non-Agilent instruments alike. By choosing Agilent as your single-vendor calibration solution, you will have the peace of mind that comes with the convenience, efficiency, and cost savings of Agilent's services.

Benefits:

- Convenience – Agilent provides high quality and comprehensive calibration for both Agilent and non-Agilent products. Our single vendor services provide you with the convenience of a one-stop shop, without compromising quality
- Efficiency – Choosing Agilent calibration can have a swift and direct impact on your bottom line. High performing equipment eradicates mistakes and saves time. These improvements will have tangible effects on your profitability
- Cost reduction – Engaging Agilent as your single vendor for both Agilent and non-Agilent services can help you save administration costs by striving for a reduction in the number of vendors you engage

Features:

- Calibration capability on over 9000 non-Agilent products
- Tests all measurement functions
- Compares performance against significantly higher standards
- Provides clear documentation showing instrument performance following calibration
- Available for VOSCAL (On-site calibration service) and Return-to-Agilent calibration services

Agilent Equipment Management Solution – Turn Information into Action

The Agilent Technologies Equipment Management Solution is a suite of tools and services created specifically to help you manage your test and measurement equipment. It provides a complete, accurate picture of all assets in your test environment.

With Equipment Management, you will know:

- precisely what equipment you have
- where it is
- how it is being used
- when it was last calibrated
- when it's due for maintenance
- when you need additional equipment and when you don't

Benefits:

- Reduced downtime – efficient calibration and repair management minimizes unplanned downtime
- Higher production – improved asset utilization increases throughput
- Reduced costs – through simplified administration

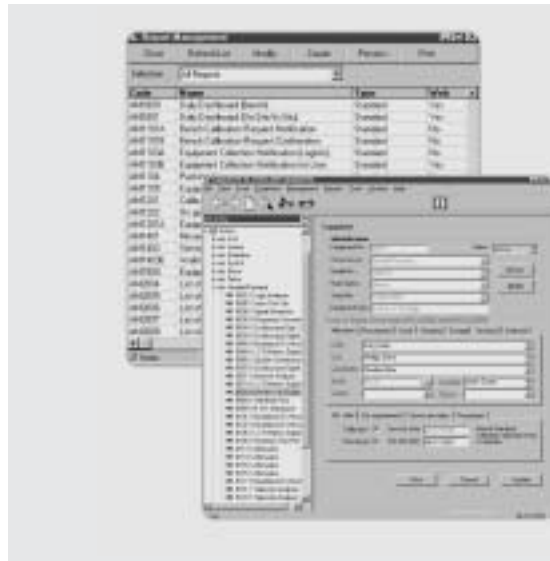
Features:

- Complete solution – with methods, tools and services – reduces risk of hidden costs
- Flexible presentation formats allow information to be presented in various ways



3

- Flexible reporting locally and via an Intranet means information can be shared where and when it's needed
- Electronic link with Agilent maintenance management systems reduces the effort required for data updates
- Centralized testing and inventory records simplify audits and administration
- Microsoft™ Windows™ 95/98/NT™/2000-based application greatly reduces learning curves



Visualize and Control your Test Environment

The Agilent Technologies Equipment Management Solution combines Agilent's equipment management expertise with powerful tools to help you visualize and control your test environment. You use a familiar Microsoft Windows interface to view all available test assets in your enterprise, including all owned, leased and rented equipment. Now you can know when new equipment is truly justified, and when it is not.

With simple menu selections, you can display equipment records, track assets, evaluate usage, and generate reports using flexible reporting tools. Using your company's intranet, you can distribute information to anyone who needs it. You also have access to the Agilent Technologies Service Center via the Internet, so you can check job status and get daily work-in-progress information.

With Agilent Services you are in Safe Hands



3

Agilent Repair and Warranty Information:

Global Warranty

Agilent Technologies provides an excellent factory warranty with all of its test and measurement equipment. It provides the peace-of-mind that today's high-tech industry requires.

Benefits:

- Peace of mind – your investment is protected by Agilent's global reach in more than 100 countries (either directly or through distributors)
- Convenience – the warranty gives you standard coverage for the country in which the product is in use, eliminating the need to ship equipment back to the country of purchase

Features:

- Multi-national customers receive trouble-free warranty assistance around the world
- Agilent's global support network
- Agilent instrument prices include worldwide warranty coverage

Repair

Agilent's repair technicians are the winning team – fully trained in the latest technologies and with access to the latest automated test verification systems for quality assurance. Our services are available at over 40 different customer service centers located around the globe.

Benefits:

- Reduced risk – through faster instrument turn-around
- Accuracy – OEM design and manufacturing knowledge means getting it right the first time
- Reassurance – greater confidence in measurement integrity

Features:

- Agilent recommended parts
- Agilent trained technicians
- Latest automated verification systems for quality assurance
- Scheduling tools to meet delivery commitments

Repair – Purchasing Options

Up-front Repair Plans

- Best Economy
- Purchased at time of hardware
- Coverage of repair costs for up to five years

Repair Services Plans

- Savings over per-incident service
- Available any time after the warranty period
- Coverage of needed repairs for single or multiple years

Pre-Incident Repair Service

- Flexible, cost-effective solution
- Available at any time after the warranty period
- As needed service

Advantage System Uptime Solutions

Agilent Advantage System Uptime Solutions are a family of test system support packages designed to balance your uptime and budgetary requirements.

Choose from three different service levels (below) that offer a range of coverage options, response time guarantees, system restoration goals and on-site or remote delivery models.

Products & Services

- **Agilent Advantage 3-Star Solutions**
Provides the quality system support you need in a cost-effective package
- **Agilent Advantage 4-Star Solutions**
Delivers preventative strategies and recovery services to keep your system up and running
- **Agilent Advantage 5-Star Solutions**
Provides round-the-clock coverage for your mission critical test systems

For more details on the Agilent Advantage System Support Program, visit: www.agilent.com/find/system_uptime



Maximizing your Return on Investment for System Purchases:

Purchasing a new test system can improve your operational efficiency and speed up your manufacturing process. Protecting that improvement with the right support package is critical to ensure you get maximum value for your equipment purchase.

Managing Test Costs in Economic Downturns:

Today's business environment requires stringent cost control. Some manufacturers cut costs by reducing or eliminating system support agreements. This decision may not produce the cost reductions hoped for, and may significantly increase costs over the life of the test system. When unplanned downtime occurs, you may pay more for repairs in one instance than the entire cost of a system support package.

What is a System?

A Test System is a control or measuring device composed of multiple instruments that are designed to work together to provide a test solution – often in mission critical applications. Typically, a test system is a large, complex fixture requiring specialized repair and calibration requirements that do not lend themselves to a Return-to-Agilent mode of service. Agilent has a number of System Uptime Services designed to achieve your service needs on your Test System.

Services that Complement the Utilization of your Equipment

- Get up and running quickly
- Optimize your equipment performance and utilization
- Maintain your competitive edge
- Expert coaching to enhance your application

As a technical professional you understand that having the right information at the right time can pay for itself many times over. Agilent offers a flexible range of engineering services specifically designed to help you optimize the use of your Agilent equipment. We can help you get started with your new instrument and provide continued assistance with the optimization of your existing instruments, or provide specific training based on your specialized requirements. These services can be provided in a variety of ways: face to face, at your site, remote (via phone and web collaboration), or self guided tutorial.



3

Start-up Assistance	Product Services	Education and Training	Application Services
Helps you get up and running with your test equipment as quickly as possible in your local environment	Provides continued engineering support for best optimization of your instrument	Increases product expertise and keeps you abreast of emerging technologies	Combines your knowledge with our expertise to enable you to meet your application goals
Provided remotely or at your site		Provided at your site	
Customized to your application or specific needs			

Engineering Services

Our Engineering Services are for customers who are under constant and growing pressure to reduce time to market, time to volume and manufacturing cycle time and to improve profit margins. Agilent offers a spectrum of services that are adaptable to widely varying customer environments and situations.

Types of Services Available:

- One-to-one instruction in product operation, specific to your application
- Application development and implementation
- Assistance with building a test system
- Interfacing instruments and workstations
- Software design and development
- Setting up, installing and initializing new systems
- Customizing measurement systems for your environment
- System and test-code optimization
- Specialized measurement troubleshooting

To learn more about Agilent's engineering services, go to: www.agilent.com/find/consulting

Education

Education is an investment in people: well-trained engineers solve problems more effectively and efficiently, ultimately making them more successful in their jobs. Agilent courses are designed for managers, engineers, and technicians who need to keep abreast of the latest technologies, techniques, and product developments. To best meet your needs and maximize the benefit of your education and training investment, Agilent offers several education options.

Dedicated Courses

With Agilent's dedicated training, we bring our courses to your site and train your staff using your hardware or ours. This alternative can be very cost effective if you have multiple students requiring the same training, because it eliminates travel time and expense. Additionally, dedicated courses allow for private discussion to address your company-specific questions.

Customized Dedicated Courses

Ask us to design a custom course to be offered at your site. You can combine topics from multiple courses, add topics of specific interest, or streamline the class by eliminating topics that do not pertain to your situation.

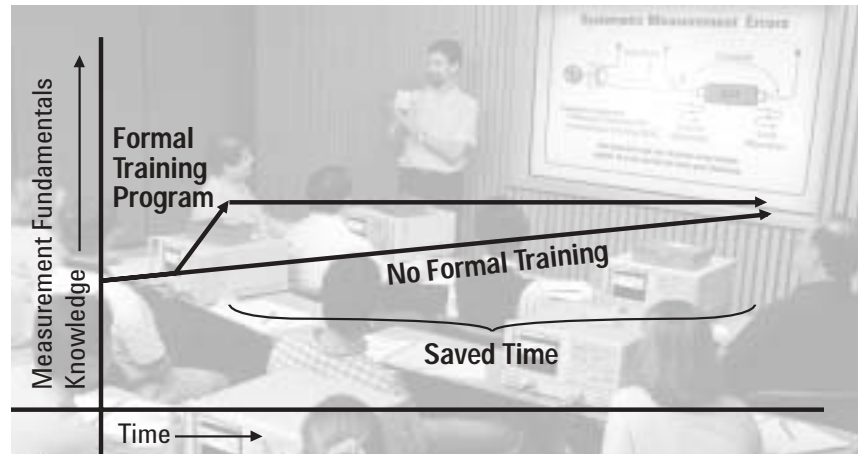
Standard Curricula

Agilent offers accelerated curricula for getting newly hired engineers and technicians up to speed quickly, and for experienced engineers and technicians who are changing jobs or who need a refresher. We can customize the curricula to meet your specific business needs.

To learn more about Agilent's education services, go to: www.agilent.com/find/education

Expert Test and Measurement Training = Faster Productivity = Improved Profits

A well-trained engineer solves problems more effectively and efficiently. That means you can get your products to market faster, which improves your profitability. With the Agilent Accelerated Education Curriculum, your engineers become productive fast, as Agilent's global experts share their real-world test and measurement expertise. Your investment in an accelerated curriculum will pay for itself quickly as you jump-start your employees' productivity.



Who can Benefit from Accelerated Education?

New Hires

Yesterday, engineers learned theory in engineering school, then honed their real-world expertise with on-the-job training. With today's intense competitive challenges and rapidly evolving technologies, you cannot afford the luxury of on-the-job training. You need your newly hired engineers to be productive immediately. The Agilent Accelerated Education Curriculum quickly gives your new hires the test and measurement expertise they need, so they become valuable contributors faster.

Experienced Engineers

With today's rapid and dramatic changes in technology, your employees' skills can get out of date quickly. The Agilent Accelerated Education Curriculum gives your seasoned engineers a fast refresher in the latest test and measurement technologies and techniques. Increase your confidence in your product development schedules by keeping your engineers abreast of emerging technologies and keeping their skills current.

Flexible, Convenient, and Cost-Effective

The Agilent Accelerated Education Curriculum offers specific training to meet your organization's needs and delivers it in a format that works best for you.

Standard and Custom Curricula –

Choose from our standard curricula or combine courses from Agilent's extensive class catalog (covering a wide variety of subjects in measurement fundamentals, technology training, product operation training, and application training) to create a tailored curriculum to meet your employees' needs.

Flexible Delivery Options –

Accelerated courses can be delivered in a choice of formats.

- Face-to-face sessions at your site or ours
- On-demand eLearning modules available over the Internet (limited classes available in this format)

Cost-Effective Training –

Managing your company's test and measurement training needs in-house means investing resources in course development, curriculum management, instructors, materials, equipment, etc. Now you can focus on your core competencies and take advantage of the cost-effective classes offered by test and measurement experts through the Agilent Accelerated Education Curriculum.

Why Agilent?

When you choose the Agilent Accelerated Education Curriculum, you get more than a training package. You get a reliable, experienced partner committed to your success. Agilent is a global leader in the test and measurement industry that trains thousands of students each year.

Select the Curriculum that Meets Your Needs

You'll save money when you select an entire curriculum compared to signing up for individual classes. Curricula are carefully designed to provide your employees with the real-world, market-tuned measurement expertise they need to thrive in today's fastchanging environment.

Test and Measurement Fundamentals Curriculum (7250B-500)

Course	Module	Description
Metrology Basics	1	Learn about the science of measurement. This course covers measurement process, classification of standards, the SI units system, laboratory calibration needs, traceability, standards bodies' requirements, interpreting calibration results and how calibration affects measurements.
Measurement Uncertainties	2	Learn how to perform measurement uncertainty analysis. This course covers terms and definitions used in CIPM and ISO uncertainty calculations; identification of errors in microwave parameters; and the mathematical summation of total measurement uncertainty.
Measurement Automation	3	Learn the fundamentals of measurement automation: what it is, features and benefits, basic elements of an automated system. Includes an introduction to the computers and computer languages and common bus interfaces used in automated systems.
Measurement Process Fundamentals	4	Learn about measurement process, instrument performance, measurement variation, measurement process capability, types of measurement errors, methods to estimate measurement errors.

RF and Microwave Fundamentals Curriculum (7250B-600)

Course	Module	Description
Cable and Connector Care	1	Gain an understanding of connector care fundamentals. This course covers requirements for effective connections; benefits and proper use of connectors; and common connector types and specifications.
Spectrum Analysis	2	Learn the theoretical fundamentals and gain experience doing practical spectrum analysis measurements on 856x, 859x or ESA series spectrum analyzers. In this class we will discuss dynamic range considerations and how to evaluate measurement accuracy.
Network Analysis Basics	3	Learn the theoretical fundamentals and gain experience performing practical network analysis measurements. Learn the major sources of errors in microwave measurements and their impact on measurement uncertainty.
Noise Figure Measurements	4	Learn the principles of noise figure measurements and how to maximize performance of your Agilent NFA-series noise figure analyzer for your application. Learn how to avoid measurement errors and quantify uncertainties.
Signal Generator and Source Basics	5	This course includes theory and practical examples to help you understand the basics of signal generators and their applications in analog and digitally modulated systems.
Transmission Line Fundamentals	6	Transmission line concepts form the basis for understanding RF and microwave technology. Understand the need for transmission lines and the complexities of dealing with high-frequency systems.
Power Measurement Basics	7	Learn RF and microwave power measurement principles including why and how to make power measurements. Learn about different sensor types and measurement approaches. Understand power transfer and insertion loss.

Understanding Optical Transmitters and Receivers and Their Characterizations (7250B-400)

Course	Module	Description
Understanding Lightwave Technology	1	Learn how and why optical devices and networks operate. This course is for engineers who already understand optical basics and want to advance their understanding of optically based systems.
Understanding DWDM	2	Gain an understanding of optical DWDM devices and how to test them for optimal performance. This course covers DWDM-enabling devices and their role in DWDM networks, performance requirements, specifications and the methods and equipment used to test them.
Understanding Optical Passive Device Characterization	3	Learn techniques for testing the performance of optical passive components. This course covers component operation, specific test techniques and ways to automate testing.
Understanding and Characterizing Optical Transmitters and Receivers	4	Learn how to test the latest optical devices. This course covers transmitters; electrical-to-optical (E/O) conversion; modulators and receivers; and optical-to-electrical (O/E) conversion.

For more information about Agilent's flexible, focused education and training options go to http://www.agilent.com/find/accelerated_education

Designing and Implementing Solutions that Address Technological Challenges and Improve Business Results

- Improve product lifecycle
- Resolve critical day to day challenges
- Optimize test strategy
- Minimize cost of ownership

We recognize that as a manager in an R&D or manufacturing environment you have responsibility for meeting or exceeding your business goals in the most cost effective and customer focused way.

Agilent Technologies is the world's leading designer and manufacturer of measurement, electronic and optical equipment. As a result, Agilent has built a wealth of knowledge, tools and experience and our professional services can help you overcome obstacles in the R&D and manufacturing environment to achieve the best results.



3

Building Solutions to Meet Your Needs

Access to industry experts that provide clear insights into critical issues, root causes, and operational gaps, which result in recommendations for practical implementation and will drive improvements in quality, cycle time and cost.

Product Lifecycle Management	R&D & Manufacturing Productivity	Test Strategy Optimization	Asset Utilization
<p>Improve the ability to manage all phases of the product lifecycle in order to repeatedly meet time to market, time to volume, price and quality goals</p>	<p>Enhance R&D, New Product Introduction and Manufacturing processes to reduce the time to resolve critical day to day problems which impact time to market</p>	<p>Improve the ability to assess, select and optimize the right test strategy and implementation to meet evolving business needs</p>	<p>Minimize the cost of ownership for test assets while ensuring the latest test technology is available and fully utilized to achieve time to market and time to volume goals</p>

Agilent Alliances Give you a Competitive Edge



Join a World-Class Team

To better respond to customers' rapidly evolving needs for complex technologies and more complete solutions, Agilent Technologies frequently forms alliances with other companies. By working with select value-added resellers, original equipment manufacturers, systems integrators, and independent hardware and software vendors who have specific vertical marketing expertise, we can help provide customers with the best possible solutions for their applications. Combining our partners' strengths in products, services, and vertical markets with high-quality Agilent products, services and worldwide support results in a win/win/win for our customers, our partners and for Agilent.

Agilent's Test and Measurement Channel Partner Program offers you a wide variety of benefits designed to help you build your sales of Agilent solutions and increase your profits. Depending on the type of agreement you sign, Agilent offers programs for cooperative selling, local marketing support and Agilent-internal promotions of your solutions. Agilent also provides technical training/assistance and financial benefits.

Program Qualifications

Please visit www.agilent.com/find/tmpartners to learn more about the Channel Partner Program and how to apply, or contact the Agilent representative in your area.

Agilent has alliances with other companies to provide you with the best possible solutions for accelerating your new products to market and improving your manufacturing efficiency. Whether they are providing fixtures, software programs, total solutions, or even full integration services for your manufacturing line, our channel partners' strengths complement Agilent's products and services to give you solutions that make you more competitive.

Agilent channel partners include value-added resellers, independent solutions suppliers, systems integrators, among others, who are experts in certain application areas. These companies typically use Agilent instruments as building blocks and add their own application-specific hardware, software or system integration capabilities to create solutions that solve your particular business problems. Through our partnership, we dramatically expand the breadth and quality of our solutions and shorten the time it takes us to deliver them to you.

Application Areas

Agilent channel partners offer solutions in the following general application areas:

- Component test
- Manufacturing test
- Signal analysis
- Frequency spectrum monitoring and management
- Antenna test
- Design verification and conformance test
- Mechanical functional test
- RF and microwave semiconductor test
- Process monitoring and control
- Additional application areas

The availability of Agilent channel partners and their areas of applications expertise vary by country. To obtain the name and telephone number of a channel partner for a specific application, or in other application areas not listed above, please visit www.agilent.com/find/tmpartners or contact the Agilent representative in your area. Please refer to the Local Assistance section on page 481.

4 General Purpose

36 Instruments



Oscilloscopes	38
Oscilloscope Probes & Accessories	57
Modulation Domain Analyzers	67
Electronic Counters	69
Digital Multimeters	76
Data Acquisition & Switching	85
Function/Arbitrary Waveform Generators	89
DC Electronic Loads	96
Power Supplies	100
AC Source/Analyzers	126



Accelerate Your Troubleshooting

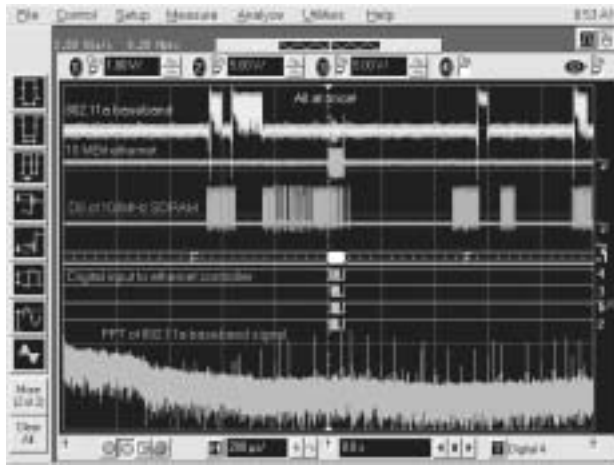
Agilent oscilloscopes are designed to help you accelerate the troubleshooting process. Based on input from customers around the world, Agilent has engineered features and unique capabilities that will enable you to keep pace with the rapid changes in technology, yet are easier to use than most competitive products. The result is you spend more time troubleshooting your design and less time fighting your oscilloscope.

- Real-time oscilloscopes with bandwidths from 60 MHz to 6 GHz
- Sampling oscilloscopes with bandwidths up to 80 GHz
- Unique mixed signal scopes with integrated oscilloscope and logic analysis features
- MegaZoom technology for fast and deep memory all the time
- High-definition displays with nearly twice the normal horizontal resolution

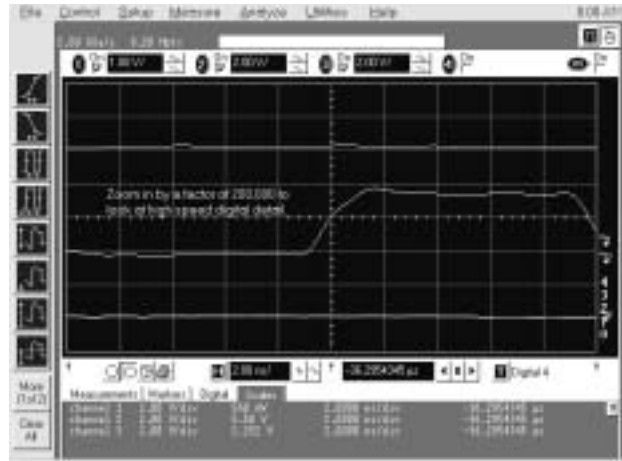
Agilent Offers a Wide Range of Oscilloscopes for Use in the Lab, Benchtop, Field, and Classroom

	Mixed Signal Pages 40 – 44	Portable Pages 48 – 50	Infiniium General-Purpose Pages 45 – 47	Infiniium High-Performance Pages 51 – 53	Infiniium DCA Pages 54 – 56
Bandwidth	60 MHz to 1 GHz	60 to 500 MHz	600 MHz to 2.25 GHz	2.5 and 6 GHz	3 to 80 GHz
Channels	2 + 16 and 4 + 16	2 and 4	2 and 4	4	Up to 4
Sampling Speed	Up to 4 GSa/s	200 MSa/s and 2 GSa/s	Up to 4 GSa/s	20 GSa/s	40 KSa/s sequential
Memory	Up to 16 M	Up to 8 M	Up to 16 M	Up to 1 M (all sample rates) Up to 32 M (≤ 2 GSa/s)	4 K
Description	A 16-channel timing analyzer is seamlessly integrated into a full-featured scope for debugging complex mixed signal designs.	Low-cost scopes for the lab, the field, or the classroom with high-definition display, flexible triggering, and MegaZoom deep memory technology.	Lab scopes with unmatched usability and MegaZoom deep memory.	Performance for deployment of state-of-the-art technologies with Infiniium's Windows®-based interface and InfiniiumMax probes.	Modular high-speed scopes that also function as digital communications analyzers and offer TDR capabilities.

- Zoom in quickly on critical signals
- Eliminate performance problems with first generation deep memory
- Forget the hassle of manually resetting memory



Using Agilent's MegaZoom deep memory, a mixed signal scope captures a full cycle of the device's operation and displays the time-aligned signals. The FFT is visible on the yellow trace.



Zooming in by a factor of 200,000:1 brings the rise time of the SDRAM clock into view.

Fast and Deep Memory All The Time

What's so great about Agilent's patented deep memory? MegaZoom gives you memory that is simultaneously fast and deep all the time, unlike first generation deep memory oscilloscopes.

First generation deep memory oscilloscopes make you select a memory depth before acquiring any waveform data. Memory depth is not set to maximum all the time because the scope's response to user input and waveform update rate slows down as memory is increased. Consequently the re-arm and waveform processing time between acquisition cycles may be many orders of magnitude larger than the acquisition time needed to detect glitches. As a result, you can miss the very problems you are trying to detect.

When operating with a first generation deep memory scope, users must estimate how much memory they are going to need for a particular measurement — and if they are wrong they have to reset the memory and restart the measurement. This can be a very time-consuming process. In contrast, because MegaZoom deep memory is always available, you simply gather the waveform and then pan and zoom to observe the fine details of your critical signals.

The MegaZoom technology is based upon a custom processor that controls the flow of data into acquisition memory and rapid post-processing for display and measurements. The MegaZoom processor operates at the full speed of the scope's A/D. Processing the data in the MegaZoom greatly reduces the amount of data transferred to the scope's CPU, for post-processing. MegaZoom substantially increases the waveform update rate and front-panel responsiveness of Agilent's deep memory scopes, making these scopes better suited to working on today's complex digital-based designs.

Oscilloscopes

40

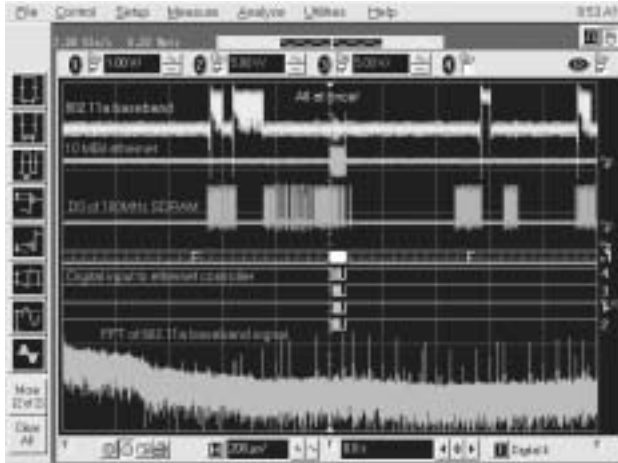
Mixed Signal Oscilloscopes

5483xD
5464xD
5462xD

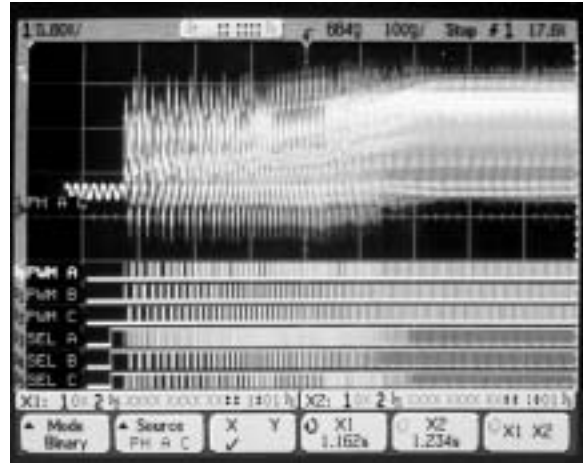
- Choose from bandwidths ranging from 60 MHz to 1 GHz
- View 18 to 20 time-aligned scope and timing channels simultaneously
- Troubleshoot mixed analog and digital designs with responsive MegaZoom deep memory
- Reveal subtle details that the typical scope won't show with a patented high-resolution display
- Take advantage of standard serial triggering including I²C, SPI, CAN frame, LIN and USB frame



Using a scope without logic channels instead of an Agilent MSO is like using a slide rule when you could have a calculator!



MegaZoom allows you to capture a full cycle of a device's operation while maintaining the ability to resolve fine details.



A high-resolution, analog-like display with 32-shades of gray helps you easily identify waveform irregularities (Agilent 54600 Series only).

Seamless Integration of Scope and Timing Channels

More Channels, More Memory, More Triggering

With the increasing digital content in today's designs, it is often difficult to capture enough channels simultaneously with a traditional 2 or 4 channel scope. To further complicate matters, the analog and digital sides are often operating at drastically different speeds.

Now you can capture, display, and analyze a variety of signals in one acquisition on one instrument screen, helping you narrow in more quickly on tough design problems. With mixed signal scopes, a 16-channel timing analyzer is seamlessly integrated into a full-featured scope. It's now easy to measure a combination of signal types and speeds all at once, including slow analog, fast digital, or baseband RF.

MegaZoom Memory

MegaZoom memory technology is fast and deep, so you can capture a full cycle of your device's operation with the resolution needed to view critical intervals of the highest speed signals. MegaZoom is available at all times and does not require a special operating mode.



Agilent's family of mixed signal oscilloscopes spans the frequency range from 60 MHz to 1 GHz, with models to meet your needs and budget.

Mixed Signal Selection Guide

	54833D Infiniium	54832D Infiniium	54831D Infiniium	54830D Infiniium	54642D Portable	54641D Portable	54622D Portable	54621D Portable
Bandwidth	1 GHz	1 GHz	600 MHz	600 MHz	500 MHz	350 MHz	100 MHz	60 MHz
Channels Scope + Timing	2 + 16	4 + 16	4 + 16	2 + 16	2 + 16	2 + 16	2 + 16	2 + 16
Sampling	4 GSa/s	4 GSa/s	4 GSa/s	4 GSa/s	2 GSa/s	2 GSa/s	200 MSa/s	200 MSa/s
Maximum Memory	Up to 16 M	Up to 16 M	Up to 16 M	Up to 16 M	8 M	8 M	4 M	4 M
MegaZoom	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Special Features	Infiniium's Windows® – based interface gives you unparalleled ease of use for both scope and logic channels. Powerful triggering, measurements, and math functions make this the scope of choice for embedded applications. LAN and Web connectivity let you share information easily and control the scope remotely.				High-definition display with 32 shades of gray to give a clear analog-like view of critical waveforms. Familiar knob-based controls for both scope and logic channels helps you put these scopes to work right out of the box. Serial triggering simplifies tracking down CAN, LIN, I ² C, SPI, USB and other serial-bus problems. IntuiLink software simplifies PC connectivity.			
Description	For DSP-based systems requiring extended analysis and deep memory	For high-performance 32-bit embedded applications with high-speed logic	For 32-bit applications with logic; ~2 ns edge speeds and 4 scope channels	For DSP-based systems requiring extended analysis and deep memory	For higher-speed embedded and DSP applications	For medium-speed embedded applications up to 50 MHz	For 8- and 16-bit microcontroller applications	The lowest-cost MSO; ideal for education and industrial applications
Notes	Standard memory is 4 M, options extend up to 16 M.				IntuiLink software is provided at no cost. Scopes have built-in parallel and RS-232 I/O. GPIB is an extra-cost option.			

Agilent Infiniium Series Mixed Signal Oscilloscope Specifications

		54830D	54831D	54832D	54833D
Channels		2 + 16	4 + 16	4 + 16	2 + 16
Scope Channels	Bandwidth	600 MHz	600 MHz	1 GHz	1 GHz
	Max Sample Rate	4 GSa/s			
	Sampling Modes	real time, equivalent time, peak detect, high resolution and averaging			
	Max Input, High Z	150 V RMS or dc, CAT I; ±250 V (dc + ac) in AC coupling			
	Max Input, 50 Ohms	5 V RMS, CAT I			
	Resolution	8 bits			
	Range	1 mV/div to 5 V/div (high Z) or 1 mV/div to 1 V/div in 50 Ohm mode			
Logic Channels	Channels	16			
	Max Sample Rate	1 GSa/s			
	Input level	500 mV p-p minimum, ±40 V Maximum			
	Threshold	±8 V in 10 mV increments			
Max Memory	Scope Channels	4 M Standard, 8 M with option 040 and 16 M with option 080			
	Logic Channels	4 M			
TimeBase	Range	500 ps/div to 20 s/div (600 MHz models) and 200 ps/div to 20 s/div for 1 GHz models			
	Resolution	4 ps			
	Accuracy	15 ppm			
	Jitter	8 ps ±0.05 ppm x (delay setting)			
Triggering	Source	All Channels (scope + D0-D15) & External			
	Modes	Edge, glitch, line, pattern, state, delay by time, delay by events, TV & violation triggers (pulse width, setup/hold, and transition)			
Display		8.4 inch diagonal color TFT-LCD Maximum Waveforms/second >8,800			
Measurements	Voltage	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area			
	Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase			
	Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase			
	Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion, Statistics, Histograms (analog channels only), Mask Testing			
Math Functions		Add, Average, Differentiate, Divide, FFT Magnitude, FFT Phase, Integrate, Invert, Magnify, Min, Max, Multiply, Subtract, Versus			
Storage		LS-120 Superdisk floppy drive reads/writes to both standard 3.5 inch 1.44 MB and 120 MB disks			
Connectivity		LAN RJ-45 ,GPIB IEEE 488.2, RS-232 (serial) COM1, Parallel Centronics printer port, USB 2 ports. Video Output 15 pin VGA, full color Auxiliary Output			
Built in Help		Infiniium's task-oriented Setup Guide provides step-by-step instructions for several advanced measurements and procedures			
Warranty		3 years standard, option increase to 5 years			
Size/Weight		Height: 216 mm (8.5 in); Width: 437 mm (17.19 in); Depth: 440 mm (17.34 in); Net Weight = 13.4 kg			

Standard Probes Included

Agilent Model	54830D	54831D	54832D*
Passive Probes	1165A 10:1 10 MΩ probes (Qty 2)	1165A 10:1 10 MΩ probes (Qty 4)	None
Logic Cable Kit	54826-68701 MSO logic cable kit (Qty 1)		

* Passive probes not included, please order option 001, 002, 004, active probe option 012 (for 54832D).

**Other languages also available

For information about higher bandwidth scope and probing solutions (up to 6 GHz of system bandwidth), please visit our web site at www.agilent.com/find/infiniimax

Agilent Portable Series Mixed Signal Oscilloscope Specifications

5483xD
5464xD
5462xD

		54621D	54622D	54641D	54642D
Channels		2 Scope + 16 Logic			
Scope Channels	Bandwidth	60 MHz	100 MHz	350 MHz	500 MHz
	Max Sample Rate	200 MSa/s	200 MSa/s	2 GSa/s	2 GSa/s
	Max Input	400 V dc + peak ac			
	Resolution	8 bits			
	High Resolution Mode	12 bits when >200 us/div average mode			
	Range	1 mV to 5 V			
	Logic Channels	Channels	16 Logic Timing		
Logic Channels	Max Sample Rate	400 MSa/s	400 MSa/s	1 GSa/s	1 GSa/s
	Input level	500 mV p-p minimum, ±40 V Maximum			
Max Memory	Scope Channels	4 M	4 M	8 M	8 M
	Logic Channels	8 M	8 M	4 M	4 M
TimeBase		5 ns/div to 50 s/div	5 ns/div to 50 s/div	1 ns/div to 50 s/div	1 ns/div to 50 s/div
Peak Detection		5 ns	5 ns	1 ns	1 ns
Triggering	Source	Internal selection of CH1, CH2, D0-D15 and External			
	Modes	Edge, pattern, pulse width, TV, sequence, and serial protocols of CAN, I ² C, LIN, SPI, & USB			
Display		High definition monochrome with 32 shades of gray and 1,000 points horizontal resolution			
	Update Rate	Up to 25,000 vectors per second			
	Modes	Normal, Average, peak detect, roll, and XY with Z blanking			
Measurements	Automatic	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, undershoot, RMS, frequency, period, +width, -width, duty cycle, time at max, time at min, phase, and delay			
	Counter	Build-in 5 digit frequency counter on any channel, counts up to 125 MHz			
	Cursors	Manually or automatically placed readout of Horizontal (X, ΔX, 1/ΔX) and Vertical (Y, ΔY)			
Math Functions		CH1 – CH2, CH1 + CH2, 1*2, FFT, Differentiate, Integrate			
Storage		3.5" 1.44 MB double density, Image formats: TIF, BMP. Data formats: X and Y (time/voltage) values in CSV format			
Connectivity		Standard RS-232 and parallel on rear panel; optional GPIB interface module (N2757A)			
Built in Help		Key-specific help in 11 languages displayed by pressing and holding key or softkey of interest			
Warranty		3 years standard, option increase to 5 years			
Size/Weight		Size: 32.26 cm Wide x 17.27 cm High x 31.75 cm Depth (without handle); Weight 6.8 kg			

5483xD
5464xD
5462xD

Ordering Information and Configuration:

Agilent Infiniium Options

54830D 2+16 channel 600MHz Infiniium Mixed Signal Oscilloscope
54831D 4+16 channel 600MHz Infiniium Mixed Signal Oscilloscope
54832D 4+16 channel 1GHz Infiniium Mixed Signal Oscilloscope
54833D 2+16 channel 1GHz Infiniium Mixed Signal Oscilloscope

Acquisition Memory Options (for scope channels only)

040 8 Mpts on half the acquisition channels (interleaved) or 4 Mpts on each acquisition channel
080* 16 Mpts on half the acquisition channels (interleaved) or 8 Mpts on each acquisition channel
N2845A** After-Purchase Memory Upgrade, 2 Mpts/ch to 4 Mpts/ch
N2846A** After-Purchase Memory Upgrade, 2 Mpts/ch to 8 Mpts/ch
N2847A** After-Purchase Memory Upgrade, 4 Mpts/ch to 8 Mpts/ch

Probe Options

5483xD-001 Add two 1165A, 10:1 passive probes for the 54830 Series; Add two 1161A, 10:1 passive probes for the 54845B/46B
5483xD-002 Add one 1162A 1:1 passive probe
5483xD-004 Add four 1165A, 10:1 passive probes for the 54830 Series; Add four 1161A, 10:1 passive probes for the 54845B/46B
5483xD-005 Add one 54826-68701 Logic Probe Kit (This probe kit comes standard with the 54830D/31D/32D)
5483xD-007 Add one Wedge Adapter Kit (1 each 3/8/16 signals, 0.5 mm)
5483xD-008 Add one 1153A 200 MHz differential probe
5483xD-009 Add one 1154A 500 MHz differential probe
5483xD-010 Add one 1159A 1 GHz differential probe
5483xD-011 Add one 1155A 2 Channel, 750 MHz active probe
5483xD-012 Add one 1156A 1.5 GHz active probe (54830B/31B/32B/30D/31D/32D only)
5483xD-013 Add one 1157A 2.5 GHz active probe (54845B only)
5483xD-014 Add one 1158A 4 GHz active probe (54846B only)
5483xD-016 (E2654A) EZ-Probe, Positioner: includes base, joystick, and articulating arm

Instrument Options

5483xD-B30 (E2645A) USB test option
5483xD-B31 (E2646A) Additional USB 2.0 SQiDD test fixture
5483xD-100 (E2625A) Communication Mask Test Kit
5483xD-200 (N2850A) VoiceControl option (English only)
5483xD-1CM (E2609A) Add one Rackmount Kit
1184A Testmobile with keyboard and mouse tray, drawer for accessories
E5850A Time-correlation fixture, integrate Infiniium scope and 16700 logic analyzer

Manual Options (for 54830 Series)

OB3 Printed service manual
OBF Printed programmer's manual
AB2 Printed user's quick start guide in simplified Chinese
ABJ Printed user's quick start guide in Japanese

Service Options

A6J ANSI Z540-compliant calibration
W32 3-year, return-to-Agilent, up-front calibration option
W34 3-year, return-to-Agilent, std comp calibration service
W50 5-year, return-to-Agilent, repair coverage (additional 2 years)
W52 5-year, return-to-Agilent, up-front calibration option

* To find out about any special promotions that may be offered, visit www.agilent.com/find/infiniium or contact your local Agilent representative.
 ** Users can install upgrades without opening the instrument case or requiring on-site service.

54600 Series Ordering Information

54621D 2 + 16 channel 60 MHz Mixed Signal Oscilloscope
54622D 2 + 16 channel 100 MHz Mixed Signal Oscilloscope
54641D 2 + 16 channel 350 MHz Mixed Signal Oscilloscope
54642D 2 + 16 channel 500 MHz Mixed Signal Oscilloscope

Accessories Included	54621D	54622D	54641D	54642D
User's Guide (localized), Service Manual, Programmer's Manual	√	√	√	√
Power Cord	√	√	√	√
10073C 10:1 Divider Probes with Readout	0	0	2	2
10074C 10:1 Divider Probes with Readout	2	2	0	0
16:2 x 8 Input Logic Input probe Assembly	√	√	√	√
Accessories Pouch and Front Panel Cover		√	√	√
IntuiLink Software RS-232 Cable	**	√	√	√

** IntuiLink Software available free on web at www.agilent.com/find/intuilink

Manual Options (if no option is specified, English ABA will be shipped)

ABA English
ABJ Japanese
AB2 Simplified Chinese

Available Options

546xxD-003 Shielding Option for use in severe environments or with sensitive devices under test – shields both ways (in and out): RS-03 Magnetic interface shielding added to CRT, and RE-02 display shield added to CRT to reduce radiated interference
546xxD-1CM Rackmount Kit (same as 1186A)

Warranty and Calibration Options

All models include a standard 3-year warranty. Contact local sales office for prices of extended options:

A6J ANSI/NSCL Z540 Calibration with test data (replaces 1BP)
W32 3-year, Customer-Return Calibration Service
W34 3-year, Customer-Return Standard Comp Cal Service
W50 Additional 2-year warranty (5 year total)
W52 5-year, Customer-Return Calibration Service
W54 5-year, Customer-Return Standard Comp Cal Service

Accessories

1183A Testmobile Scope Cart
1185A Carrying Case
1186A Rackmount Kit (same as option 1CM)
N2726A Accessory Pouch & Front Panel Cover (standard with 100-MHz models, optional with 60-MHz models)
N2727A Seiko Thermal Printer and Pouch, Parallel Cable, Power Cable, 2 rolls Paper, Front Panel Cover
N2728A 10 rolls of Printer Paper
N2757A GPIB Interface Module for 54620-Series and 54640-Series Scopes
N2758A CAN Trigger Module

- Choose from bandwidths up to 2.25 GHz, sample rates up to 8 GSa/s, and memory depths up to 16 M points
- Simplify measurement setup with familiar Windows-based graphical user interface and analog-like front panel
- Find answers quickly with advanced help system
- Share measurement resources with LAN connectivity
- Free hands for probing with VoiceControl option (English only)
- Get accurate insight into system performance with active probes



Simplify your debugging using Infiniium's Windows-based interface, its analog-like control knobs, and built-in help system.

Advanced Troubleshooting That's Easy to Use

Agilent's Infiniium oscilloscopes combine ease of use and the right specifications with a broad feature set to help you get your job done faster. If you are tired of spending 80 percent of your lab time fighting your instrumentation and only 20 percent making meaningful measurements, Infiniium is the scope for you.

Windows Interface

Infiniium's intuitive Windows-based graphical user interface (GUI), coupled with its analog-like control knobs, puts the scopes' powerful triggering, measurements, and waveform math functions at your fingertips. Infiniium's design has won eight industry awards and the hearts of oscilloscope users around the world.

Agilent Infiniium 54800 Series Selection Guide

	54846B Infiniium	54845B Infiniium	54833B Infiniium	54832B Infiniium	54831B Infiniium	54830B Infiniium
Bandwidth	2.25 GHz	1.5 GHz	1 GHz	1 GHz	600 MHz	600 MHz
Channels	4	4	2	4	4	2
Maximum Sampling	8 GSa/s	8 GSa/s	4 GSa/s	4 GSa/s	4 GSa/s	4 GSa/s
Maximum Memory	64 K	64 K	Up to 16 M	Up to 16 M	Up to 16 M	Up to 16 M
MegaZoom	No	No	Yes	Yes	Yes	Yes
Special Features	Cycle-to-cycle jitter measurements and high-speed USB compliance testing in addition to all other Infiniium features.		11 trigger modes isolate circuit problems. 12 voltage, 11 time measurements, 14 waveform math functions, 7 eye diagram measurements, and 8 histogram measurements allow full circuit characterization.			
Description	The signal integrity scope offering the highest-fidelity reproduction of high-speed signals with the 1158A probe.	The scope for systems needing greater than 1 GHz performance at an affordable price.	When you need more than 500 MHz bandwidth and the power of Infiniium at a budget price.	The scope for projects where edge speeds are in the nanosecond range. Four deep MegaZoom channels show all the details.	Four channels of 16 M deep MegaZoom and Infiniium's ease of use bring your critical measurements into view.	When you need more than 500 MHz bandwidth and the power of Infiniium at a budget price.
Notes	Option 014 adds one 1158A 4 GHz active probe	Option 013 adds one 1157A 2.5 GHz active probe	Standard memory is 4 M, options available for up to 16 M. Option 100 communications mask test kit and Option 200 voice control kit may be used with all Infiniium models.			

For more information about Agilent 54800 Series Scopes, go to www.agilent.com/find/infiniium

MegaZoom Deep Memory

MegaZoom is Agilent's unique, patented technology that gives you the advantages of deep memory without the usual drawbacks. With MegaZoom, deep memory is always available – it is not a special mode. MegaZoom deep memory lets you capture a full cycle of your system's operation and zoom in on specific areas of interest while applying Infiniium's rich measurement power.

Triggering Power

To solve complex problems, you need to isolate specific events of interest. Infiniium scopes offer a full range of advanced triggers to help you isolate and capture critical areas of your waveform. Setup for advanced triggers is simple, with all the settings you need grouped in easy-to-access dialog boxes.

Signal Integrity

If you need an easy-to-use yet powerful signal integrity tool, use the 2.25 GHz Infiniium with 8 GSa/s sampling along with Agilent's 4 GHz 1158A active probes to get a better look at your signal integrity problems. The 115xA probes are uniquely designed for a flat frequency response over the entire probe bandwidth, eliminating the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance.

Advanced Help System

In addition to the usual how-to-do-it information you expect to find, Infiniium's help system contains measurement advice from the experts in Agilent's labs to help you quickly determine exactly what is going on in your device under test.

Information Sharing

The scope's PC architecture and LAN interface makes it easy to share your work and communicate your results. Use a Java™ – enabled Web browser to share access with team members working remotely.

54800
Series

4

Agilent Infiniium General-Purpose Specifications

	54846B	54845B
Channels		
Scope Channels	4	4
Bandwidth	2.25 GHz	1.5 GHz
Rise Time (10% to 90%)	178 ps	233 ps
Max Sample Rate	8 GSa/s	
Sampling Modes	Real time, equivalent time, peak detect, high resolution and averaging	
Max Input, High Z	±100 V (DC + AC)(AC<10 kHz), CAT I	
Max Input, 50 Ohms	5 Vrms, CAT I	
Resolution	8 bits	
Range	High Z; 2 mV/div to 2 V/div 50 Ohms; 1 mV/div to 1 V/div	
Max Memory		
Standard	64 K	
TimeBase		
Range	100 ps/div to 20 s/div	
Resolution		
Accuracy	70 ppm (±0.007%)	
Jitter	8 ps ± 0.005 ppm x (delay setting)	
Triggering		
Modes	Edge, glitch, line, pattern, state, delay by time, delay by events, & TV	
Violation triggers	Pulse width, setup/hold, and transition	
Display		
	8.4 inch diagonal color TFT-LCD	
Measurements		
Voltage	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area	
Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase	
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase	
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion	
Jitter Measurements	Available as E2681A EZJIT Jitter analysis software	
Math Functions		
	Add, Average, Differentiate, Divide, FFT Magnitude, FFT Phase, Integrate, Invert, Magnify, Min, Max, Multiply, Subtract, Versus	
Storage		
	LS-120 Superdisk floppy drive reads/writes to both standard 3.5 inch 1.44 MB and 120 MB disks	
Connectivity		
	LAN RJ-45, GPIB IEEE 488.2, RS-232 (serial) COM1, Parallel Centronics printer port, USB 2 ports, Video Output 15 pin VGA, full color Auxiliary Output	
Built in Help		
	Infiniium's task-oriented Setup Guide provides step-by-step instructions for several advanced measurements and procedures	
Warranty		
	3 years standard, option increase to 5 years	
Size/Weight		
	Height: 216 mm (8.5 in); Width: 437 mm (17.19 in); Depth: 440 mm (17.34 in); Net Weight = 13 kg	

Agilent Infiniium General-Purpose Oscilloscope Specifications

	54830B	54831B	54832B	54833B
Channels				
Scope Channels	2	4	4	2
Bandwidth	600 MHz	600 MHz	1 GHz	1 GHz
Max Sample Rate	4 GSa/s			
Sampling Modes	Real time, equivalent time, peak detect, high resolution and averaging			
Max Input, High Z	150 V RMS or dc, CAT I; ±250 V (dc + ac) in AC coupling			
Max Input, 50 Ohms	5 V RMS, CAT I			
Resolution	8 bits			
Range	1 m V/div to 5 V/div (high Z) or 1 mV/div to 1 V/div in 50 Ohm mode			
Max Memory				
Scope Channels	4 M Standard, 8 M with option 040 and 16 M with option 080			
TimeBase				
Range	500 ps/div to 20 s/div (600 MHz models) and 200 ps/div to 20 s/div for 1 GHz models			
Resolution	4 ps			
Accuracy	15 ppm			
Jitter	8 ps ± 0.05 ppm x (delay setting)			
Triggering				
Source	All scope CH & External			
Modes	Edge, glitch, line, pattern, state, delay by time, delay by events, TV & violation triggers (pulse width, setup/hold, and transition)			
Display				
	8.4 inch diagonal color TFT-LCD Maximum Waveforms/second >8,800			
Measurements				
Voltage	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area			
Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase			
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase			
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion, Statistics, Histograms (analog channels only), Mask Testing			
Math Functions				
	Add, Average, Differentiate, Divide, FFT Magnitude, FFT Phase, Integrate, Invert, Magnify, Min, Max, Multiply, Subtract, Versus			
Storage				
	LS-120 Superdisk floppy drive reads/writes to both standard 3.5 inch 1.44 MB and 120 MB disks			
Connectivity				
	LAN RJ-45, GPIB IEEE 488.2, RS-232 (serial) COM1, Parallel Centronics printer port, USB 2 ports, Video Output 15 pin VGA, full color Auxiliary Output			
Built in Help				
	Infiniium's task-oriented Setup Guide provides step-by-step instructions for several advanced measurements and procedures			
Warranty				
	3 years standard, option increase to 5 years			
Size/Weight				
	Height: 216 mm (8.5 in); Width: 437 mm (17.19 in); Depth: 440 mm (17.34 in); Net Weight = 13.4 kg			

Ordering Information and Configuration

Agilent Model	54830B	54831B	54832B	54833B	54845B	54846B
Channels	2	4	4	2	4	4
Bandwidth	600 MHz	600 MHz	1 GHz	1 GHz	1.5 GHz	2.25 GHz
Sample Rate		4 GSa/s (interleaved = CH/2) 2 GSa/s on each channel			8 GSa/s (interleaved = CH/2) 4 GSa/s on each channel	
Memory Depth		4 M (interleaved = CH/2) 2 M on each channel			64 K (interleaved = CH/2) 32 K on each channel	

The above models include: Optical USB Mouse, Condensed Keyboard, User's Quick Start Guide in English language**, Documentation CD (Service Guide, Programmer's Guide, Programmer's Quick Reference Guide***), Recovery CD, Information System in English language**, accessory pouch (54810-68701), front panel cover power cord, and three-year warranty.

Standard Probes Included

Agilent Model	54830B	54831B	54832B/33B*	54845B	54846B*
Passive Probes	1165A 10:1 10 MΩ probes (Qty 2)	1165A 10:1 10 MΩ probes (Qty 4)	None	1161A 10:1 10 MΩ probes (Qty 4)	None

* Passive probes not included, please order option 001, 002, 004, active probe option 012 (for 54832B) or option 014 (for 54846B).

** Other languages also available

*** 54845B/46B only

For information about higher bandwidth scope and probing solutions (up to 6 GHz of system bandwidth), please visit our web site at www.agilent.com/find/infiniimax

Ordering Information and Configuration: Agilent Infiniium Options

5483xB/4xB General Purpose Infiniium Oscilloscopes

Acquisition Memory Options (for analog channels only)

- 548xxB-040 8 Mpts on half the acquisition channels (interleaved) or 4 Mpts on each acquisition channel
- 548xxB-080* 16 Mpts on half the acquisition channels (interleaved) or 8 Mpts on each acquisition channel
- N2845A** After-purchase memory upgrade, 2 Mpts/ch to 4 Mpts/ch
- N2846A** After-purchase memory upgrade, 2 Mpts/ch to 8 Mpts/ch
- N2847A** After-purchase memory upgrade, 4 Mpts/ch to 8 Mpts/ch

Probe Options

- 548xxB-001 Add two 1165A, 10:1 passive probes for the 54830 Series; Add two 1161A, 10:1 passive probes for the 54845B/46B
- 548xxB-002 Add one 1162A, 1:1 passive probe
- 548xxB-004 Add four 1165A, 10:1 passive probes for the 54830 Series; Add four 1161A, 10:1 passive probes for the 54845B/46B
- 548xxB-005 Add one 54826-68701 logic probe kit (This probe kit comes standard with the 54830D/31D/32D)
- 548xxB-007 Add one Wedge adapter kit (1 each 3/8/16 signals, 0.5 mm)
- 548xxB-008 Add one 1153A, 200 MHz differential probe
- 548xxB-009 Add one 1154A, 500 MHz differential probe
- 548xxB-010 Add one 1159A, 1 GHz differential probe
- 548xxB-011 Add one 1155A, 2 Channel, 750 MHz active probe
- 548xxB-012 Add one 1156A, 1.5 GHz active probe (54830B/31B/32B/30D/31D/32D only)
- 548xxB-013 Add one 1157A, 2.5 GHz active probe (54845B only)
- 548xxB-014 Add one 1158A, 4 GHz active probe (54846B only)
- 548xxB-016 (E2654A) EZ-Probe, Positioner: includes base, joystick, and articulating arm

* To find out about any special promotions that may be offered, visit

www.agilent.com/find/infiniium or contact your local Agilent representative.

** Users can install upgrades without opening the instrument case or requiring on-site service.

Instrument Options

- 548xxB-B30 (E2645A) USB test option
- 548xxB-B31 (E2646A) Additional USB 2.0 SqiDD test fixture
- 548xxB-100 (E2625A) Communication Mask Test Kit
- 548xxB-200 (N2850A) VoiceControl option (English only)
- 548xxB-1CM (E2609A) Add one rackmount kit
- 1184A Testmobile with keyboard and mouse tray, drawer for accessories
- E5850A Time-correlation fixture, integrate Infiniium scope and 16700 logic analyzer

Manual Options (for 54830 Series)

- OB3 Printed service manual
- OBF Printed programmer's manual
- AB2 Printed user's quick start guide in simplified Chinese
- ABJ Printed user's quick start guide in Japanese

Service Options

- A6J ANSI Z540-compliant calibration
- W32 3-year, return-to-Agilent, up-front calibration option
- W34 3-year, return-to-Agilent, std comp calibration service
- W50 5-year, return-to-Agilent, repair coverage (additional 2 years)
- W52 5-year, return-to-Agilent, up-front calibration option

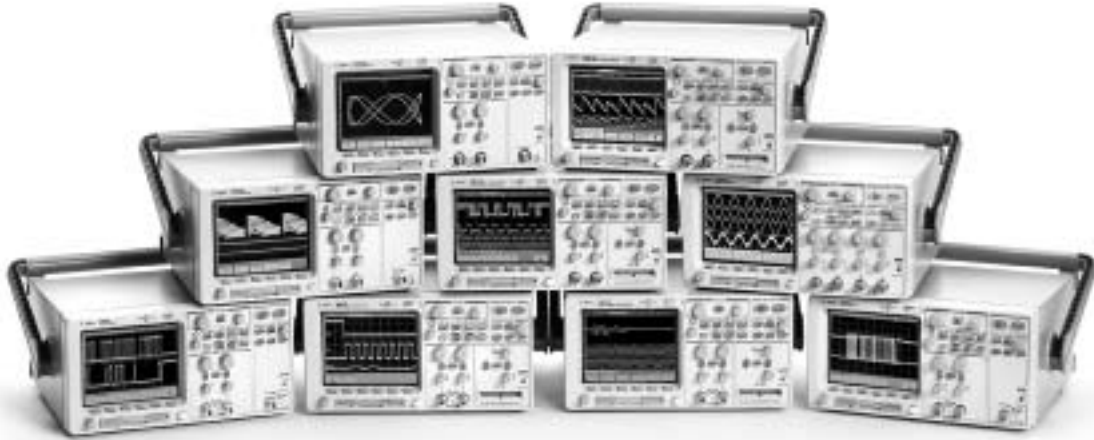
Oscilloscopes

48

54600 Series Portable Oscilloscopes

54600
Series

- Choose from bandwidths ranging from 60 to 500 MHz
- Troubleshoot complex designs with responsive MegaZoom deep memory
- Reveal subtle details that the typical scope won't show with a patented high-resolution display
- Take advantage of powerful triggering feature set
- Pick a compact, lightweight scope that's ideal for benchtop, field, or classroom settings



Agilent 54600 Series portable oscilloscopes combine analog-like knobs with built-in help to make advanced features as easy to use as everyday scope functions.

Performance Packed at a Budget Price

Just because they're portable doesn't mean they've sacrificed performance. In fact, with the increasing digital content of today's electronic designs, you need a portable scope that packs more powerful features without sacrificing ease of use.

With bandwidths ranging from 60 to 500 MHz, MegaZoom deep memory technology, advanced triggering, a high definition display, the look and feel of an analog scope, and built-in help, Agilent's 54600 Series give you a view into your system performance that is unmatched by any other portable digital signal analyzer (DSO), at a price that fits within your budget.

Affordable Deep Memory

Now you can apply the power of deep memory at a price that won't break your budget. Although the Agilent portable deep memory scopes cost slightly more than competitive shallow memory scopes, the benefits are more than worth it.

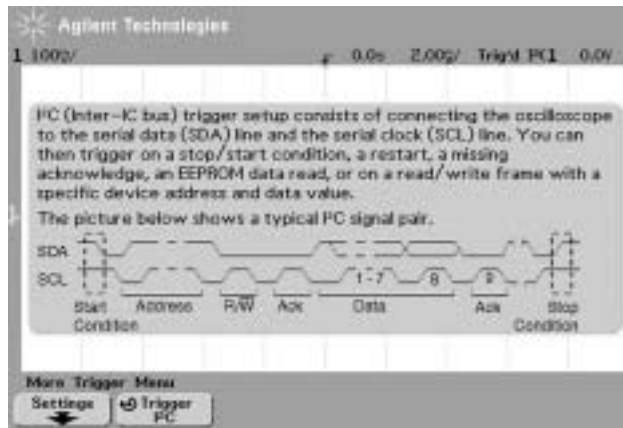
MegaZoom technology gives you higher sampling speeds where you need them to observe the wide range of signals in your system rather than just the faster few sweep speeds. MegaZoom is available at all times and does not require a special operating mode.

Measurement data are mapped into a high-resolution screen with 32 levels of intensity and 1000 points resolution, nearly twice the display standard. Now glitches are more clearly identifiable.

Powerful Triggering

Because of increased digital content in today's electronic circuits, traditional level and slope scope triggering is no longer enough. Agilent's 54600 Series portable oscilloscopes offer a rich triggering feature set that lets you easily isolate and analyze complex signals and fault conditions. Triggers include:

- CAN
- LIN
- I²C
- SPI
- USB
- Pulse width
- TV



Simply press and hold a menu key for built-in help, such as this explanation of Inter-IC bus triggering.

Waveform Measurements

You can find the root cause of your toughest problems with confidence that your measured data is a correct representation of your circuit's performance. Eight voltage and 11 timing measurements, as well as a 5-digit frequency counter, complement cursor measurements to translate your circuit's characteristics into repeatable and accurate measurement data.

54600 Series

Agilent 54600 Series Selection Guide

	54642A	54641A	54624A	54622A	54621A
Bandwidth	500 MHz	350 MHz	100 MHz	100 MHz	60 MHz
Channels	2	2	4	2	2
Maximum Memory	8 M	8 M	4 M	4 M	4 M
MegaZoom	Yes	Yes	Yes	Yes	Yes
Special Features	Ease-of-use features such as dedicated controls for each channel, autoscale, and built-in help keep you focused on your test, instead of your test tools. Each of these scopes has a full triggering feature set with serial triggers, pulse width, and TV. Automatic and cursor measurements provide critical waveform characterization. MegaZoom deep memory and Agilent's unique high-resolution display show you exactly how your circuit is performing.				
Description	The personal lab scope for professionals needing high-bandwidth measurements at an affordable price. MegaZoom allows high-fidelity viewing of your fastest signals while viewing a full cycle of the system.	With 350 MHz bandwidth and 1 ns rise time, this is the scope for high-speed applications on a limited budget. This is the lowest-cost deep-memory scope to offer 1 ns performance.	Four full channels of MegaZoom deep memory make this the ideal scope for power electronics, electromechanical, and bio-physical applications. Each of the four channels has its individual dedicated control knobs for simplified operation.	The personal scope for professionals working with less than 50 MHz logic devices. Rich triggering and measurement capabilities make it an ideal lab scope for many applications.	Lowest-cost deep memory in the market. Ideally suited for electromechanical and education labs. Easily view your most demanding signals with MegaZoom and a high-resolution display.

For more information about Agilent 54600 Series Scopes, go to www.agilent.com/find/megazoom

Agilent 54600 Series Portable Oscilloscope Specifications

		54621A	54622A	54624A	54641A	54642A
Channels		2 Scope	2 Scope	4 Scope	2 Scope	2 Scope
Scope Channels	Bandwidth	60 MHz	100 MHz	100 MHz	350 MHz	500 MHz
	Max Sample Rate	200 MSa/s	200 MSa/s	200 MSa/s	2 GSa/s	2 GSa/s
	Max Input	400 V dc + peak ac				
	Resolution	8 bits				
	High Resolution Mode	12 bits when >200 us/div average mode				
	Range	1 mV to 5 V				
Max Memory	Scope Channels	4 M	4 M	4 M	8 M	8 M
TimeBase		5 ns/div to 50 s/div				
Peak Detection		5 ns				
Triggering	Source	Internal selection of CH1, CH2, (3 & 4) and External				
	Modes	Edge, pattern, pulse width, TV, sequence, and serial protocols of CAN, I ² C, LIN, SPI, & USB				
Display	High definition monochrome with 32 shades of gray and 1,000 points horizontal resolution					
	Update Rate	Up to 25,000 vectors per second				
	Modes	Normal, Average, peak detect, roll, and XY with Z blanking				
Measurements	Automatic	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, undershoot, RMS, frequency, period, + width, - width, duty cycle, time at max, time at min, phase, and delay				
	Counter	Build-in 5 digit frequency counter on any channel, counts up to 125 MHz				
	Cursors	Manually or automatically placed readout of Horizontal (X, ΔX, 1/ΔX) and Vertical (Y, ΔY)				
Math Functions		CH1 – CH2, CH1 + CH2, 1*2, FFT, Differentiate, Integrate				
Storage		3.5" 1.44 MB double density, Image formats: TIF, BMP. Data formats: X and Y (time/voltage) values in CSV format				
Connectivity		Standard RS-232 and parallel on rear panel; Optional GPIB interface module (N2757A)				
Built in Help		Key-specific help in 11 languages displayed by pressing and holding key or softkey of interest				
Warranty		3 years standard, option increase to 5 years				
Size/Weight		Size: 32.26 cm Wide x 17.27 cm High x 31.75 cm Depth (without handle); Weight 6.8 kg				

Ordering Information

54621A 2-channel 60 MHz Oscilloscope
 54622A 2-channel 100 MHz Oscilloscope
 54624A 4-channel 100 MHz Oscilloscope
 54641A 2-channel 350 MHz Oscilloscope
 54641A 2-channel 500 MHz Oscilloscope

Accessories Included:	54621A	54622A	54624A	54641A	54642A
User's Guide (localized), Service Manual, Programmer's Manual	✓	✓	✓	✓	✓
Power cord	✓	✓	✓	✓	✓
10073C 10:1 divider probes with readout	0	0	0	2	2
10074C 10:1 divider probes with readout	2	2	4	0	0
16:2 x 8 input logic input probe assembly					
Accessories pouch and front panel cover		✓	✓	✓	✓
IntuiLink software RS-232 cable	**	✓	✓	✓	✓

** IntuiLink Software available free on web at www.agilent.com/find/intuilink

Manual Options (if no option is specified, English ABA will be shipped)

ABA English
 ABJ Japanese
 AB2 Simplified Chinese

Available Options

546xxA-003 Shielding Option for use in severe environments or with sensitive devices under test – shields both ways (in and out): RS-03 Magnetic interface shielding added to CRT, and RE-02 display shield added to CRT to reduce radiated interference
 546xxA-1CM Rackmount Kit (same as 1186A)

Warranty and Calibration Options

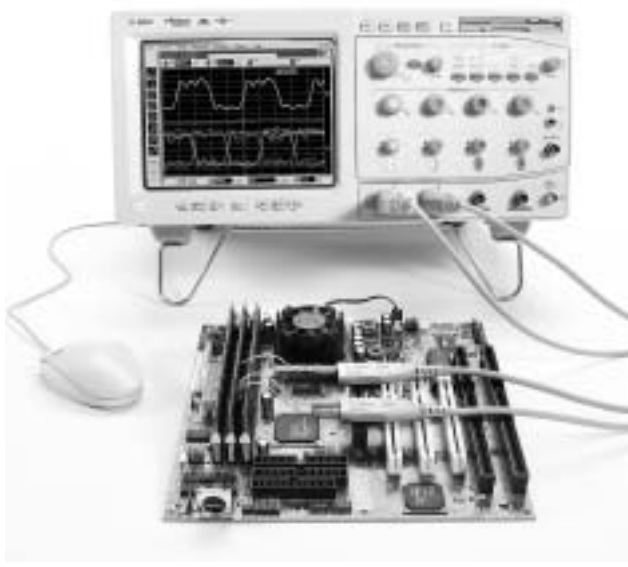
All models include a standard 3-year warranty. Contact local sales office for prices of extended options:

A6J ANSI/NSCL Z540 Calibration with test data (replaces 1BP)
 W32 3-year, Customer-Return Calibration Service
 W34 3-year, Customer-Return Standard Comp Cal Service
 W50 Additional 2-year warranty (5 year total)
 W52 5-year, Customer-Return Calibration Service
 W54 5-year, Customer-Return Standard Comp Cal Service

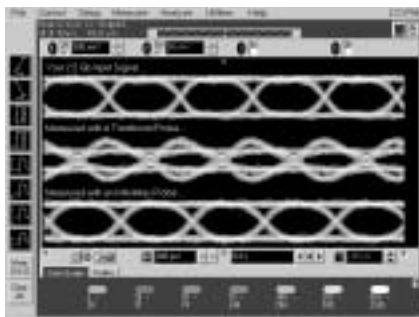
Accessories

1183A Testmobile Scope Cart
 1185A Carrying Case
 1186A Rackmount Kit (same as option 1CM)
 N2726A Accessory Pouch & Front Panel Cover (standard with 100-MHz models, optional with 60-MHz models)
 N2727A Seiko Thermal Printer and Pouch, Parallel Cable, Power Cable, 2 rolls Paper, Front Panel Cover
 N2728A 10 rolls of Printer Paper
 N2757A GPIB Interface Module for 54620-Series and 54640-Series Scopes
 N2758A CAN Trigger Module

- Choose between 6, 4 and 2.5 GHz bandwidth real-time oscilloscopes with 20 GSa/s sample rate on all four channels simultaneously
- Track down elusive glitches with up to 1 M points MegaZoom deep memory on all sample rates and 32 M points MegaZoom deep memory at 2 GSa/s and slower rates
- Improve reliability with solid state attenuators
- Take advantage of trigger jitter as low as 1.0 ps rms
- Ensure probing accuracy with highest performance differential and single-ended probes available (InfiniiumMax 7, 5, and 3.5 GHz probing systems)



The newest members of Agilent's award-winning Infiniium Series are 6, 4 and 2.5 GHz high performance real-time oscilloscopes. The InfiniiumMax high bandwidth active probe system offers unmatched performance, accuracy, and connectivity.

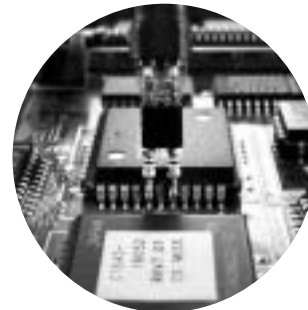


Compare the input on the top trace to that of a competitive probe in the center and an InfiniiumMax on the bottom.

Unmatched Performance, Accuracy, and Connectivity

Experienced scope users know that their measurements are only as good as their probing system. And as bandwidth increases, it is increasingly important to make sure you are measuring your circuit, not your scope probe. Nothing is more frustrating than chasing down an apparent design problem, only to find that it was caused by an inferior scope probe.

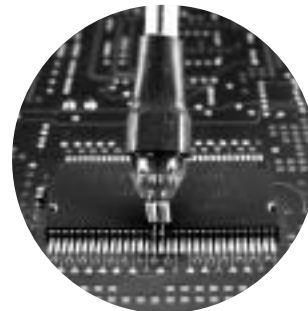
Together, the newest Infiniium scopes and the breakthrough InfiniiumMax high-performance probing systems offer an end-to-end measurement solution with unmatched performance, accuracy, and connectivity. The results are measurements you can trust and better insight into circuit behavior.



InfiniiumMax 7 GHz differential socketed probe head.



InfiniiumMax 6 GHz differential browser probe head.



InfiniiumMax 7 GHz differential solder-in probe head.

Performance-Enabling Technology

When you need to make multi-channel measurements on projects that use sub-nanosecond logic, you need powerful instruments. These newest Infiniium oscilloscopes maintain their full sampling performance of 20 GSa/s on all channels, so you can make critical timing measurements at the full performance of the oscilloscope.

The combination of 6 GHz and 20 GSa/s on all channels makes the 54850 Series ideal for designs incorporating PCI-Express, Serial ATA, Rapid IO, HyperTransport, InfiniBand, or Gigabit Ethernet. MegaZoom deep memory enables the capture of the data transmission across these buses with the resolution required to perform high-resolution parametric measurements of the system's operation.

Agilent Infiniium 54850 Series Oscilloscopes Selection Guide

	54855A	54854A	54853A
Bandwidth	6 GHz	4 GHz	2.5 GHz
Channels	4	4	4
Maximum Sampling	20 GSa/s	20 GSa/s	20 GSa/s
Maximum Memory	1 M/32 Mpts	1 M/32 Mpts	1 M/32 Mpts
MegaZoom	Yes	Yes	Yes
Special Features	Full set of 9 jitter measurements provide circuit characterization		
Description	The scope to use for leading-edge technology projects. Infiniium's ease of use, performance, and InfiniiMax probes help you bring your project to market ahead of the competition.	Pushing the envelope on a tight budget? These are the scopes for you. It has all the features of the top-of-the-line 54855A but with a reduced bandwidth of 4 and 2.5 GHz.	
Notes	Standard memory is 256 K at all sampling speeds. Option 001 provides 1 M up to 20 GSa/s and 32 M at 2 GSa/s and slower sampling.		

Agilent Infiniium 54850 Series Oscilloscopes Specifications

	54855A	54854A	54853A
Channels			
Scope Channels	4	4	4
Bandwidth	6 GHz	4 GHz	2.5 GHz
Rise Time (10% to 90%)	70 ps	105 ps	155 ps
Max Sample Rate	20 GSa/s		
Sampling Modes	Real Time (R.T.), R.T. with averaging, & R.T. with peak detect		
Max Input, 50 Ohms	1 mV/div to 1 V/div		
Resolution	8 bits		
Range	1 mV/div to 1 V/div		
Max Memory	262,144 at all sample rates		
Option 001	1 M at all sample rates; 32 M = 2 GSa/s sample rate		
TimeBase			
Range	5 ps/div to 20 s/div		10 ps/div to 20 s/div
Resolution			
Accuracy	±1 ppm pk	±1 ppm pk	±1 ppm pk
Jitter	2 ps RMS	2.5 ps RMS	3.0 ps RMS
Triggering			
Modes	Edge, glitch, line, pattern, state, delay by time, delay by events		
Violation triggers	Pulse width, setup/hold, and transition		
Display	8.4 inch diagonal color TFT-LCD		
Measurements			
Voltage	Peak-to-Peak, Minimum, Maximum, Average, RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower, Area		
Time	Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, Rise Time, Fall Time, Tmin, Tmax, Channel-to-Channel Phase		
Frequency Domain	FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, FFT Phase		
Eye Pattern	Eye Height, Eye Width, Jitter, Crossing %, Q-Factor, Duty Cycle Distortion		
Jitter Measurements	Available as E2681A EZJIT Jitter analysis software		
Math Functions	Add, average, differentiate, divide, FFT magnitude, FFT phase, integrate, invert, magnify, min, max, multiply, subtract, versus, common mode, smoothing		
Storage	CD-RW drive on rear panel, standard 3.5 inch 1.44 MB floppy		
Connectivity	LAN RJ-45, GPIB IEEE 488.2, RS-232 (serial) COM1, Parallel Centronics printer port, USB 2 ports Video. Output 15 pin VGA, full color Auxiliary Output		
Built in Help	Infiniium's task-oriented Setup Guide provides step-by-step instructions for several advanced measurements and procedures		
Warranty	3 years standard, option increase to 5 years		
Size/Weight	Height: 216 mm (8.5 in); Width: 437 mm (17.19 in); Depth: 440 mm (17.34 in); Net Weight = 13 kg		

Infiniium High-Performance Active Probe System

The innovative Infiniium probing system provides either differential or single-ended probing solutions for the most demanding mechanical requirements, without sacrificing performance. A flat frequency response over the entire probe bandwidth eliminates the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance.

Agilent 1130 Series Infiniium Probing Selection Guide

	1134A	1132A	1131A	E2669A	E2667A
Bandwidth	7 GHz	5 GHz	3.5 GHz	Differential kit	Single-ended kit
Description	Probe amplifier, order one or both of the connectivity kits per probe amplifier.			Connectivity kit, includes browser, solder-in and socket probe heads supporting the measurement type.	
Oscilloscope Compatibility	54855A	54854A	54845B/ 54846B		
Notes	Probe amplifier specifications: dynamic range = ± 2.5 V DC, offset range = ± 12 V				

Ordering Information

54855A 6 GHz (4 ch., 20 GSa/s, 262 kpts per channel) oscilloscope
54854A 4 GHz (4 ch., 20 GSa/s, 262 kpts per channel) oscilloscope
54853A 2.5 GHz (4 ch., 20 GSa/s, 262 kpts per channel) oscilloscope
 The above models include: optical USB mouse, compact keyboard, user's quick-start guide, documentation CD (service guide, programmer's guide, programmer's quick reference guide), recovery CD, accessory pouch, power cord, two 3.5 mm input adapters, probe deskew and performance verification kit, high-performance calibration cable (54855A only), and a three-year warranty. No probes are included with the 54850 Series oscilloscopes. The Infiniium 1130 Series probes must be purchased separately.

Acquisition Memory Options

5485xA-001 1 M/ch memory upgrade for Infiniium 5485xA oscilloscopes (32 M/ch for sample rates ≤ 2 GSa/s)

Instrument Options

5485xA-1CM (E2609A) Rackmount Kit

Service Options

A6J ANSI Z540-compliant calibration

Accessories

E2681A EZJIT jitter analysis software for Infiniium 5485xA oscilloscopes
E2654A EZ Probe Positioner[®]: includes base, joystick, and articulating arm
E2680A After-purchase memory upgrade for Infiniium 5485xA oscilloscopes. Order 5485xA-001 when purchasing a new Infiniium 5485xA oscilloscope. The E2680A is for customers who own a 5485xA scope and wish to upgrade the acquisition memory
1184A Testmobile with keyboard and mouse tray, drawer for accessories
E5850A Time-correlation fixture – integrate Infiniium scope and 1670x logic analyzer
E2655A Additional probe deskew/performance verification kit for Infiniium probes
54855 – 67604 18 GHz BNC-compatible to precision 3.5 mm (f) adapter for Infiniium 5485xA scopes. Allows highest fidelity connection of 3.5 mm or SMA cables
E2688A Serial Data Analysis/Mask Testing with Clock Recovery. Easily perform mask testing and characterize serial data streams that employ embedded clocks. The E2688A provides mask templates and clock recovery for verifying compliance to computer, communication and data-com standards. You can even characterize proprietary serial buses with the built-in, general purpose golden PLL clock recovery.
 Features include:
 Golden PLL clock recovery
 Set up wizard to configure the clock recovery
 Real-time eye diagram display
 Recovered clock display
 Time interval error (TIE) jitter measurement with statistics on the data stream
 Mask template loading
 Standard masks include:
 PCI Express (2.5 Gbps)
 Serial ATA (1.5 Gbps)
 Fibre Channel Electrical (1.0625, 2.125 Gbps)
 Ethernet IEEE 802.3 (10/100/1000Base-T)

Download Serial ATA Signal Quality Compliance Test.¹ If you develop Serial ATA host bus adapters or devices and would like to perform compliance testing to the standard, the sigtest program provides the following features:

- Program runs inside Infiniium 54855A and tests host bus adapters and devices for compliance to Serial ATA standard, as issued by Serial ATA working group
- Written test procedure for Agilent Infiniium 54855A and Agilent 81134A pulse/pattern generator
- Software automatically sets up the oscilloscope, allows user to transfer setups to pattern generator, acquires waveform data and launches eye measurement (sigtest)
- Includes support for OOB (out of band) signal testing
- Solution has been evaluated and proven at Serial ATA plugfests

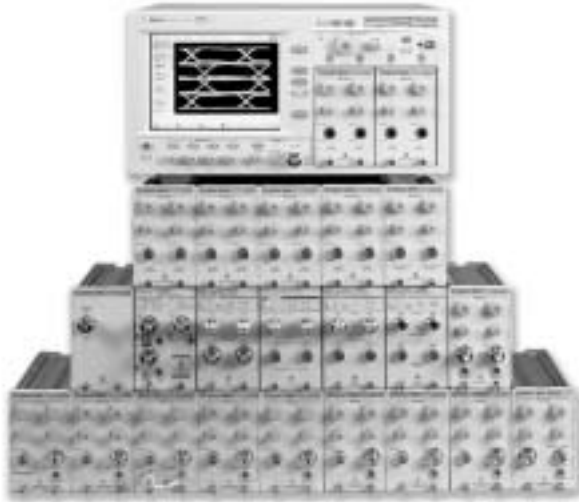
Program can be downloaded for free from the following URL:
[www.http://www.cos.agilent.com/manuals/](http://www.cos.agilent.com/manuals/)

Foot Switch Kinesis Savant 3-Action Programmable Foot Switch P/N AC004PF.² Allows you to easily program the 3-action foot pedals to perform the following scope functions: run, stop, toggle between run and stop, save waveform, save screenshot, measure any five waveform parameters and recall an instrument setup. See http://www.kinesis-ergo.com/prog_fs.htm for additional information and ordering instructions

¹No Charge

²Contact manufacturer

- Test digital communications waveforms beyond 40 Gb/s
- Select from a variety of plug-in modules for testing both optical and electrical signals
- Perform compliance mask and parametric testing at the touch of a button



Infiniium DCA is easily configured to meet your needs, with a wide selection of measurement modules.

Three Instruments in One

Full-Featured Wide-Bandwidth Oscilloscope, a Digital Communications Analyzer (DCA), and a Time-Domain Reflectometer

The Agilent 86100B Infiniium DCA wide-bandwidth oscilloscopes use equivalent time sampling to provide the highest measurement bandwidth in Agilent's scope family. Measurement bandwidth up to 80 GHz enables time domain analysis of repetitive signals up to and beyond 40 Gb/s.

Measurement Speed

With the Windows-based graphical user interface, you won't have to waste time trying to figure out how to make a measurement. Infiniium DCA's usability combined with its high-speed hardware will cut valuable time out of your project's test phase.

Digital Communications Analysis

Accurate eye-diagram analysis is essential for characterizing the quality of transmitters used from 100 Mb/s to 40 Gb/s. Compliance mask and parametric testing no longer require a complicated sequence of setups and configurations.

You can perform a complete compliance test by simply pressing a button. The important measurements you need are right at your fingertips, including:

- Industry-standard masks
- Extinction ratio measurements
- Eye measurements

Eye-Diagram Mask Testing

Infiniium DCA provides efficient, high-throughput waveform compliance testing with a suite of standards-based eye diagram masks. Infiniium's usability has been extended to provide a streamlined test at industry-standard data rates.

Time-Domain Reflectometry

TDR measurements are focused on high-speed applications where it is necessary to optimize electrical system components, when imperfections cause signal distortion and reflections. Signal integrity is a critical requirement in high-speed, digital signal transmission.

The Agilent 54754A provides two 18 GHz channels that have built-in TDR step generators. The two channels can work in tandem to provide differential and common-mode TDR stimulus/response, or they can be used independently. Either channel works as a normal oscilloscope vertical system when the TDR/TDT step generators are not operating.

Agilent Infiniium 86100B DCA Module Selection Guide (Modules are listed in descending order of their electrical bandwidth)

Module	Electrical Bandwidth	Channels	Wavelength Range (nm)	Unfiltered Optical Bandwidth	Fiber Input (nm)	Mask-Test Sensitivity
86116B	80 GHz	1 of each	1480 to 1620	65 GHz	9	NA
86118A with two remote sampling heads	70 GHz	2 electrical	NA	NA	NA	NA
86117B	65 GHz	2 electrical	NA	NA	NA	NA
86116A	63 GHz	1 of each	1000 to 1600	53 GHz	9	NA
86117A	50 GHz	2 electrical	NA	NA	NA	NA
86109B	50 GHz	1 of each	1000 to 1600	40 GHz	9	NA
86109A	40 GHz	1 of each	1000 to 1600	30 GHz	9	NA
86106B	40 GHz	1 of each	1000 to 1600	28 GHz	9	-7 dBm
86105B	20 GHz	1 of each	1000 to 1600	15 GHz	9	-12 dBm
86112A	20 GHz	2 electrical	NA	NA	NA	NA
86102U	20 GHz	1 of each	750 to 860	15 GHz	62.5	-7.5 dBm
86102A	20 GHz	1 of each	750 to 860	10 GHz	62.5	-13.5 dBm
86103B	20 GHz	1 of each	1000 to 1600	10 GHz	62.5	-15 dBm
86103A	20 GHz	1 of each	1000 to 1600	2.58 GHz	62.5	-20 dBm
869101A	20 GHz	1 of each	750 to 860	2.85 GHz	62.5	-17 dBm
54754A with TDR	18 GHz	2 electrical	NA	NA	NA	NA
85115B	NA	2 optical	1000 to 1600	28 GHz	9	-7 dBm
86111U	NA	2 optical	750 to 860	15 GHz	62.5	-7.5 dBm
86111A	NA	2 optical	750 to 860	2.85 GHz	62.5	-17 dBm
86113A	NA	2 optical	1000 to 1600	2.85 GHz	62.5	-20 dBm

86100B
DCA
Module

4

Infiniium DCA Ordering Information

86100B Infiniium DCA mainframe, wide bandwidth digital oscilloscope

- 86100B-001 12 GHz trigger bandwidth
- 86100B-AX4 Rackmount flange kit
- 86100B-AXE Rackmount flange kit with handles
- 86100B-UK6 Commercial cal certificate with test data

Optical/Electrical Modules

- 86101A** 2.85 GHz optical channel; multimode, amplified (750 – 860 nm) 20 GHz electrical channel
- 86101A-201 155, 622 Mb/s
 - 86101A-202 1.063, 1.25 Gb/s
- 86102A** 10 GHz optical channel; multimode, amplified (750 – 860 nm) 20 GHz electrical channel
- 86102A-201 2.125, 3.187 Gb/s
 - 86102A-202 2.488, 3.125 Gb/s
 - 86102A-203 2.72, 3.32 Gb/s
- 86102U** 15 GHz optical channel; multimode, unamplified (750 – 860 nm) 20 GHz electrical channel
- 86102U-201 1.25, 2.488 Gb/s
 - 86102U-202 2.488, 3.125 Gb/s
 - 86102U-203 3.125, 10.3125 Gb/s
- 86103A** 2.85 GHz optical channel; multimode, amplified (1000 – 1600 nm) 20 GHz electrical channel
- 86103A-201 155, 622 Mb/s
 - 86103A-202 1.063, 1.25 Gb/s
- 86103B** 10 GHz optical channel; multimode, amplified (1000 – 1600 nm) 20 GHz electrical channel
- 86103B-201 622 Mb/s, 2.488 Gb/s
 - 86103B-202 1.063, 1.25 Gb/s
 - 86103B-203 2.125, 2.488 Gb/s
- 86105B** 15 GHz optical channel; single-mode, unamplified (1000 – 1600 nm) 20 GHz electrical channel
- 86105B-101 9.953, 10.3125, 10.51875, 10.664, 10.709 Gb/s
 - 86105B-102 155, 622 Mb/s
 - 2.488, 2.666, 9.953, 10.3125, 10.51875, 10.664, 10.709 Gb/s
 - 86105B-103 1.063, 1.250, 2.125, 2.488, 2.666, 9.953, 10.3125, 10.51875, 10.664, 10.709 Gb/s

86106B 28 GHz optical channel; single-mode, unamplified (1000 – 1600 nm) 40 GHz electrical channel

- 86106B-410 9.953, 10.3125, 10.664, 10.709 Gb/s

86109A 30 GHz optical channel; single-mode, unamplified (1000 – 1600 nm) 40 GHz electrical channel

86109B 40 GHz optical channel; single-mode, unamplified (1000 – 1600 nm) 50 GHz electrical channel

86116A 53 GHz optical channel; single-mode, unamplified (1000 – 1600 nm) 63 GHz electrical channel

86116B 65 GHz optical channel; single-mode, unamplified (1480 – 1620 nm) 80 GHz electrical channel

Dual Optical Channel Modules

86111A Dual 2.85 GHz optical channels; multimode, amplified (750 – 860 nm)

- 86111A-201 155, 622 Mb/s
- 86111A-202 1.063, 1.25 Gb/s

86111U Dual 15 GHz optical channels; multimode, unamplified (750 – 860 nm)

- 86111U-201 1.25, 2.488 Gb/s
- 86111U-202 2.488, 3.125 Gb/s
- 86111U-203 3.125, 10.3125 Gb/s

86113A Dual 2.85 GHz optical channels; multimode, amplified (1000 – 1600 nm)

- 86113A-201 155, 622 Mb/s
- 86113A-202 1.063, 1.25 Gb/s
- 86113A-301 155 Mb/s, 622 Mb/s, 2.488 Gb/s

86115B Dual 28 GHz optical channels; single-mode, unamplified (1000 – 1600 nm)

- 86115B-101 9.953 Gb/s
- 86115B-410 9.953 Gb/s, 10.3125, 10.664, 10.709 Gb/s

Dual Electrical Channel Modules

86112A Dual 20 GHz electrical channels

86117A Dual 50 GHz electrical channels

86117B Dual 65 GHz electrical channels

86118A Dual 70 GHz electrical remote sampling channels

86100B
DCA
Module

TDR/TDT Modules

Included with each of these TDR Modules is a TDR demo board, programmers guide, 250 Ω terminations, APC-3.5 (m), and one short, APC-3.5 (m).
54754A Differential TDR Module with dual 18 GHz TDR/electrical channels

Trigger Module

86107A Precision timebase reference module
86107A-010 2.5 and 10 GHz clock input capability
86107A-020 10 and 20 GHz clock input capability
86107A-040 10, 20 and 40 GHz clock input capability

Clock Recovery Modules

The following modules provide a recovered clock from the data signal for triggering at standard telecommunications and enterprise data rates:

83491A Electrical signals. Data rates 155, 622, 1063, 1250, 2125, 2488, 2500 Mb/s
83492A Multimode optical. Data rates 155, 622, 1063, 1250, 2125, 2488, 2500 Mb/s
83493A Single-mode signals. Data rates 155, 622, 1250, 2488, 2500 Mb/s
83494A Single-mode signals. Data rates 155, 622, 2488 Mb/s and 49.953 Gb/s
83494A-103 Single-mode signals. Data rates 155, 622, 2488 Mb/s and 10.3125 Gb/s
83494A-106 Single-mode signals. Data rates 155, 622, 2488, 2666 Mb/s and 10.664 Gb/s
83494A-107 Single-mode signals. Data rates 155, 622, 2488, 2666 Mb/s and 10.709 Gb/s

Warranty Options (for All Products)

R1280A Customer return repair service
R1282A Customer return calibration service

Connector Options (for All Optical Modules)

81000 AI Diamond HMS-10 Connector
81000 FI FC/PC Connector Adapter
81000 SI DIN Connector Adapter
81000 VI ST Connector Adapter
81000 KI SC Connector Adapter

Accessories

10086A ECL terminator
11667B Power splitter, DC to 26.5 GHz, APC 3.5 mm
11667C Power splitter, DC to 50 GHz, 2.4 mm
11742A 45 MHz to 26.5 GHz DC blocking capacitor
11742A-K01 50 GHz DC blocking capacitor
11898A 1.5 meter remote extender module
54008B 24 ns delay line
54121-68701 RF accessories kit
83430A 2.5 Gb/s lightwave transmitter
83440B/C/D Optical-to-electrical converters (6/20/32 GHz)
83446A 2.5 Gb/s lightwave receiver
8490D-020 2.4 mm 20 dB attenuator
86101-60005 Filler panel
C3751-60201 Mouse (included with 86100B)
E2610-68700 Keyboard (included with 86100B)
N1020A 6 GHz TDR probe kit
N1025A 1 GHz active differential probe

Probes**1130 Series InfiniMax Probing Systems**

1134A 7 GHz InfiniMax probe amp – order one or both E266xA connectivity kits per amp
1132A 5 GHz InfiniMax probe amp – order one or both E266xA connectivity kits per amp
1131A 3.5 GHz InfiniMax probe amp – order one or both E266xA connectivity kits per amp

Connectivity Kits Model

E2669A InfiniMax connectivity kit for differential measurements
E2668A InfiniMax connectivity kit for single-ended measurements

Additional Components

E2675A InfiniMax differential browser probe head and accessories. Includes 20 replaceable tips and ergonomic handle. Order E2658A for replacement accessories
E2676A InfiniMax single-ended browser probe head and accessories. Includes 2 ground collar assemblies, 10 replaceable tips, a ground lead socket and ergonomic browser handle. Order E2663A for replacement accessories
E2677A InfiniMax differential solder-in probe head and accessories. Includes 20 full bandwidth and 10 medium bandwidth damping resistors. Order E2670A for replacement accessories
E2678A InfiniMax single-ended/differential socketed probe head and accessories. Includes 48 full bandwidth damping resistors, 6 damped wire accessories, 4 square pin sockets and socket heatshrink. Order E2671A for replacement accessories
E2679A InfiniMax single-ended solder-in probe head and accessories. Includes 16 full bandwidth and 8 medium bandwidth damping resistors and 24 zero ohm ground resistors. Order E2672A for replacement accessories

Adapters

N1022A Adapts 113x/115x active probes to 86100 Infiniium DCA

Other Compatible Probes

54006A 6 GHz passive probe
54701A 2.5 GHz active probe

Adapters for Electrical Channels

11900B 2.4 mm (f-f) adapter
11901B 2.4 mm (f) to 3.5 mm (f) adapter
11901C 2.4 mm (m) to 3.5 mm (f) adapter
54124-24101 2.4 mm termination
5061-5311 3.5 mm (f-f) adapter
1250-1158 SMA (f-f) adapter
1810-0118 3.5 mm termination

Firmware and Software

Firmware and software upgrades are available through the Web www.agilent.com/comms/dcaupgrade or your local sales office

Oscilloscope/Probe Compatibility

Oscilloscope	General Purpose Passive Probes										
	10:1	100:1	1000:1	1:1	Low Mass 10:1	Low Mass 20:1	Low Z	50 Ohm	Active	Differential	Current
Infiniium Oscilloscopes 54810/15/20/25A	1160A 1164A	10440B ² , 10076A	N2771A	1162A	—	—	1163A	10437B	1152A, 1155A,	1153A ² , 1154A, 1159A	1146A, 1147A
Infiniium Oscilloscopes 54830/31/32/33B/D	1165A	10440B ² , 10076A	N2771A	1162A	—	—	1163A	10437B	1156A, 1155A,	1153A ² , 1154A, 1159A	1146A, 1147A
Infiniium Oscilloscopes 54835A, 54845A/B, 54846A/B	1161A	10440B ² , 10076A	N2771A	1162A	—	—	1163A	10437B	1152A ² , 1155A ² ,	1153A ² , 1154A, 1159A	1146A, 1147A
54751/52A/B	—	—	—	—	—	—	54006A	—	54701A ^{2,4}	1141A ^{2,3}	—
54711/12/21/22A	—	—	—	—	—	—	54006A	—	54701A ⁴	1141A ^{2,3}	—
54714/15A/13B	10441B	10440B, 10076A	N2771A	10439B	1170A ¹	1172A ¹	10442B	10437B	1144A ² , 1145A ² , 54701A ⁴	1141A ^{2,3}	—
54645A/D	10074C	10440B, 10076A	N2771A	10070C	1171A ¹	1173A ¹	—	—	1144A ² , 1145A ² w 50 Ohm term	1141A ³ w 50 Ohm term N2772A	1146A, N2774A ⁵
54621A/D 54622A/D/24A	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A ¹	1173A ¹	—	—	—	1141A ³ w 50 Ohm term	1146A, N2774A ⁵
54641A/D 42A/D	10073C	10440B	N2771A	10070C	1171A ¹	1173A ¹	—	—	1144A ² , 1145A ²	1141A ³	1146A, N2772A
54615/16B/16C	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	—	1163A ¹ , 10442B	10437B	1144A, 1145A	1141A ³ N2772A	1146A, N2774A ⁵
54610A/B	10073C	10440B, 10076A	N2771A	10070C, 10439B	—	—	1163A ¹ , 10442B	10437B	1144A ² , 1145A ²	1141A ^{2,3} , N2772A	1146A, N2774A ⁵
54600/01/02/03A/B	10074C	10440B, 10076A	N2771A	10070C, 10439B	1171A ¹	1173A ¹	—	—	1144A ² , 1145A ² w 50 Ohm term	1141A ³ w 50 Ohm term N2772A	1146A, N2774A ⁵
54520/22/40/42A/C	10441B	10440B ² , 10076A	N2771A	10439B	—	—	10442B	10437B	1144A, 1145A	1141A	1146A, N2774A ⁵
54502/03/04/10A/05/06/10/12B	10441B	10440B ² , 10076A	N2771A	10439B	—	—	10442B	10437B	1144A ² , 1145A ²	1141A ³	1146A, N2774A ⁵
54501A	10433B	10440B, 10076A	N2771A	10439B	—	—	—	—	1144A ² , 1145A ² w 50 Ohm term	1141A ³ w 50 Ohm term	1146A, N2774A ⁵
54201A/D	10433B	10440B, 10076A	N2771A	10439B	—	—	10442B	10437B	—	1141A ³	1146A, N2774A ⁵
54200A/D	10433B	10440B, 10076A	N2771A	10439B	—	—	—	—	—	1141A ³ w 50 Ohm term	1146A, N2774A ⁵
54121/22/23/24T	—	—	—	—	—	—	54006A	10020A	54701A ^{2,4}	1141A ³	—
54111/112D	10441B	10440B, 10076A	N2771A	10439B	—	—	10442B	10437B	1144A ² , 1145A ²	1141A ³	1146A, N2774A ⁵
1980, 1950AA/B	10433B	10440B, 10076A	N2771A	10439B	—	—	10442B	10437B	—	—	1146A, N2774A ⁵
1740/41/42/43/44/45/46A	10436B	10076A	N2771A	10439B	—	—	10442B	10437B	1144A ² , 1145A ²	1141A ³	1146A, N2774A ⁵
1715/22/25/26/27	10433B	10440B, 10076A	N2771A	10439B	—	—	10442B	10437B	1144A ² , 1145A ²	1141A ³	1146A, N2774A ⁵

¹ Must remove pogo pin and configure scope for probe manually.
² Not commensurate with oscilloscope bandwidth.

³ Requires the 1142A probe power supply.
⁴ Requires the 1143A probe offset and power module.

⁵ Requires N2775A power supply.

10070 Passive Divider Probe Family

The 10070 family of rugged, general purpose probes are designed to operate with the 54600 family of oscilloscopes. This family provides a range of high-quality probing solutions at very reasonable prices.

These reliable probes come with one retractable hook tip, eight color identification tags, one ground bayonet, one IC Tip, one adjustment tool, and one ground lead.

See page 61 for compatible SMT probing kit.



10070 Passive Divider Probe Series.

Model	Length	Division Ratio	Circuit Loading (1 MΩ scope input)	Typical Scope Bandwidth	Compensates Oscilloscope Input
10070C	1.5 m	1:1	1 MΩ; 70 pF	20 MHz	High Impedance
10073B	1.5 m	10:1	2.2 MΩ; 12 pF	500 MHz	1 MΩ; 6 to 15 pF
10074C ³	1.5 m	10:1	10 MΩ; 15 pF	150 MHz	1 MΩ; 9 to 17 pF
10076A	1.8 m	100:1	66.7 MΩ; 3 pF	250 MHz	1 MΩ; 7 to 20 pF

³ Probe ID pin

Other 10070 Series Probe Accessories

Accessory	p/n
Probe tip to BNC (m) adapter	5081-7705
Replacement parts accessory kit	5081-7690
SMT probe accessory kit	10072A
0.5 mm IC probing kit	10075A
Retractable hook tip, qty 2	N2769A
Alligator ground lead, qty 2	N2770A

Other Accessories

Accessory	p/n
BNC 50 Ω feedthrough	10100C
BNC 75 Ω feedthrough	11094B
BNC AC blocking capacitor	10240B

10400B Passive Divider Probe Family

The 10400B probe family are reliable general-purpose high performance passive probes that replace the 10400A family of probes. These probes include a no-slip browser. The crown point of the browser digs in to solder and won't slip while the pogo pin allows small hand movements without losing contact.

The 10400B family of probes also comes complete with a range of accessories. For grounding, there's an alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements and a socketed ground lead. The accessories also include 2 IC clips for probing 50 mil SMDs and a dual-lead adapter so that both the probe tip and ground can easily be connected to surface mount devices.

The miniature probe has a narrow, sharp tip that is good for probing SMDs. The handle of the probe can be unscrewed and pulled back on the cable to reduce the probe's mass and size. This makes attaching to fine pitch ICs and small devices easier. For connection to fine pitch ICs order the Wedge probe adapter or the 0.5 mm IC clips.

The 10400 family of probes are built and tested for high reliability. The cable has a Kevlar strengthener for added pull strength and the general purpose retractable hook tip is made from durable music wire. The probe tips are replaceable.

See page 61 for compatible SMT probing solutions.



10400B Passive Divider Probe Series.

Model	Length	Division Ratio	Circuit Loading	Typical Scope Bandwidth	Compensates Oscilloscope Input
10437B	2 m	1:1	50 Ohm	—	50 Ohm
10439B ¹	1.5 m	1:1	65 pF	—	High Z
10433B	2 m	10:1	10 MOhm; 10 pF	300 MHz	1 MOhm; 10 – 16 pF
10436B	2 m	10:1	10 MOhm; 11 pF	100 MHz	1 MOhm; 18 – 22 pF
10441B	1.8 m	10:1	10 MOhm; 9 pF	500 MHz	1 MOhm; 6 – 9 pF
10442B	2 m	10:1	500 Ohm; 1.2 pF	1 GHz	50 Ohm
10440B	2 m	100:1	10 MOhm; 2.5 pF	300 MHz	1 MOhm; 6 – 14 pF

¹This probe can be used with many oscilloscopes, but because of the relatively high capacitance, there will be bandwidth degradation.

10400B Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD clips	5
01160-68701	Accessory Kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	4 4 4 1
5063-2167	10433B probe tip	5
5063-2168	10436B probe tip	5
5063-2138	10437B probe tip	5
5063-2138	10439B probe tip	5
5063-2171	10440B probe tip	5
5063-2172	10441B probe tip	5
5063-2139	10442B probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.32 in)	4

PC Board Mini-Probe Sockets



The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

- N2765A Horizontal Mini-Probe Socket, qty 5
- N2766A Horizontal Mini-Probe Socket, qty 25
- N2767A Vertical Mini-Probe Socket, qty 5
- N2768A Vertical Mini-Probe Socket, qty 25

1160A Family Miniature Passive Probes

The 1160 family of miniature probes are reliable general-purpose probes for use with Infiniium Oscilloscopes (54800 series). The 1160 family probes include a no-slip browser with a crown point that digs in to solder, and won't slip. The pogo pin allows hand movement without losing contact.

A variety of grounding accessories are included. An alligator ground lead for general-purpose probing, 4 spring grounds for high frequency measurements, a socketed ground lead and 2 SMD IC clips for probing 50 mil SMD. Also included is a dual lead adapter so that both the probe tip and ground can be connected to SMD devices. For connection to 0.5 mm – 0.8 mm devices, order the 10467-68701 0.5 mm IC clips.

The 1160 family probes are built and tested for high reliability. The cable has a kevlar strengthener for added pull strength. The general-purpose retractable hook tip has a durable music wire hook. And probe tips are replaceable.

The miniature probe has a narrow, sharp tip that is good for probing SMD. To fully miniaturize the probe, unscrew the handle and pull it back on the cable. The 1160 family probes are compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.



1160A Miniature Passive Probe Series.

Model	Type of Probe	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1160A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 9 pF	500 MHz ¹	1 MOhm, 6 – 9 pF
1161A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	500 MHz ²	1 MOhm, 12 – 14 pF
1162A	High Impedance, Passive	1.5 m	1:1	1 MOhm, 50 pF + scope input	25 MHz ³	1 MOhm
1163A	500 Ohm Resistive Divider	1.5 m	10:1	500 Ohm, 1.5 pF	1.5 GHz ²	50 Ohm
1164A	High Impedance, Passive	2.0 m	10:1	10 MOhm, 10 pF	500 MHz ¹	1 MOhm, 6 – 9 pF
1165A	High Impedance, Passive	1.5 m	10:1	10 MOhm, 10 pF	600 MHz ⁴	1 MOhm, 12 – 14 pF

¹ System bandwidth with 54810A/15A/20A/25A.

² System bandwidth with 54845A.

³ System bandwidth with all Infiniium scopes.

⁴ System bandwidth with 54830B/31B/32B/30D/31D/32D/33A/33D.

1160 Family Replacement Parts

p/n	Description	Qty
5063-2115	Browser	1
5063-2120	Socketed ground lead	1
5063-2135	General-purpose retractable hook tip	2
5063-2140	Alligator ground lead	2
5063-2147	Dual lead adapter	1
5063-2149	SMD IC clips	5
01160-68701	Accessory kit: Spring grounds Browser pogo pins Barrel insulators Screwdriver	4 4 4 1
5063-2136	1160A probe tip	5
5063-2137	1161A/65A probe tip	5
5063-2138	1162A probe tip	5
5063-2139	1163A probe tip	5
5063-2151	1164A probe tip	5

Fine Pitch IC Probing Accessories

p/n	Description	Qty
E2613B	Wedge probe adapter, 0.5 mm, 3-signal	2
E2614A	Wedge probe adapter, 0.5 mm, 8-signal	1
E2615B	Wedge probe adapter, 0.65 mm, 3-signal	2
E2616A	Wedge probe adapter, 0.65 mm, 8-signal	1
E2643A	Wedge probe adapter, 0.5 mm, 16-signal	1
E2644A	Wedge probe adapter, 0.65 mm, 16-signal	1
10467-68701	0.5 mm IC clips for surface SMT parts with lead spacings of 0.5 mm (0.020 in) to 0.8 mm (0.32 in)	4

PC Board Mini-Probe Sockets



The PC board mini-probe sockets are ideal for reliable, stable, and convenient connection between the probe tip and the circuit under test. These probe sockets are designed for use with the 1160A-family and 10400B-family of passive probes.

Ordering Information

- N2765A Horizontal Mini-Probe Socket, qty 5
- N2766A Horizontal Mini-Probe Socket, qty 25
- N2767A Vertical Mini-Probe Socket, qty 5
- N2768A Vertical Mini-Probe Socket, qty 25

1171A
1173A
10467-68701
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A



The 117x Low Mass Passive Probe.

4

The 117x family of low mass high performance passive probes for the Infiniium Oscilloscopes is designed specifically to make the probing of fine pitch ICs and dense circuit boards easier. The probe tip is exceptionally small and light, weighing less than 1 gram, so it is easier to attach to those small devices and surface mount ICs. Even though small and light, these probes are designed for high performance and the ruggedness required for general purpose use. The cable is re-enforced with Kevlar for added pull strength.

The probe also includes a no-slip browser for precise and safe browsing. The crown point of the browser digs in to solder and won't slip and the pogo pin allows small movements without losing contact.

The 117xA family of probes will connect directly to the Wedge probe adapter for an easy hands-free solution for probing 0.5 and 0.65 mm IC packages. See pages 61 for more information.



Easy hands-free connection to fine pitch ICs using the Wedge and 117x probe.

All probes come complete with a range of accessories for both general purpose probing and the probing of fine pitch ICs and dense circuit boards.

The 117x family of probes is compatible with the AutoProbe Interface, which completely configures the Infiniium Oscilloscope for the probe.

Model	Length	Division Ratio	Circuit Loading	System Bandwidth (Scope and Probe)	Oscilloscope Input
1171A	1.4 m	10:1	10 MOhm; 10 pF	500 MHz	1 MOhm; 12 – 14 pF
1173A	1.2 m	20:1	10 MOhm; <5 pF	500 MHz	1 MOhm; 12 – 14 pF

117x Family Replacement Parts

Ordering Information

Fine Pitch IC Probing Accessories

- E2613A Wedge probe adapter, 0.5 mm, 3-signal, qty1
- E2613B Wedge probe adapter, 0.5 mm, 3-signal, qty2
- E2614A Wedge probe adapter, 0.5 mm, 8-signal, qty1
- E2615A Wedge probe adapter, 0.65 mm, 3-signal, qty1
- E2615B Wedge probe adapter, 0.65 mm, 3-signal, qty2
- E2616A Wedge probe adapter, 0.65 mm, 8-signal, qty1
- E2643A Wedge probe adapter, 0.5 mm, 16-signal, qty1
- E2644A Wedge probe adapter, 0.65 mm, 16-signal, qty1
- 10467-68701 0.5 mm IC clips for surface SMT parts with leg spacing of 0.5 mm (0.020 in) to 0.8 mm (0.32 in), qty 4

Other Accessories

- E9638A Probe tip to BNC adapter

Fine-Pitch Probing Kits

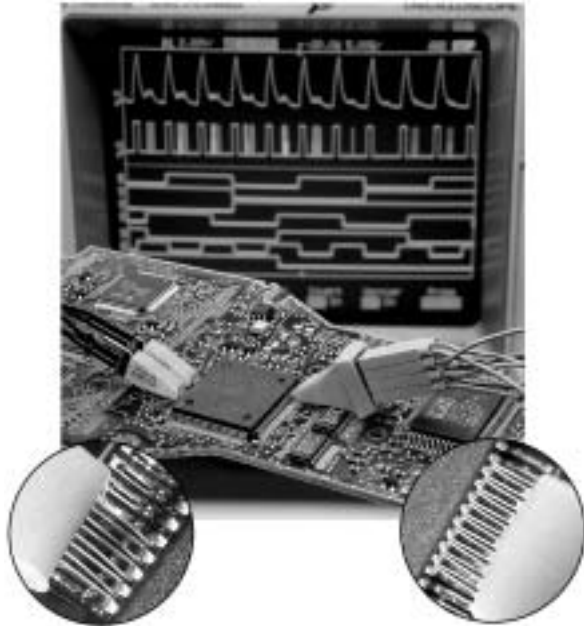
A Complete Solution at a Bargain Price

These fine-pitch probing kits take the 117x family of probes and add the most useful accessories to give you a versatile and complete probing solution. Each kit includes 2 117x-family probes (20:1 models) and related accessories, 2 of the 0.5 mm Wedge probe adapter, 4 of our 0.5 mm IC clips and 10 standard IC clips. All for a price substantially less than the individual parts.

Ordering Information

- E2652A Fine-Pitch Probing Kit for the 54810/15/20/25A and 54830 Series Infiniium Oscilloscopes
- E2653A Fine-Pitch Probing Kit for 54835A, 54840 and 54850 Series Infiniium Oscilloscopes

- Easy connection to 0.5 mm, 0.65 mm TQFP and PQFP packages
- Reliable contact with little chance of shorting to adjacent pins
- Mechanically noninvasive
- Can be inserted while the board is active
- 3, 8, and 16-signal versions



At one end, Wedge conductor segments are inserted into the space between IC pins; at the other end, they easily connect to scopes and logic analyzers.

Wedge Probe Adapter

Precise Problem-free Probing

The Agilent Wedge probe adapter solves the problem of connecting your scope or logic analyzer to fine pitch thin quad flat pack (TQFP) and plastic quad flat pack (PQFP) surface mount ICs. It provides accurate, mechanically noninvasive and reliable electrical contact to 0.5 and 0.65 mm IC packages, with little chance of shorting. It is available in 3-, 8-, and 16-signal versions.

Easy to Insert, Then Stays Put

It works by inserting compressible dual conductors between adjacent IC pins. The flexible conductors conform to the size and shape of each leg to ensure tight contact. It's then a simple matter to connect your scope or logic analyzer to the Agilent Wedge.

Electrical Reliability

The Wedge's unique design delivers secure redundant contact on each pin, with little chance of shorting to adjacent pins. The redundant physical connection created by two contact points on each pin of the IC and its short electrical length dramatically increases the reliability of the electrical connection. Since the Agilent Wedge doesn't latch directly onto the IC and doesn't require expansion beforehand (as a clip does), it can be inserted while the board is active. Plus, it's mechanically noninvasive so it won't damage your device under test.



3- and 8-signal versions for 0.5 and 0.65 mm IC Packages.



10467-68701 0.5 mm IC Clips.

0.5 mm IC Clips

These IC clips are the smallest in the industry to date and are suitable for connecting to PQFP and SOIC SMT packages from 0.5 – 0.8 mm pitch. The thin body allows clips to be mounted side by side for probing adjacent IC pins. They are suitable for use with all Agilent oscilloscope probes and logic analyzers and have a maximum input voltage of ± 40 V (dc + peak ac).



10467-68701 0.5 mm IC Clips.

10467-68701
10072A
10450A
10467A
E2613A
E2613B
E2614A
E2615A
E2615B
E2616A
E2643A
E2644A

4

10075A and 10467-68701 0.5mm IC Clip Accessory Kit

The 10075A includes four 0.5mm IC clips (10467-68701) and two dual-lead adapters for use with passive probes. Plug the probe tip into one end of the adapter and connect the IC clip to the other end.

The 10075A is compatible with the 10070A family of passive probes. The 10467-68701 is compatible with the 10400A family of passive probes. The 1160A and 10400B family of probes include a dual-lead adapter as a standard accessory. For these probes the accessory kit is not required.

Ordering Information

- E2613A Wedge probe adapter, 0.5 mm 3-signal, qty 1
- E2613B Wedge probe adapter, 0.5 mm 3-signal, qty 2
- E2614A Wedge probe adapter, 0.5 mm 8-signal, qty 1
- E2615A Wedge probe adapter, 0.65 mm 3-signal, qty 1
- E2615B Wedge probe adapter, 0.65 mm 3-signal, qty 2
- E2616A Wedge probe adapter, 0.65 mm 8-signal, qty 1
- E2643A Wedge probe adapter, 0.5 mm 16-signal, qty 1
- E2644A Wedge probe adapter, 0.65 mm 16-signal, qty 1
- 10467-68701 0.5 mm IC Clips, qty 4
- 10072A SMT Probe Accessory Kit

10072A SMT Probe Accessory Kit

The 10072A includes 10 SMT lead clips that adapt the 10070A family of low-cost probes to fine-pitch devices.



1141A
1142A
1153A
1154A
1159A
N2772A
N2773A



1141A Differential Probe with 1142A Power Supply

The 1141A is a 1X FET differential probe with 200 MHz bandwidth and a 3000:1 CMRR (Common Mode Rejection Ratio). The probe has a high-input resistance and low-input capacitance of 7 pF to minimize circuit loading. The 1141A must be used with the 1142A probe control and power module, which controls input coupling modes dc, dc with variable offset, and dc reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ± 30 V.



1154A, 1159A Differential Probes for Infiniium

The new 1154A and 1159A are high bandwidth differential probes compatible with Infiniium family oscilloscopes. The 1154A offers 500 MHz bandwidth with flexibility of 10X gain and 10:1 attenuation for a maximum of 100:1 attenuation. The 1159A gives you 1 GHz bandwidth and 1:1 attenuation, making it ideal for fast, low voltage signals.

The new 1154A and 1159A differential probes have an input resistance of 1 MOhm and low input capacitance of <6 pF to minimize circuit loading. The CMRR is >40 dB at 10 MHz for 1154A and >19 dB at 500 MHz for 1159A without external attenuators connected. The 1154A and 1159A are compatible with the AutoProbe interface which completely configures the Agilent Infiniium Oscilloscope for the probe. The probes also feature external AC coupling to eliminate dc for simplified measurement of ac voltage. These probes connect directly to the Wedge probe adapter to make probing fine-pitch devices easier to use and more reliable.

4



1153A 200 MHz Differential Probe

The 1153A is a 200 MHz Differential Probe for use with Agilent Infiniium Oscilloscopes. It is a 1X FET differential probe with 200 MHz bandwidth and 3000:1 CMRR (Common Mode Rejection Ratio). The probe has high-input resistance of 1 MOhm and low-input capacitance of 7 pF to minimize circuit loading. The 1153A is compatible with the AutoProbe Interface, which provides power and completely configures the Infiniium Oscilloscope for the probe.

Input coupling modes include dc, dc with variable offset, and 1 f reject. Two attenuators, 10X and 100X, are provided to expand the linear differential input range to ± 30 V.



N2772A Differential Probe with N2773A Power Supply

The N2772A is a new active differential probe compatible with any of the 54600 series oscilloscopes. With 20 MHz bandwidth and switchable attenuation of 20:1 and 200:1, N2772A provides the versatility for a broad range of applications including high-voltage circuits, motor speed controls, power supply design, electronic high-power converters, and numerous other situations where signals are floating above earth ground.

The N2772A differential probe has an input impedance of 10 MOhm and the CMRR is >50 dB at 1 MHz.

The probe requires a 9 V dc battery or N2773A power supply. The power supply has selectable ac frequency settings for 115 V and 230 Vac at 50 Hz, 60 Hz, and 400 Hz.

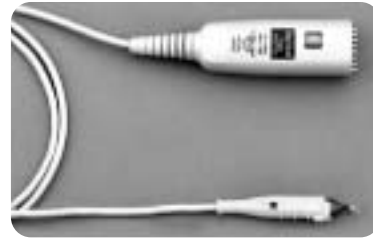
Ordering Information

- 1141A 200 MHz Differential Probe
- 1142A Power Supply
- 1153A 200 MHz Differential Probe
- 1154A 500 MHz Differential Probe
- 1159A 1 GHz Differential Probe
- N2772A 20 MHz Differential Probe
- N2773A Power supply for N2772A



1155A Low Mass Active Probe for Surface-Mount Devices

The two-channel 1155A low mass active probe for Infiniium oscilloscopes has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF), and high input resistance (1 MOhm). A versatile set of accessories are provided, including an Agilent browser with a crown point that digs deep in to solder and a spring loaded tip that helps absorb small movements. When used in conjunction with the Agilent Wedge, the 1155A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 61 for more information.



1156A/57A/58A Active Probe, 1.5/2.5/4.0 GHz

The Agilent 1156A, 1157A, and 1158A family of active probes offers R & D engineers the performance they need to probe small geometries in hard-to-reach areas on the DUT. These probes were designed specifically for the Infiniium 54800 Series oscilloscopes.

As the speeds in your design increase, you may notice more overshoot, ringing, and other perturbations when connecting an oscilloscope probe. Probes form a resonant circuit where they connect to the device. If this resonance is within the bandwidth of the oscilloscope probe you are using, it will be difficult to determine if the measurement perturbations are due to your circuit or the probe.

Agilent is the only company that has overcome the resonance formed by the connection of a probe to a device. The Agilent 1156/7/8A probes optimize performance to make your job easier.



1144A 800 MHz Active Probe

The 1144A features 800-MHz bandwidth, 1 MΩ input resistance, 2 pF input capacitance, 10:1 attenuation, and ±40 Vdc + peak ac maximum-input voltage. The 1144A can access power directly from the 54520 and 54540 series and the 54615B and 54616B oscilloscopes. These oscilloscopes provide power for two channels of active probing. If four channels of probing are needed, a special one-input, two-output adapter is available (p/n 01144-61604). Two adapters are needed for four channels of probing. If the 1144A is used with any scope not listed above, then the 1142A power supply is required. The 01144-61604 adapter can be used with this power supply to provide power for two channels of active probing.



InfiniiMax 113xA Probing System

InfiniiMax High-Performance Active Probe System

The innovative InfiniiMax probing system provides either differential or single-ended probing solutions for the most demanding mechanical requirements, without sacrificing performance. A flat frequency response over the entire probe bandwidth eliminates the distortion and frequency-dependent loading effects that are present in probes that have an in-band resonance.

Agilent 1130 Series InfiniiMax Probing Selection Guide

	1134A	1132A	1131A	E2669A	E2667A
Bandwidth	7 GHz	5 GHz	3.5 GHz	Differential kit	Single-ended kit
Description	Probe amplifier, order one or both of the connectivity kits per probe amplifier.			Connectivity kit, includes browser, solder-in and socket probe heads supporting the measurement type.	
Oscilloscope Compatibility	54855A	54854A	54845B/ 54846B/ 54853A		
Notes	Probe amplifier specifications: dynamic range = ±2.5 V DC, offset range = ±12 V				

- 1142A
- 1143A
- 1144A
- 1145A
- 1152A
- 1155A
- 54701A

1142A
1143A
1144A
1145A
1152A
1155A
54701A



1145A Low Mass Active Probe for Surface-Mount Devices

4

The two-channel 1145A low mass active probe has a probe tip that weighs less than 1 gram making it ideal for attaching to fine pitch ICs and probing surface mount components. The probe combines high bandwidth (750 MHz), low input capacitance (2 pF) and high input resistance (1 MOhm). A versatile set of accessories are provided and when used in conjunction with the Wedge, the 1145A provides a hands-free solution for probing 0.5 mm and 0.65 mm IC packages. See page 61 for more information.

This probe can access power directly from the 54520/40 series and 54615/16B oscilloscopes. The 1142A power supply is required for all other instruments. This configuration requires 50 Ohm inputs.

Ordering Information

- 1131A 3.5 GHz Infiniimax Active Probe System
- 1132A 5 GHz Infiniimax Active Probe System
- 1133A 7 GHz Infiniimax Active Probe System
- 1142A Power supply for 1144A and 1145A
- 1143A Probe Offset and Power Module for 54701A
- 1144A 800 MHz Active Probe
- 1145A 2-Channel, 750 MHz Active Probe
- 1152A 2.5 GHz, 0.6 pF Active Probe
- 1155A Low Mass Active Probe
- 1156A 1.5 GHz Active Probe
- 1157A 2.5 GHz Active Probe
- 1158A 4 GHz Active Probe



10076A 100:1 High-Voltage Probe

The 10076A 4 kV 100:1 passive probe gives you the voltage and bandwidth you need for making high-voltage measurements. Its compact design makes it easier to probe today's small power electronics components and its rugged construction means it can withstand rough handling without breaking. You can measure dc voltages up to 4 kV peak. The 250 MHz probe bandwidth enables you to capture fast, high-voltage signals. The 10077A accessory kit can be used with this high voltage probe for wider range of application.



N2771A 1000:1 High-Voltage Probe

The N2771A is a new 1000:1 high voltage probe for the measurement of fast high voltage signals, up to 30 kV dc + peak ac, 10 kVrms and 50 MHz probe bandwidth.

The probe's large size and rugged construction provides superior protection. The ground lead is fed through the body of the probe and protrudes behind the safety barrier, keeping the ground connection away from the high voltage.



54006A 6-GHz Passive Divider Probe

The low 0.25 pF input capacitance and sophisticated ground design of the 54006A probe lets you probe multi-GHz systems with minimal loading of the circuit under test. The small size of this probe also allows you to access very small components. The 54006A is supplied with 10:1, 500 Ω , and 20:1, 1 k Ω resistive dividers.



1146A Oscilloscope AC/DC Current Probe

This ac/dc current probe expands oscilloscope applications into industrial, automotive or power environments, and is ideal for analysis and measurement of distorted current waveforms and harmonics. This probe permits accurate display and measurement of currents from 100 mA to 100 A rms, dc to 100 kHz without breaking into the circuit. The 1146A uses Hall-effect technology to measure ac and dc signals. Compatible with any scope or voltage measuring instrument with BNC input, 0.2 to 0.5 V/div, and a minimum input impedance of 1 M Ω . 1 mV/100 mA Range; Output Signal: 10 mV/A ac/dc. 1mV/10 mA Range; Output Signal: 100 mV/A ac/dc. Working Voltage: 660 V max., Battery: 9 V alkaline.



N2774A 50 MHz Current Probe

Compatible with any scope or voltage measuring instruments with BNC input, the Agilent N2774A is a high bandwidth, active current probe that offers an accurate and reliable solution for measuring dc and ac currents. The probe uses a hybrid technology that includes a Hall effect sensor, which senses the dc current, and a current transformer, which senses the ac current, making it unnecessary to make an electrical connection to the circuit. The N2774A current probe requires the N2775A power supply to supply DC power for the probe.

1146A
10020A
10076A
10077A
54006A
N2771A

4

Oscilloscope Probes & Accessories

1146A
10020A
10076A
10077A
54006A
N2771A



1147A 50 MHz Current Probe

The Agilent 1147A is a wide bandwidth, active current probe for 54800-series Infiniium oscilloscopes. The probe features flat bandwidth (DC-50 MHz), low noise (<2.5 mA rms) and low circuit insertion loss. The 1147A is ideal for capturing transient current signals such as those found in motor controllers, in switching power supplies, inverters and current amplifiers driving inductive loads.

Related Literature

Publication Title	Publication Type	Publication Number
Agilent Technologies 54600 Series Oscilloscopes	Data Sheet	5968-8152EN
Agilent Technologies Infiniium 54800 Series Oscilloscopes	Brochure	5988-3788EN
Infiniium 54850 Series Oscilloscopes InfiniiMax 1130 Series Probes	Data Sheet	5988-7976EN
Infiniium 86100B DCA: Modular platform for fast, accurate waveform testing up to 40 Gb/s	Brochure	5988-5235EN

4

The following literature provides useful information on using oscilloscopes for specific applications.

Optimizing Oscilloscope Measurement Accuracy on High-Performance Systems with Agilent Active Probes	Application Note 1385	5988-5021EN
Debugging a PCI Bus with a Mixed-Signal Oscilloscope	Application Note 1417	5988-7745EN
Mixed Analog and Digital Signal Debug and Analysis Using a Mixed-Signal Oscilloscope Wireless LAN Example Application	Application Note 1418	5988-7746EN
Finding Hidden Problems Using Agilent's Deep-Memory Oscilloscope: How IBM Solved a Mystery	Customer Success Story	5988-5655EN
The Truth About the Fidelity of High-Bandwidth Voltage Probes	Application Note 1404	5988-6515EN
Verifying <i>Bluetooth</i> ™ Baseband Signals Using Mixed-Signal Oscilloscopes	Application Note 1333-3	5988-2181EN
Spectral Analysis Using a Deep-Memory Oscilloscope Fast Fourier Transform (FFT) For Use with Infiniium 54830B Series Deep-Memory Oscilloscopes	Application Note 1383-1	5988-4368EN
54622D Agilent I ² C Debugging	Application Note 1351	5980-0796EUS
Debugging Digital Cameras: Detecting Redundant Pixels	Application Note	5988-3358ENUS
54622D Agilent MSO and CEBus PL Communications Testing	Application Note 1352	5980-0794EUS
Debugging Serial Bus Systems with a Mixed-Signal Oscilloscope	Application Note 1395	5988-5997EN
54622D Agilent Debugging Modern Power Electronics: Seeing the Whole Picture	Application Note 1350	5980-0797EUS
Agilent Infiniium Oscilloscopes Performance Guide Using 89601A Vector Signal Analyzer Software	Product Note	5988-4096EN

For more oscilloscope application notes, on-line demos and events information, go to www.agilent.com/find/appcentral and select oscilloscopes.

Ordering Information

1146A 100-kHz AC/DC Current Probe
10076A 100:1 High Voltage Probe
10077A Accessory Kit for 10076A
54006A 6-GHz Passive Divider Probe
N2771A 1000:1 High Voltage Probe
N2774A 50-MHz Current Probe
N2775A Power Supply for the N2274A

Modulation Domain Analysis: A New View of Complex Signals

As a pioneer of counter/timer technology, Hewlett-Packard recognized a need to expand traditional frequency and time measurement techniques. Now, with modulation domain analyzers, Agilent Technologies offers a unique method for viewing complex signals that is both intuitive and insightful.

Oscilloscopes display amplitude (voltage) versus time: the time domain. Spectrum analyzers show amplitude versus frequency: the frequency domain. The 53310A brings a new dimension to frequency and time interval analysis with views of the modulation domain:

- Frequency versus time
- Phase versus time
- Time interval versus time

Improved Measurement Analysis

A wide range of applications benefit from modulation domain analysis. Jitter measurements in digital communication systems, disk and tape drives, and mechanical systems are dramatically improved. Identify the sources of jitter – the first step in improving system performance.

Modulation domain analyzers simplify the study of step response for voltage-controlled oscillators. They easily characterize the frequency-hopping performance of an agile transmitter or measure cellular phone switching from cell to cell. Chirp linearity and phase switching in radar systems are easily understood from displays of frequency or phase versus time.

Modulation Domain Analyzer Selection Guide

Model	Key Selection Criteria	Feature Highlights
53310A	Low-cost, easy to use	Auto set-up RF transmitter characterization features Fast histograms
53305A	Software	Phase analysis software

Modulation Domain Analyzers

Agilent modulation domain analyzers provide a range of features and performance. Analysis features include views of frequency and phase versus time, with built-in statistics and histograms. GPIB programmability lets you control these analyzers remotely, or use the front panel measurement and display options for quick on-the-spot measurements.

The 53310A combines modulation domain analysis in a low-cost offering. Single-button functions and automated setup and measurement capabilities make the 53310A the easiest to operate of the modulation domain analyzers. The 53310A-031 option includes features that further simplify the analysis steps for RF mobile communications designers, and 53310A-305 option provides software for complete phase analysis.

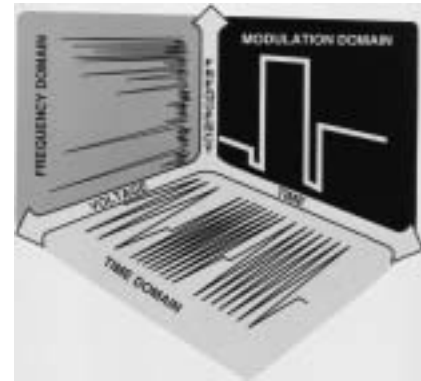
53310A: Affordable, easy-to-use modulation domain analyzer

Modulation Domain Analyzer Applications

The following application example illustrates one of the many situations that benefit from Agilent Technologies modulation domain analyzers. For complete product specifications or to arrange a product demonstration, contact the Agilent Call Center in your region.

Modulation Analysis for Mobile Communications

The 53310A's Option 53310A-031 "Digital RF Communications Analysis/High Resolution 2.5 GHz Input" provides automatic measure-



The Modulation Domain adds a third dimension of frequency vs. time.

ments of synthesizer settling time, Frequency Shift Keyed (FSK) center frequency, and FSK peak deviation on DECT, CT2 and CT3 radios. Features for optimizing RF designs include:

- High resolution measurements – built-in downconversion provides superior frequency resolution for RF signals
- RF envelope trigger – simplifies measurement setup by automatically triggering on a detected TDMA burst
- Automatic measurements – synthesizer settling time, Frequency Shift Keyed (FSK) center frequency, and FSK deviation

53310A-305 phase analysis software adds the power of phase analysis to your 53310A. Direct phase analysis lets you measure digital communication systems and extract data, including phase settling time, phase noise (phase spectrum), phase deviation, and phase trajectory. When used in combination, both options allow direct profiles of both wide- and narrowband modulations up to a 500 KHz modulation rate and eliminate the need for external downconversion.

Modulation Domain Analyzers

68

Modulation Domain Analyzers

53305A
53310A

- 200 ps rms single-shot resolution, 1 ps with averaging
- DECT, CT2, CT3 mobile communications measurements
- Easy to use



53310A

53310A Modulation Domain Analyzer

4

Affordability and Ease of Use

The most affordable modulation domain analyzer, the 53310A, includes many innovations for ease of use. Characterization of modulation and jitter is easy with built-in analysis. Parameters such as peak-to-peak deviation, carrier frequency, and modulation rate are all quickly and automatically displayed. Jitter analysis is simplified with automated mean, standard deviation, and probability functions. Key features of this frequency and time interval analysis product include:

Automated Setup: A single button can set up the 53310A for measurement. Signals are automatically evaluated.

Single-touch Measurements: Peak-to-peak deviation, carrier frequency, and modulation rate are easily and quickly measured for quantifying modulation. The Save/Recall function stores up to 10 measurement steps for fast repeat operations.

Built-in Statistics: Mean, standard deviation, and probability function buttons simplify jitter analysis.

Softkey-driven Menus: Measurement parameters and analysis functions are easily selected while viewing measurement data.

Large Display: The expanded screen displays measurement results clearly and aids analysis.

Low Cost: The 53310A is priced to fit budget-constrained projects and departments.

Modulation Domain Analyzer Specification Highlights

Model	Frequency Range (extension)	Single-shot Freq. Res. (1 s gate)	Time Interval Resolution (single-shot/averaging)	Maximum Continuous Meas. Rate (meas/s)	Memory Size	Output Meas/s	Analysis and Display
53310A	200 MHz (2.5 GHz)	10 digits	200 ps/1ps	2.5 M	8000 (32,000 w/53310A-001)	GPIO: to 7,500	Frequency and time interval vs. time; auto-scale (setup); large display; jitter analysis; simple triggering; digital RF communications (53310A-031)

Product Features

The 53310A offers powerful analyzer features:

Dual Timebases: Main timebase and window timebase allow data capture while viewing measurement details in the window.

Auto or Triggered Operation: Select auto triggering, edge triggering (rising or falling), or a unique feature: measurement value triggering (frequency or time interval). Value triggering can eliminate the need for and expense of external sync signal generation, shortening project time and lowering costs.

Display vs. Time or Histogram: Select appropriate views.

Fast Histograms: Up to 16 million measurements per acquisition.

Automated Measurements: Autoscale selects appropriate setup parameters; built-in analysis functions eliminate calculations.

Ordering Information

53310A Modulation Domain Analyzer

53310A-001 Extended Measurement Memory (4 x)

53310A-010 High Stability Oven Timebase

53310A-030 2.5 GHz Channel C

53310A-031 Digital RF Communications Analysis/High Resolution 2.5 GHz Input

53310A-305 Phase Analysis Software

53310A-W30 3-Year Extended Repair Service

53310A-W32 3-Year Calibration Service

53310A-W34 3-Year Standards Compliant Cal Service

53310A-W50 5-Year Return Repair Service

53310A-W52 5-Year Return Calibration Service

53310A-W54 5-Year Standards Compliant Cal Service

53310A-A6J ANSI Z540 Compliant Calibration

Available Separately

53305A Phase Analysis Software

Electronic Counters

Starting with the first frequency-measurement projects in the 1940s, Hewlett-Packard pioneered the major technologies enabling today's electronic counters and modulation-domain analyzers. Today, Agilent Technologies offers the industry's broadest line of electronic counters and counter/timers.

Electronic counter/timers are used throughout most technical industries for measuring and analyzing frequency, phase, and time-interval signal characteristics. The breadth of the Agilent offering allows the best product to be selected for each application. An ideal functional and performance fit delivers the greatest value: the best and most cost-effective solution.

Agilent counter/timers offer:

- High-measurement accuracy
- Fast system throughput/GPIB capability
- Low cost of ownership
- Ease of use
- Data reduction on many models
- Triggering simplicity

New Measurement Technology

Modulation domain products feature "continuous count" technology. Unlike traditional counters, these products do not stop between measurements to process data. Rather, they measure continuously and process results on the fly. As a result, new kinds of measurements are made possible. Modulation domain products include:

53310A: Combines affordability and ease of use

For more information on modulation domain products, see the section starting on page 67.

Counter Products

RF Counter



The 53181A RF counter offers outstanding measurement performance in a low-cost, easy-to-use package.

The 53181A leads off Agilent's newest line of frequency counters. The 53181A RF counter employs continuous measurement technology to provide superior performance at a very low price. Frequency and period measurements are provided over the range of 0.1 Hz to 225 MHz with exceptional

resolution of 10 digits in one second. An optional second channel increases the frequency range to 1.5 GHz, 3 GHz, 5 GHz, or 12.4 GHz, making it easy to cover your exact RF measurement needs. Other features of the 53181A include GPIB, automatic limit testing, analog display mode, single-button recall, extensive in-box statistical and math analysis, and more.

The 53181A RF counter is designed for systems and bench applications where high-precision frequency measurements are required in an easy-to-use, small and rugged package.

53181A: The low-cost RF counter for systems and bench use

Universal Frequency and Time Interval Counters



The 53131A frequency counter offers high performance for system or bench.

The Agilent universal counter/timers incorporate frequency measurements, just like the 53181A, and additional capabilities for time-interval measurements. Specifically, these counters measure precise timing between two trigger events. These high-performance universal products also provide complete, automatic characterization of rise time, pulse width, and other signal parameters. Options are available (frequency extensions, high-precision time bases) to customize the products.

The current Agilent frequency counter offering includes two high-performance universal counters: the 53131A and 53132A.

The 53131A is designed for manufacturing test, troubleshooting, and service. This counter allows you to easily make highly reliable frequency and timing measurements. Featured are extensive in-box analysis, automatic limit testing, analog display mode, single button recall, and more. The 53131A's half-rack size and light weight make it well suited for both bench-top and rackmounting.

The 53132A is designed for high-performance ATE systems. It combines the functionality of the 53131A with improved frequency and time interval resolution.

53131A: High-performance system and bench counter (10 digits/sec. and 500 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

53132A: Highest resolution universal counter for system applications (12 digits/sec. and 150 ps LSD). Frequency range up to 225 MHz on 2 channels (with optional 3, 5 or 12.4 GHz on the third channel).

Microwave and Millimeter-Wave Frequency Counters

These products provide fundamental high-performance frequency measurements, dc to 46 GHz. Many enhancements – power measurement, battery operation, systems interface (GPIB), and high-accuracy time bases – are available standard or as options.

Pulse counters add the capability to automatically measure and profile burst or pulsed microwave or millimeter-wave signals.

53150A/53151A/53152A: Portable CW microwave counter with power measurement for telecommunications service

53147A/53148A/53149A: Portable CW microwave counter with dc DVM plus true power meter for improved power accuracy

High-Precision Oscillators

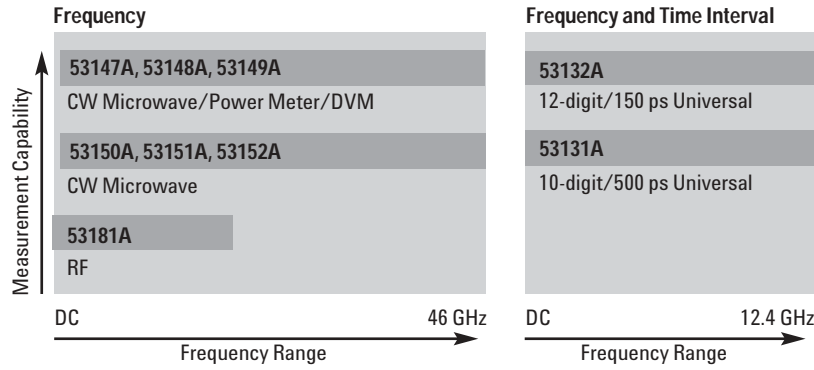
The accuracy of frequency and time-interval measurements is vitally dependent on the time base or reference element selected. Agilent has pioneered the field of high-precision crystal oscillators. The current counter product line benefits from Agilent's leadership in quality and precision oscillator technology. Three oscillator varieties are standard or optional with Agilent counters and counter/timers:

RTXO: Room-temperature crystal oscillators are designed for minimum frequency change over a change in temperature.

TCXO: Temperature-compensated oscillators use external components to offset temperature effects. TCXO time bases have temperature characteristics which are typically five times better than an RTXO, or $<5 \times 10^{-7}$ for a 0° to 50°C change.

Oven Time Base: This alternative places the crystal and temperature-sensitive elements within a temperature-controlled environment. A heating element maintains a consistent temperature. The best stability is achieved when the operating point is 15° to 20°C above the highest temperature to which the unit will be exposed. After warm-up, the frequency remains very stable, typically $<7 \times 10^{-9}$ over a 0° to 50°C variation.

For more information, please request Application Note 200-2, "Fundamentals of Quartz Oscillators" from the Agilent Call Center in your region.



Counter Selection Guide

Model	Frequency Range (extension)	Freq. Resolution (1 s gate time)	Best Sensitivity	Time-Interval Res. (single-shot LSD)	Additional Features	Page
Universal Counters						
53131A	225 MHz (3, 5, 12.4 GHz)	10 digits	20 mVrms	500 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization	71
53132A	225 MHz (3, 5, 12.4 GHz)	12 digits	20 mVrms	150 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization	71
RF Counter						
53181A	225 MHz (1.5, 3, 5, 12.4 GHz)	10 digits	20 mVrms	—	GPIB standard, full math, statistics, limit testing	71
CW Microwave Counters						
53150A	20 GHz	1 Hz	-30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	73
53151A	26.5 GHz	1 Hz	-30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	73
53152A	46 GHz	1 Hz	-30 dBm	—	GPIB standard, battery optional, simultaneous power measurement	73
CW Microwave Counter/Power Meter/DVMs						
53147A	20 GHz	1 Hz	-30 dBm	—	DVM and GPIB standard, battery optional, -70 dBm to +20 dBm true power meter	75
53148A	26.5 GHz	1 Hz	-30 dBm	—	DVM and GPIB standard, battery optional, -70 dBm to +20 dBm true power meter	75
53149A	46 GHz	1 Hz	-30 dBm	—	DVM and GPIB standard, battery optional, -70 dBm to +20 dBm true power meter	75

Additionally, Agilent offers electronic counters and counter/timers in an industry standard platform: VXIbus. With VXIbus counters from Agilent, you can rely on the same exceptional performance that you have always had from Agilent's high-performance rack-

and-stack universal counters. All B-size instruments can be adapted to fit into the C-size VXIbus mainframes. Please refer to the VXIbus Products section in Chapter 9 for additional information.

- High-resolution frequency measurements to 225 MHz (optional 1.5, 3.0, 5.0 or 12.4 GHz)
- High-resolution time-interval measurements with 53131A and 53132A
- Intuitive user interface with shallow menu structure
- GPIB standard with data transfer rate of up to 200 fully-formatted measurements/second; talk-only RS-232
- Limit test capability
- IntuiLink Connectivity Software included



53181A RF Counter

A Full Family of High-Performance RF and Universal Counters

Within Budget, Without Compromise

The 53131A/132A/181A high-performance counters offer exceptional price and performance in a rugged, lightweight package with a unique combination of ease of use, complete measurement set, extensive analysis capability, reliability, and high measurement and data transfer speed.

These instruments use real-time digital signal processing technology to analyze data while simultaneously taking new readings, speeding measurement throughput. The technology, developed for Agilent's high-end line of modulation-domain analyzers, allows the counters to gather more data for each measurement so you get the high-resolution measurements in a fraction of the time it takes a conventional counter.

Powerful Analysis Capability

The 53131A/132A/181A counters offer built-in statistics and math functions so you can scale measurements and simultaneously measure and track average, min./max. and standard deviation. Automated limit testing lets you set upper and lower limits for any measurement. When a measurement falls outside those limits, the counters log the out-of-limit conditions, notify the operator and generate an output signal to trigger external devices or stop the test. An analog display mode carries limit testing one step further, letting you see at a glance whether a measurement falls within pass/fail limits.



Analog display mode uses an asterisk to represent the current measurement relative to user-defined upper and lower limits. The colon on the left represents the lower limit and the colon on the right represents the upper limit.

High-Speed Automated Test Capability

For computer-controlled systems applications, each counter includes a standard GPIB interface with a data transfer rate of up to 200 fully-formatted measurements per second. The counters use the Standard Commands for Programmable Instruments (SCPI) protocol, letting you leverage your programming investment across your measurement system. The standard RS-232 talk-only interface provides printer support or data transfer to a computer through a terminal-emulation program.

- 53181A: 10-digit/s resolution
- 53131A: 10-digit/s and 500 psec resolution
- 53132A: 12-digit/s and 150 psec resolution

53131A
53132A
53181A



53131A and 53132A Universal Counters

53181A RF Counter

Optimized for RF applications, the single-channel 53181A gives you frequency, period, and peak-voltage measurements with up to 10 digits/sec frequency and period resolution. The low-cost 53181A counter is ideal for benchtop, system RF and analog applications.

A digit-blanking function lets you easily eliminate unnecessary digits when you want to read measurements quickly. For higher-frequency measurements, an optional second channel provides 1.5, 3, 5 or 12.4 GHz bandwidth.

53131A and 53132A Frequency Counters

The two-channel 53131A counter offers 10 digits per second of frequency and period resolution at up to 225 MHz. Single-shot time-interval resolution is specified at 500 ps and averaging can reduce this even further. Measurements include frequency, time interval, ratio, period, phase angle, totalize, peak voltage, pulse parameters and more. For quick access to frequently used tests, a single key-stroke recalls up to 20 different stored front-panel set-ups. Choose the 53131A for general bench or system test where you need excellent performance at an unbeatable price.

For applications requiring higher resolution, the 53132A offers the same features and functions as the 53131A with up to 12 digits/s frequency and period resolution. Single-shot time-interval resolution is specified at 150 ps. Choose the 53132A when you need the very best in accuracy and resolution, or when speed in an automated system is critical. With the 53132A, expanded external arming features can be used to control time interval measurements using an external signal.

Whichever counter you choose, you'll have an accurate, reliable counter that will serve you for years to come. We back that claim with a standard three-year warranty that can be extended an additional two years.

Options Increase Versatility

The 53131A/132A/181A counters can be ordered with an optional RF-input channel to provide frequency measurements up to 3 GHz (531xxA-030), 5 GHz (531xxA-050) or 12.4 GHz (531xxA-124). (See table on page 72.)

A choice of optional timebases is available for the 53131A/132A/181A counters to increase your measurement accuracy. Option 531xxA-010 provides a high-stability oven timebase with aging of less than 5×10^{-10} per day. Option 53132A-012 provides an ultra-high-stability oven timebase with aging of less than 1×10^{-10} per day. (See table on page 72.)

Agilent IntuiLink for counters software turns your PC and counter into a powerful, easy-to-use measurement system. IntuiLink lets you easily configure and run tests from your Windows-based PC, making data gathering more convenient. IntuiLink software helps you get more information from your data by providing a variety of basic display formats and analysis tools that let you manipulate and understand your data quickly and easily.

Electronic Counters

72

Frequency and Time Interval Counters (cont.)

Abridged Measurement Specification & Characteristics

	53131A	53132A	53181A
Measurements	Frequency, frequency ratio, time interval, period, rise/fall time, positive/negative pulse width, duty cycle, phase (CH 1 to CH 2), totalize, peak voltage, time interval average, time interval delay		Frequency, frequency ratio (with optional CH 2), period, peak voltage
Analysis	Automatic limit testing, math (scale and offset), statistics (minimum, maximum, mean, standard deviation). Statistics available on all measurements or only measurements that fall within limits.		
Measurement Characteristic			
Frequency range	CH 1 & 2: dc – 225 MHz	CH 1 & 2: dc – 225 MHz	CH 1: dc – 225 MHz
Frequency resolution:	10 digits/s	12 digits/s	10 digits/s
Time interval resolution (LSD)	500 ps	150 ps	NA
Measurement speed:	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB
Voltage Range & Sensitivity (Sinusoid)			
DC to 100 MHz:	20 mVrms to ±5 Vac + dc	20 mVrms to ±5 Vac + dc	20 mVrms to ±5 Vac + dc
100 MHz to 200 MHz:	30 mVrms to ±5 Vac + dc	30 mVrms to ±5 Vac + dc	30 mVrms to ±5 Vac + dc
200 to 225 MHz:	40 mVrms to ±5 Vac + dc	40 mVrms to ±5 Vac + dc	40 mVrms to ±5 Vac + dc
Input Conditioning	(Independently selectable on CH 1 & 2)		
Impedance, coupling	1 MΩ or 50 Ω, ac or dc	1 MΩ or 50 Ω, ac or dc	(Selectable on CH 1) 1 MΩ or 50 Ω, ac or dc
Low pass filter	100 kHz, switchable	100 kHz, switchable	100 kHz, switchable
Attenuation	x1 or x10	x1 or x10	x1 or x10
External Timebase Reference Input	1, 5, 10 MHz	10 MHz	1, 5, 10 MHz
Trigger	CH 1 & 2 Trigger on rising/falling edge; set level by percent of signal level or absolute voltage; set sensitivity to LOW, MED, or HIGH	CH 1 & 2	CH 1
Gating and Arming	Auto, manual (set gate time or number of digits of resolution); external, delay (expanded on 53132A)		
Interfaces	GPIB (IEEE 488.1 and 488.2) with SCPI-compatible language; talk only RS-232		
Software	Includes IntuiLink Connectivity Software		
Power	100 to 120 VAC ± 10% –50, 60 or 400 Hz ± 10% } AC line voltage selection is automatic 220 to 240 VAC ± 10% –50 or 60 Hz ± 10%		
Net Weight/Size	3 kg (6.5 lbs), 88.5 mm H x 212.6 mm W x 348.3 mm D (3.54 in x 8.50 in x 13.932 in)		

For full specifications, request a Product Overview, or visit our web site: www.agilent.com/find/bi

Standard and Optional High-Stability Timebases

	Standard (0° to 50°C)	Medium Stability Oven (Option 001)	High Stability Oven (Option 010)	Ultra High Stability Oven (Option 012, 53132A only)
Temperature Stability: (referenced to 25°C)	<5 x 10 ⁻⁶	<2 x 10 ⁻⁷	<2.5 x 10 ⁻⁹	<2.5 x 10 ⁻⁹
Aging Rate (after 30 days)				
Per Day:		<4 x 10 ⁻⁸	<5 x 10 ⁻¹⁰	<1 x 10 ⁻¹⁰
Per Month:	<3 x 10 ⁻⁷	<2 x 10 ⁻⁷	<1.5 x 10 ⁻⁸	<3 x 10 ⁻⁹
Per Year:				<2 x 10 ⁻⁸
Turn-on Stability vs. Time: (in 30 minutes)		<2 x 10 ⁻⁷ (referenced to 2 hours)	<5 x 10 ⁻⁹ (referenced to 24 hours)	<5 x 10 ⁻⁹ (referenced to 24 hours)
Calibration:	Manual Adjust	Electronic	Electronic	Electronic

Note that power to the time base is maintained when the counter is placed in standby via the front panel switch. The internal fan will continue to operate under this condition to maintain long-term instrument reliability.

Optional High-Frequency Channels

	Frequency Range	Coupling	Power Range and Sensitivity	Damage Level
53181A-015 ¹ 1.5 GHz channel	100 MHz to 1.5 GHz	ac	-27 dBm to +19 dBm	5 Vrms
531xxA-030 3.0 GHz channel	100 MHz to 3.0 GHz	ac	-27 dBm to +19 dBm (100 MHz to 2.7 GHz) -21 dBm to +13 dBm (2.7 GHz to 3 GHz)	5 Vrms
531xxA-050 5.0 GHz channel	200 MHz to 5.0 GHz	ac	-23 dBm to +13 dBm	25 dBm
531xxA-124 12.4 GHz channel	200 MHz to 12.4 GHz	ac	-23 dBm to +13 dBm	25 dBm

¹ Option 015 is available only for 53181A counters.

Ordering Information

- 53131A Frequency Counter
- 53132A Frequency Counter
- 53181A RF Counter
 - 531xxA-001 Medium-Stability Timebase
 - 531xxA-010 High-Stability Timebase
 - 53132A-012 High-Stability Timebase (53132A only)
 - 53181A-015 1.5 GHz Ch. w/BNC Connector (53181A only)
 - 531xxA-030 3 GHz Channel with BNC Connector
 - 531xxA-050 5 GHz Channel with Type-N Connector
 - 531xxA-124 12.4 GHz Channel with Type-N Connector
 - 531xxA-060 Rear-Panel Connectors
 - 531xxA-A6J ANSI Z540 Compliant Calibration
 - 531xxA-1CM Rackmount Kit
- 34161A Accessory Pouch
- 34131A Hard Transit Case

- Ultra wide range, single input (from 50 MHz up to 46 GHz)
- Simultaneous frequency and power measurement with analog peaking indicator
- Fully programmable via GPIB and RS-232 standard
- Lightweight with optional battery

53150A
53151A
53152A



53152A

53150A, 53151A, 53152A Microwave Counters

The Agilent 53150 series represent a total re-thinking of microwave counters: innovative designs that offer no-compromise performance and quality while attaining true portability. The 53150A, 53151A, and 53152A measure both frequency and power over the frequency ranges of 20 GHz, 26.5 GHz, and 46 GHz, respectively, and feature a single, extremely wideband microwave input (50 MHz up to 46 GHz).

No Compromise Performance

Utilizing a unique single board design with low phase noise PLL circuitry, the 53150 series offers exceptional sensitivity, excellent power measurement accuracy and repeatability as well as fast acquisition times and full programmability. Performance equals or surpasses the industry standard HP 5350 series in virtually every aspect, and in a package that is less than half the weight and size.

Frequency and Power Measurements with a Single Connection

The heart of the 53150 series is an advanced sampler design that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows the convenient measurement of both frequency and power with a single connection. The unique cable-loss-compensation feature (power correction) yields accuracies and repeatabilities that rival power meters. Best of all, since the frequency of the test signal is measured simultaneously, the diode's frequency response is automatically adjusted for. And like the latest in diode sensors, deviation from square law is also compensated for.

Functionality Without Clutter

The 53150 series offers a clean, uncluttered front panel with a minimum of push buttons. Despite their simple appearance, these counters retain all the powerful functions one expects in precision instrumentation, with such useful functions as: measurement averaging, arbitrary as well as nulling offsets for both frequency and power, display of power in either dBm or Watts and full control of resolution, sampling rate, and GPIB address plus extensive self-diagnostics.

Field Tough but Ready for Benchtop or ATE Applications

The 53150 series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. For easy transportation, a soft carrying case is also available. The "see anywhere" backlit LCD display ensures visibility in all environments, from dark to full sunlight. And in situations where AC is unavailable, the internal, replaceable camcorder batteries provide over 2.5 hours of continuous operation. Alternatively, the unit can be powered from an external 11-18 VDC source.

For benchtop and ATE applications, the 53150 series delivers full functionality and high measurement speed along with fully programmable RS-232 interface and high speed GPIB (SCPI compliant) as standard. In addition, these counters are compatible with standard Agilent rackmount hardware.

53150A
53151A
53152A

53150 Series Abridged Measurement Specifications and Characteristics

All measurement specifications are over the full signal ranges of channels 1 and 2. For full specifications, please call your Agilent representative and request a Product Overview for the 53150 series microwave counters.

Input Characteristics

	Input 1 (1 MΩ)	Input 2 (50 Ω)
Frequency Range		
53150A	10 Hz to 125 MHz	0.05 – 20 GHz
53151A	10 Hz to 125 MHz	0.05 – 26.5 GHz
53152A	10 Hz to 125 MHz	0.05 – 46 GHz
Sensitivity		53150/51 53152
<30 Hz	40 mVrms	—
to 125 MHz	25 mVrms	—
<250 MHz	—	-20 dBm
to 12.4 GHz	—	-33 dBm
to 18 GHz	—	-33 dBm
to 20 GHz	—	-29 dBm
to 26.5 GHz	—	-25 dBm (151)
to 40 GHz	—	-23 dBm
to 46 GHz	—	-17 dBm
Maximum Input	2 Vrms	+5 dBm, <2 GHz +13 dBm, >2 GHz
Damage Level	5 Vrms to 120 Vp	+27 dBm
Coupling	AC	AC

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Connector: BNC female
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance: 20 MHz p-p max. @ 10 MHz rate to 26.5 GHz;
12 MHz p-p max. @ 10 MHz rate to 46 GHz
AM Tolerance: Any depth/rate within dynamic range of input
Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. for less than 75 MHz separation
Connector: 3.5 mm SMA compatible (53150A/53151A);
2.92 mm removable (53152A)

Power Measurement

Range: Counter sensitivity to +7 dBm
Units: dBm or milliwatts/microwatts
Resolution: 0.01 dB

Accuracy* (0 to -20 dBm):

	53150/51	53152
<12.4 GHz	±1.5 dB	±1.0 dB
to 20 GHz	±1.5 dB	±1.5 dB
to 26.5 GHz	±2.0 dB (151)	±1.5 dB
to 46 GHz	—	±2.0 dB

*At channel two input connector

General

Display: Backlit LCD

Sample Rate: User-selectable Fast, Medium, Slow or Hold

Programming: GPIB and RS-232C, SCPI compatible

Math Functions

- Offset: Last reading and/or entered offset to reading for either power or frequency
- Averaging: 1 to 99 measurement running average
- Power Correction (Cable Loss Compensation): Offsets power reading via linear interpolation of up to 10 user-entered frequency attenuations

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled

Sleep Mode (battery option only): Automatically activated if no input is present for 5 minutes

Power Requirements

- 75 VA max. (25 W typ.)
- 90 – 132 VAC; 50, 60, 400 Hz
- 216 – 264 VAC; 50, 60 Hz
- 11 – 18 VDC; 2 A max.: battery option only

Battery (option):

- Type: VHS camcorder, sealed lead acid (2 each)
- Charge Time: 8 hours in unit
- Capacity: 2.5 hours minimum at 25°C

Timebase:

	TCX0 (std)	Option 001
Aging Rate	1 x 10 ⁻⁷ /mo	5 x 10 ⁻¹⁰ /day
Short Term (1 sec. avg.)	1 x 10 ⁻⁹	2 x 10 ⁻¹⁰
Temperature (0° – 55°C)	<1 x 10 ⁻⁶	<3 x 10 ⁻⁹

Accessories Furnished: Power cord and operating, programming, and service manuals

Size: 88.5 mm H x 213 mm W x 300 mm D (3.54 in x 8.52 in x 12 in)

Weight: 4 kg (8.8 lb) without battery option; 6.4 kg (14.08 lb) with battery option

Ordering Information

53150A 20 GHz Microwave Counter

53151A 26.5 GHz Microwave Counter

53152A 46 GHz Microwave Counter

5315xA-001 Oven Timebase

5315xA-002 Battery/DC Input

5315xA-007 Soft Carrying Case

5315xA-A6J ANSI Z540 Compliant Calibration

5315xA-1CM Rack Mounting Kit

- Three frequency ranges up to 46 GHz
- True power meter with 8480 series sensors
- DVM standard and battery optional
- Fully standard programmable GPIB and RS-232 standard



53149A

53147A, 53148A, 53149A Microwave Counter/Power Meter/DVMs

The Agilent 53140 series microwave counter/power meter/dvms have all the fundamental measurements required to install and maintain today's digital microwave radio links. Rugged field portability and a battery option complete the ensemble. These instruments are also at home in ATE applications with GPIB and RS-232 fully programmable I/O ports as standard features. For those demanding R&D application, the 53140 series offer the laboratory-level performance and accuracy you've come to expect from Agilent Technologies.

53140 Series Abridged Measurement

Specifications and Characteristics

For full specifications, please call your Agilent representative and request a Product Overview for the 53140 series microwave counters.

Counter Specifications

Input Characteristics

	Input 1 (1 M Ω)	Input 2 (50 Ω)	
Frequency Range			
53147A	10 Hz to 125 MHz	0.05 – 20 GHz	
53148A	10 Hz to 125 MHz	0.05 – 26.5 GHz	
53149A	10 Hz to 125 MHz	0.05 – 46 GHz	
Sensitivity		53147A/48A	53149A
<30 GHz	40 mVrms	—	—
to 125 MHz	25 mVrms	—	—
<250 GHz	—	-20 dBm	-20 dBm
to 12.4 GHz	—	-33 dBm	-33 dBm
to 18 GHz	—	-33 dBm	-30 dBm
to 20 GHz	—	-29 dBm	-27 dBm
to 26.5 GHz	—	-25 dBm (148)	-27 dBm
to 40 GHz	—	—	-23 dBm
to 46 GHz	—	—	-17 dBm
Damage Level	5 Vrms to 120 Vp	+27 dBm	

Channel 1

Resolution: Selectable 1 Hz to 1 MHz
Low Pass Filter: 50 kHz, selectable

Channel 2

Resolution: Selectable 1 Hz to 1 MHz
Acquisition Time: 100 ms to 140 ms
Gate Time: 1/Resolution
FM Tolerance

- 20 MHz p-p max. @ 10 MHz rate to 26.5 GHz
- 12 MHz p-p max. @ 10 MHz rate to 46 GHz

Amplitude Discrimination (above 250 MHz): 20 dB typ. for greater than 75 MHz separation; 10 dB typ. For less than 75 MHz separation

Connector: 3.5 mm SMA compatible (53147A/53148A)
 2.92 mm removable (53149A)

Power Meter Specifications

Frequency Range: 10 MHz to 50 GHz, sensor-dependent

Power Range: -70 dBm to +20 dBm, sensor-dependent

Power Sensors: 8480 series

Display Units: Watts, dBm

Resolution: 0.01 dB in log mode, 0.1% of full scale in linear mode

Accuracy

- Instrumentation: ± 0.02 dB or $\pm 0.5\%$

Power Reference

- Power Output: 1.00 mW. Factory set to $\pm 0.7\%$, traceable to U.S. National Institute of Standards and Technology.

DVM Specifications

Function: DC volts

Range: ± 50 Vdc

General

Display: Backlit LCD

Programming: GPIB and RS-232C, SCPI compatible

Math Functions

- Offset: Last reading and/or entered offset to reading for either power or frequency
- Averaging: 1 to 99 measurement running average

Save and Recall: Up to 9 complete instrument setups may be saved and later recalled

Power Requirements:

- 90 – 132 VAC; 50, 60, 400 Hz
- 216 – 264 VAC; 50, 60 Hz
- 11 – 18 VDC: battery option only

Battery (option):

- Type: VHS camcorder, sealed lead acid (2 each)
- Charge Time: 8 hours in unit
- Capacity: 2 hours typical

Timebase:

	TXCO (std)	Oven (opt)
Aging Rate	1×10^{-7} /mo	5×10^{-10} /day
Short Term (1 sec. avg.)	1×10^{-9}	2×10^{-10}
Temperature (0°C – 55°C)	$< 1 \times 10^{-9}$	$< 3 \times 10^{-9}$

Accessories Furnished: Power cord, 1.5 m power sensor cable (11730A), operating, programming and service manuals

Ordering Information

53147A 20 GHz Counter/Power Meter/DVM

53148A 26.5 GHz Counter/Power Meter/DVM

53149A 46 GHz Counter/Power Meter/DVM

5314xA-001 Oven Timebase

5314xA-002 Battery/DC Input

5314xA-007 Soft Carrying Case

5314xA-1CM Rackmount Kit

53147A
 53148A
 53149A



Agilent offers a full line of digital multimeters.



34970A

Find Your Fit in the Agilent Family

From a bench top to a test rack to a VXIbus system, there's an Agilent digital multimeter (DMM) that's right for the job:

3458A Multimeter

Up to 8 1/2 digits and up to 100,000 readings per second. Test engineers, R&D engineers, and metrologists worldwide rely on its accuracy and speed.

34420A Nanovolt/Micro-ohmeter

With 7 1/2 digits of resolution, 8 nVpp noise, and built-in resistance and SPRT functions, the 34420A can handle your most demanding low-level measurements.

34401A Multimeter

The world's best-selling benchtop/system DMM delivers 6 1/2-digit performance at a 5 1/2-digit DMM price.

VXIbus DMMs

Perfect for data acquisition and computer-aided test applications. Refer to the VXIbus section of this catalog (Chapter 9) for more information.

34970A Data Acquisition Switch Unit

Three slot mainframe with a built-in 6 1/2-digit DMM. Choose from 8 optional plug-in modules to create a compact data logger, full-featured data acquisition system, or low-cost switching unit.

Selection Table for Digital Multimeters, Voltmeters

	34401A	3458A	34970A ¹	34420A
Type	DMM 6 1/2 Digit	DMM 8 1/2 Digit	Data Logger/Scanning DMM 6 1/2 Digit	Nanovolt/micro-ohm meter 7 1/2 Digit
Basic Measurements	dc & ac voltage, dc & ac current, 2 & 4 wire resistance, frequency & period			dc voltage, 2 & 4 wire resistance, low power resistance, ratio
Additional Measurements	continuity, diode test	3 modes of true RMS, Digitizing	Scanning 20 to 60 2-wire channels	2 Channels – ratio and difference
Temperature	—	Thermistor, RTD	Thermocouple, RTD, Thermistor	Direct SPRT, RTD, Thermistor, Thermocouple
dcV Accuracy² ±(% of reading + % of range)	0.0035 + 0.0005	0.0008 + 0.000005 (0.0004 + 0.000005) ³	0.0035 + 0.0005	0.003 + 0.0004
acV Accuracy⁴ ±(% of reading + % of range)	0.06 + 0.03	0.007 + 0.002	0.06 + 0.04	—
Resistance Accuracy⁵ ±(% of reading + % of range)	0.010 + 0.001	0.0010 + 0.00005	0.010 + 0.001	0.006 + 0.0002
Math Functions	Null, statistics, dBm, dB, limit test	Null, statistics, dBm, dB limit test, scale, offset, filter, % error	Null, statistics, limit test, scale, offset	Null, statistics, dBm, dB limit, test, scale, offset, filter, moving avg. filter
Software	Include Intuilink SW		Include BenchLink Data Logger SW	Include Intuilink SW

¹ Requires plug-in modules. 34970A has three slots and 8 modules to choose from (34901A, 34902A, 34903A, 34904A, 34905A, 34906A, 34907A, 34908A).

² dcV accuracy; 1yr, 10 V range.

³ dcV accuracy with optional high stability reference (3458-002).

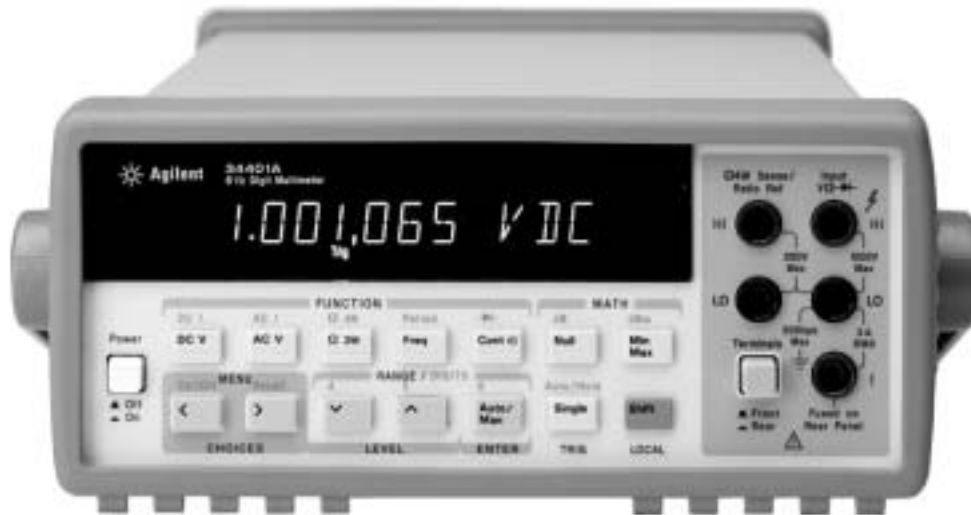
⁴ acV accuracy; 1yr, 10 V range, 10 Hz to 20 kHz, (3458A 40 Hz to 1 kHz).

⁵ Resistance accuracy; 1 yr, 4 wire-ohm, 100 k ohm range. (34420A 10 k ohm range).

- 12 measurement functions
- 1000 V maximum input
- 15 ppm basic dcV accuracy (24-hour)
- 1000 readings per second direct to GPIB

- GPIB and RS-232 standard
- 512-reading memory
- SCPI commands standard
- IntuiLink Connectivity Software included

34401A



34401A

34401A Digital Multimeter

The 34401A digital multimeter establishes a new price/performance standard by offering such features as 6½ digits of resolution, 1000 readings per second, and 15 ppm basic dc accuracy at a surprisingly affordable price. The 34401A has been designed for superior performance while providing the flexibility to meet both your present and future needs.

Great Bench Performance

The clear, logical front panel of the 34401A allows you to easily select all primary measurement functions. Traditional “bench” functions, such as continuity and diode test, are included. Math functions, such as NULL, dB, dBm, limit test, and min/max/avg are easily selected. A simple menu scheme gives you access to powerful advanced features, such as the ability to store up to 512 readings in internal memory. Measurement results are displayed on a bright, high-visibility readout. A rugged case ensures survival even under the toughest conditions, and the optional accessory pouch makes it easy to pack up and go with the 34401A.

Superior Performance in Your System

The 34401A can take up to 1000 readings per second, including GPIB bus transfer in ASCII format. Both GPIB and RS-232 are standard, letting you select the interface that best meets your needs. The 34401A responds to three different command languages. It accepts SCPI commands (Standard Commands for Programmable Instruments), which ensures present and future compatibility. Drivers are also available for both National Instruments Labview and Agilent’s VEE software.

IntuiLink Software, included with your 34401A, allows you to transfer your measurement data and images into Microsoft Excel or Microsoft Word with little or no programming. You can specify the meter setup and take a single reading or log data to the Excel spreadsheet in specific time intervals. Programmers can use the ActiveX components to control the DMM using SCPI commands. To find out more about IntuiLink, visit www.agilent.com/find/intuilink

Abbreviated Technical Specifications

DC Voltage

Input Characteristics

Range	Maximum Reading (6½ digits)	Resolution in Digits			Input Resistance
		6½	5½	4½	
100 mV	120.0000	100 nV	1 µV	10 µV	10 MΩ or >10 GΩ
1 V	1.200000	1 µV	10 µV	100 µV	10 MΩ or >10 GΩ
10 V	12.000000	10 µV	100 µV	1 mV	10 MΩ or >10 GΩ
100 V	120.0000	100 µV	1 mV	10 mV	10 MΩ
1000 V	1050.000	1 mV	10 mV	100 mV	10 MΩ

Input Protection: >1000 V on all ranges
Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
100 mV	0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035
1 V	0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007
10 V	0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005
100 V	0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006
1000 V	0.0020 + 0.0006	0.0035 + 0.0010	0.0045 + 0.0010

Noise Rejection: (50 or 60 Hz, 1 kΩ unbalance in LO lead)

DC CMRR: 140 dB

AC CMRR: 70 dB

Normal Mode Rejection (60 Hz/50 Hz) ± 0.1%:

100 PLC (1.67 s/2.00 s): 60 dB

10 PLC (167 ms/200 ms): 60 dB

1 PLC (16.7 ms/20.0 ms): 60 dB

<1 PLC (3 ms or 800 µs): 0 dB

Maximum Reading Rate: (readings/s)

Power Line Frequency	Resolution in Digits		
	6½	5½	4½
60 Hz	6	300	1000
50 Hz	5	300	1000

AC Voltage (true rms)

Measurement Accuracy: ±(% of reading + % of range); 1 year, 23°C ± 5°C

Frequency	Ranges	
	100 mV	1, 10, 100, 750 V
3 to 5 Hz	1.00 + 0.04	1.00 + 0.03
5 to 10 Hz	0.35 + 0.04	0.35 + 0.03
10 Hz to 20 kHz	0.06 + 0.04	0.06 + 0.03
20 to 50 kHz	0.12 + 0.04	0.12 + 0.05
50 to 100 kHz	0.60 + 0.08	0.60 + 0.08
100 to 300 kHz	4.00 + 0.50	4.00 + 0.50

Note: -3 dB frequency typically >1 MHz

Input Resistance: 1 MΩ ± 2%, in parallel with 100 pF

Input Protection: >750 V rms on all ranges

Maximum Volt-Hz Product: 8 x 10⁷

Crest Factor: Maximum of 5:1 at full scale

Maximum Reading Rate: 10 readings/s (50 readings/s with default delays defeated)

Frequency and Period

Range: 3 Hz to 300 kHz (333 ms to 3.33 µs)

1-Year Accuracy: 0.01% (40 Hz to 300 kHz); 0.05% (3 to 40 Hz)

Resolution: 10 µHz to 1 Hz

Other Measurement Functions: Continuity, Diode Test, Ratio dc:dc, Limit Test

Math Functions: NULL, Min/Max/Avg, dB, dBm, Limit Test

Memory: 512-reading internal storage

Standard Programming Languages: SCPI, HP 3478A and Fluke 8840A/42A

Computer Interface: GPIB and RS-232C standard

Accessories Included: Test lead kit, operators manual, service manual, test report, and power cord

Warranty: 3 years standard

Resistance: (2-wire Ω, 4-wire Ω)

Input Characteristics

Range	Maximum Reading (6½ digits)	Resolution in Digits		
		6½	5½	4½
100 Ω	120.0000	100 µΩ	1 mΩ	10 mΩ
1 kΩ	1.200000	1 mΩ	10 mΩ	100 mΩ
10 kΩ	12.000000	10 mΩ	100 mΩ	1 Ω
100 kΩ	120.0000	100 mΩ	1 Ω	10 Ω
1 MΩ	1.200000	1 Ω	10 Ω	100 Ω
10 MΩ	12.000000	10 Ω	100 Ω	1 kΩ
100 MΩ	120.0000	100 Ω	1 kΩ	10 kΩ

Input Protection: >1000 V on all ranges

Measurement Accuracy: ±(% of reading + % of range)

Specs are for 4-wire Ω or 2-wire Ω using Math Null

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Current Source
100 Ω	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	1 mA
1 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	1 mA
10 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	100 µA
100 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	10 µA
1 MΩ	0.0020 + 0.001	0.008 + 0.001	0.010 + 0.001	5.0 µA
10 MΩ	0.0150 + 0.001	0.020 + 0.001	0.040 + 0.001	500 nA
100 MΩ	0.3000 + 0.010	0.800 + 0.010	0.800 + 0.010	500 nA*

* Measurement is computed from 10 MΩ in parallel with input.

Maximum Reading Rate: Same as dcV

DC Current

Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Shunt Resistance
10 mA	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	5.0 Ω
100 mA	0.010 + 0.004	0.030 + 0.005	0.050 + 0.005	5.0 Ω
1 A	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.1 Ω
3 A	0.100 + 0.020	0.120 + 0.020	0.120 + 0.020	0.1 Ω

Burden Voltage: <2 V for 3 A input; <0.1 V for 10 mA input

Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse

Maximum Reading Rate: Same as dcV

AC Current (true rms)

Measurement Accuracy: ±(% of reading + % of range); 1 year, 23°C ± 5°C

Frequency	Ranges	
	1 A	3 A
3 to 5 Hz	1.00 + 0.04	1.10 + 0.06
5 to 10 Hz	0.30 + 0.04	0.35 + 0.06
10 Hz to 5 kHz	0.10 + 0.04	0.15 + 0.06

Burden Voltage: <1.5 V rms for 3 A input

Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse

Maximum Reading Rate: Same as acV

General Specifications

Power: 100/120/220/240V, ±10%

Power Line Frequency: 45 to 66 Hz, 360 to 440 Hz

Power Consumption: 25 VA peak (10 W average)

Operating Environment: 0 to 55°C, full accuracy to 80% RH, 40°C

Storage Environment: -40°C to 75°C

Size: 88.5 mm H x 212.6 mm W x 348.3 mm D (4 in x 8.5 in x 14 in)

Weight: Net, 3.6 kg (8.0 lb); shipping, 5.9 kg (13 lb)

Safety: Designed to UL-1244, IEC-348, CSA

Ordering Information

34401A Multimeter

34401A-1CM Rackmount Kit

34401A-A6J ANSI Z540 Compliant Calibration

34161A Accessory Pouch

34171A Input Terminal Connector (sold in pairs)

34172A Input Calibration Short (sold in pairs)

34131A Hard Transit case

- 1.3 nV rms noise/8 nVp-p
- 100 pV, 100 nΩ sensitivity
- Two-channel programmable voltage input; difference and ratio functions
- 7½ digit resolution

- 1 mV to 100 V ranges
- SCPI and Keithley 181 languages
- Direct SPRT, RTD, Thermistor, and thermocouple temperature measurements
- IntuiLink Connectivity Software included

34420A



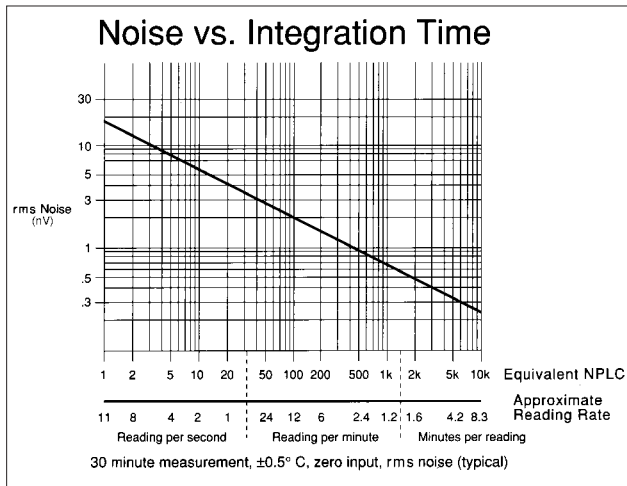
34420A

34420A Nanovolt/Micro-ohm Meter

The Agilent 34420A sets a price/performance standard in low-level measurement capability. The noise performance of the 34420A nanovolt/micro-ohm meter is more than an order of magnitude better than that previously available from Hewlett-Packard.

Accurate, Repeatable Low-Level Measurements

A shielded copper pin screw-down connector, a 7½-digit A/D converter, 2 ppm basic dc accuracy, and a new measurement algorithm that gives 100 dB normal mode rejection without front-end filtering result in measurement capability you can depend on to make accurate and repeatable low-level measurements. Low noise input amplifiers and a highly-tuned input protection scheme bring reading noise down to 8 nVp-p. Longer integration times improve noise performance even further.



Unprecedented Functionality

Two input channels allow voltage measurements to be made independently, or they can be mathematically combined to make difference and ratio measurements. Ohms measurements combine the low-noise input circuits with a highly-stable current source to provide outstanding low-resistance measurements. Offset compensation is employed to eliminate the effects of stray thermal EMFs that would otherwise result in measurement error. Low power ohms and a low-voltage resistance measurement capability allow repeatable measurements to be made where a low voltage (20 mV) is required to avoid oxidation punch-through. A wide range of temperature measurement capabilities are also built in, providing support for SPRT, thermocouple, RTD, and thermistor temperature sensors.

Math Functions Enhance Capabilities

Math functions such as NULL, STATS, and SCALE ease the capture of minimum and maximum readings, provide averages and standard deviation, scale your measurement results, and ultimately makes it easier for you to characterize your input signal. The 34420A can also store up to 1024 readings in internal memory.

Built-in Versatility

You will find that the 34420A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the 34420A from the front panel is straightforward and intuitive. For system applications, the 34420A includes both GPIB and RS-232 interfaces standard, and uses Standard Commands for Programmable Instrumentation (SCPI). This ensures both present and future compatibility. The 34420A also responds to commands for the Keithley 181 nanovoltmeter.

Agilent IntuiLink: Easy Data Access

The Included Agilent IntuiLink software allows your captured data to be put to work easily, using PC applications such as Microsoft Excel or Microsoft Word, to analyze, interpret, display, print, and document the data you get from the 34420A. To find out more about IntuiLink, visit www.agilent.com/find/intuilink

Abbreviated Technical Specifications

Accuracy Specifications: ±(% of reading + % of range)

DC Voltage¹ – 7½ digits Resolution all Ranges

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 mV	0.0025 + 0.0020	0.0040 + 0.0020	0.0050 + 0.0020
10 mV	0.0025 + 0.0002	0.0040 + 0.0002	0.0050 + 0.0003
100 mV	0.0015 + 0.0003	0.0030 + 0.0004	0.0040 + 0.0004
1 V	0.0010 + 0.0003	0.0025 + 0.0004	0.0035 + 0.0004
10 V	0.0002 + 0.0001	0.0020 + 0.0004	0.0030 + 0.0004
100 V	0.0010 + 0.0004	0.0025 + 0.0005	0.0035 + 0.0005

DCV1/DCV2 (ratio): Ratio error in % = channel 1 accuracy in % + channel 2 accuracy in %

DCV1-2 (difference): Difference error = channel 1 (% reading + % range) + channel 2 (% reading + % range)

DC Voltage Noise Specifications²

Range	2-Minute rms Noise	2-Minute p-p Noise	24-Hour p-p Noise
1 mV	1.3 nV RMS	8 nV p-p	12 nV p-p
10 mV	1.5 nV RMS	10 nV p-p	14 nV p-p
100 mV	10 nV RMS	65 nV p-p	80 nV p-p
1 V	100 nV RMS	650 nV p-p	800 nV p-p
10 V	450 nV RMS	3 μV p-p	3.7 μV p-p
100 V	11 μV RMS	75 μV p-p	90 μV p-p

DC Voltage

- Input Resistance:
 - 10 MΩ ± 1% (100 V range)
 - >10 GΩ (1 mV through 10 V range)
- Input Protection:
 - 150 V peak to Channel 1 LO

Resistance³ – 7½ digits Resolution all Ranges

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	100 μA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 kΩ	10 μA	0.0015 + 0.0003	0.0040 + 0.0004	0.0060 + 0.0004
1 MΩ	5 μA	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Low Power Resistance³

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	100 μA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	10 μA	0.0015 + 0.0004	0.0040 + 0.0004	0.0060 + 0.0004
100 kΩ	5 μA	0.0015 + 0.0012	0.0040 + 0.0015	0.0060 + 0.0015
1 MΩ	5 μA	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Voltage Limited Resistance³

Voltage limit selectable: 20 mV, 100 mV, or 500 mV

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
10 Ω	1 mA	0.0020 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
100 Ω	100 μA	0.0025 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002

Temperature – 0.001°C Resolution

Probe Type	Accuracy
SPRT ⁴	SPRT probe accuracy +0.003°C
RTD	RTD probe accuracy +0.05°C
Thermistor	Thermistor probe accuracy +0.1°C
Thermocouple ⁵	Thermocouple probe accuracy +0.2°C

Temperature

SPRT: ITS-90 calibrated temperature within the range of –190°C to +660°C
RTD: Type α = 0.00385 and α = 0.00392. R₀ from 4.9 Ω to 2.1 KΩ. ITS-90 (IEC 751) Callendar – Van Dusen conversion

Thermistor: 5 KΩ

Thermocouple: ITS-90 conversions of type B, E, J, K, N, R, S, T

Chart Out (Analog Out)

Resolution: 16 bits

Maximum Output: ±3 V

Span and Offset: Adjustable

Filter (Analog or Digital or Both)

Analog: Low pass 2 pole @ 13 Hz, available for dcV on 1 mV, 10 mV, 100 mV ranges

Digital: Moving average filter. 10 (fast), 50 (medium) or 100 (slow) reading averages

Math Functions

NULL (Channel 1 dcV, Channel 2 dcV, Difference, Resistance, Temperature)

STATS (Min/max/avg, peak-peak, standard deviation, number of readings)

SCALE (Allows linear scaling as Y=MX + B)

CHART NULL (Establishes zero for rear-panel output)

General Specifications

Front-Panel Connection: Shielded, low-thermal, copper contacts

Interface: GPIB and RS-232 standard

Languages: SCPI-1994 (IEEE-488.2), Keithley 181

Warranty: 3 years standard

Ordering Information

34420A Nanovolt/Micro-Ohm Meter

Includes low-thermal input cable (34102A), low-thermal shorting plug (34103A), operating and service manuals, quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.

34420A-1CM Rackmount Kit

34420A-A6J ANSI Z540 Compliant Calibration

Accessories

34102A Low-Thermal Input Cable (four-conductor with copper spade lugs)

34103A Low-Thermal Shorting Plug

34104A Low-Thermal Input Connector

34161A Accessory Pouch

34131A Hard Transit Case

¹ Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.

² After a 2-hour warm-up ±1°C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.

³ All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.

⁴ For 25 Ω SPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013°C for 24-hour, 0.035°C for 90-day, and 0.055°C for 1-year specifications.

⁵ For fixed reference junction. Add 0.3°C for external reference junction, add 2.0°C for internal reference junction.



3458A

3458A Multimeter

The Agilent 3458A multimeter shatters long-standing performance barriers of speed and accuracy on the production test floor, in research and development, and in the calibration lab. The 3458A is the fastest, most flexible, and most accurate multimeter offered by Agilent Technologies. In your system or on the bench, the 3458A saves you time and money with unprecedented test-system throughput and accuracy, seven-function measurement flexibility, and low cost of ownership.

Select a rate of 100,000 reading per second for maximal test throughput. Or achieve highest levels of precision with up to 8½ digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this the 3458A's simplicity of operation, and you have the ideal multimeter for your most demanding applications.

High-Test System Throughput

Faster Testing

- Up to 100,000 readings/s
- Internal test setups >340/s
- Programmable integration times from 500 ns to 1 s

Greater Test Yield

- More accuracy for tighter test margins
- Up to 8½ digits resolution

Longer Uptime

- Two-source (10 V, 10 k Ω) calibration, including ac
- Self-adjusting, self-verifying auto-calibration for all functions and ranges, including ac

High-Resolution Digitizing

Greater Waveform Resolution and Accuracy

- 16 to 24-bits resolution
- 100,000 to 0.2 sample/s
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory

Calibration Lab Precision

Superb Transfer Measurements

- 8½ digits resolution
- 0.1 ppm dc volts linearity
- 0.1 ppm dc volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary Accuracy

- 0.6 ppm for 24 hours in dc volts
- 2.2 ppm for 24 hours in Ω
- 100 ppm mid-band ac volts
- 8 ppm (4 ppm optional) per year voltage reference stability

3458A Multimeter Performance Features

DC Volts

- 5 ranges: 0.1 V to 1000 V
- 8½ to 4½ digits resolution
- Up to 100,000 readings/s (4½ digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24-hour accuracy
- 8 ppm (4 ppm optional)/year voltage reference stability

Resistance

- 9 ranges: 10 Ω to 1 G Ω
- 2-wire and 4-wire Ω with offset compensation
- Up to 50,000 readings/second (5½ digits)
- Maximum sensitivity: 10 $\mu\Omega$
- 2.2 ppm 24-hour accuracy

AC Volts

- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 50 readings/s with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

DC Current

- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/s (5½ digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24-hour accuracy

AC Current

- 5 ranges: 100 μ A to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/second
- 500 ppm 24-hour accuracy

Frequency and Period

- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 second
- 0.01% accuracy
- AC or dc coupled

Throughput

Maximum Reading Rates

- 100,000 readings/s at 4½ digits (16 bits)
- 50,000 readings/s at 5½ digits
- 6,000 readings/s at 6½ digits
- 60 readings/s at 7½ digits
- 6 readings/s at 8½ digits

Measurement System Speed

- 100,000 readings/s over GPIB or with internal memory
- 110 autoranges/s
- 340 function or range changes/s
- Postprocessed math from internal memory

Abbreviated Technical Specifications

DC Voltage

Range	Full Scale	Maximum Resolution	1-Year* Accuracy	Transfer Accuracy 10 min., tref ±0.5°C	Input Impedance
100 mV	120.00000	10 nV	ppm of reading + 9(5) + 3	0.5 + 0.5	>10 GΩ
1 V	1.2000000	10 nV	8(4) + 0.3	0.3 + 0.1	>10 GΩ
10 V	12.000000	100 nV	8(4) + 0.05	0.05 + 0.05	>10 GΩ
100 V	120.000000	1 μV	10(6) + 0.3	0.5 + 0.1	10 MΩ ± 1%
1000 V	1050.00000	10 μV	10(6) + 0.1	1.5 + 0.05	10 MΩ ± 1%

One-year specifications for NPLC 100 within 24 hours and ±1°C of last ACAL. Tcal ±5°C, MATH NULL, fixed range. Add 2 ppm of reading additional error for Agilent factory traceability of 10 V dc to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration. Transfer specifications for NPLC 100, following 4-hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range using accepted metrology practices.*High stability (Option 002) ppm of reading in parentheses.

Noise Rejection (dB)¹

	AC NMR ²	AC ECMR	DC ECMR
NPLC <1	0	90	140
NPLC ≥1	60	150	140
NPLC ≥10	60	150	140
NPLC ≥100	60	160	140
NPLC =1000	75	170	140

¹Applies for 1 kΩ unbalance in the LO lead and ±0.1% of the line frequency currently set for LFREQ.

²For line frequency ±1%, ACNMR is 40 dB for NPLC ≥1, or 55 dB for NPLC ≥100. For line frequency ±5%, ACNMR is 30 dB for NPLC ≥100.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk

True rms AC Voltage

(Synchronous Subsampled Mode)

Range	Full Scale	Maximum Resolution	Accuracy* 24 hour – 2 year 40 Hz to 1 kHz % of reading + % of range	Input Impedance
10 mV	12.00000	10 nV	0.02 + 0.011	1 MΩ ±15% with <140 pf
100 mV	120.00000	10 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
1 V	1.2000000	100 nV	0.007 + 0.002	1 MΩ ±15% with <140 pf
10 V	12.000000	1 μV	0.007 + 0.002	1 MΩ ±2% with <140 pf
100 V	120.00000	10 μV	0.02 + 0.002	1 MΩ ±2% with <140 pf
1000 V	700.0000	100 μV	0.04 + 0.002	1 MΩ ±2% with <140 pf

*Specifications apply for full scale to 10% of full scale, dc <10% of ac, sine-wave input, crest factor of 1.4. Within 24 hours and ±1°C of last ACAL. Peak (ac+dc) input limited to 5 x full scale for all ranges. Add 2 ppm of reading additional error for Agilent factory traceability of 10 Vdc to US NIST.

Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
HI or LO to earth	±1000 V pk	±1200 V pk
Volt-Hz product	1 x 10 ⁸	—

Resistance

Range	Full Scale	Maximum Resolution	Current Through Unknown	1-Year Accuracy* (4-wire Ω) ppm of rdg+ppm of range
10 Ω	12.00000	10 μΩ	10 mA	15 + 5
100 Ω	120.00000	10 μΩ	1 mA	12 + 5
1 kΩ	1.2000000	100 μΩ	1 mA	10 + 0.5
10 kΩ	12.000000	1 mΩ	100 μA	10 + 0.5
100 kΩ	120.00000	10 mΩ	50 μA	10 + 0.5
1 MΩ	1.2000000	100 mΩ	5 μA	15 + 2
10 MΩ	12.000000	1 Ω	500 nA	50 + 10
100 MΩ	120.00000	10 Ω	500 nA	500 + 10
1 GΩ	1.2000000	100 Ω	500 nA	0.5% + 10

*Specifications for 100 NPLC, offset compensation on, within 24 hours and ±1°C of last ACAL, Tcal ±5°C. Add 3 ppm of reading additional error for Agilent factory traceability of 10 kΩ to US NIST.

Memory

	Standard Readings	Bytes	Option 001 Readings	Bytes
Reading Storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for Subprograms and/or State Storage	—	14 k	—	—

Math Functions

The 3458A performs the following math functions on measurements: NULL, SCALE, OFFSET, RMS FILTER, SINGLE POLE FILTER, THERMISTOR LINEARIZATION, DB, DBM, % ERROR, PASS/FAIL LIMIT TESTING, and STATISTICS. Two math functions may be used at one time.

General Specifications

Operating Temperature: 0°C to 55°C

Warmup Time: Four hours to all specifications except where noted

Humidity Range: 95% RH, 0°C to 40°C

Storage Temperature: -40°C to +75°C

Power: 100/120 V, 220/240 V ± 10%, 48 to 66 Hz, 360 to 420 Hz automatically sensed. Fused at 1.5 A @ 115 V or 0.5 A @ 230 V. <30 W, < 80 VA (peak).

Size: 88.9 mm H x 425.5 mm W x 502.9 mm D (3.5 in x 16.75 in x 19.8 in)

Weight: Net, 12 kg (26.5 lb); shipping, 14.8 kg (32.5 lb)

Ordering Information

3458A Multimeter (with GPIB, 20 KB reading memory, and 8 ppm stability)

3458A-001 Extended Reading Memory (expands total to 148 KB)

3458A-002 High-Stability (4 ppm/year) Reference

3458A-A6J ANSI Z540 Compliant Calibration

3458A-907 Front-handle Kit

3458A-908 Rack Flange Kit

3458A-909 Rack Flange Kit (with handles)

Digital Multimeter Accessory Compatibility Chart and Products

Accessory	34401A	3458A	34420A ¹
34132A Deluxe Test Lead Kit	Yes	No	No
34132B Deluxe Test Lead Kit w/retractable sheath	Yes	Yes	No
11059A Kelvin Probe Set	Yes	Yes	No
11062A Kelvin Clip Set	Yes	Yes	Yes
34133A Precision Electronic Probe	Yes	No	No
11060A Surface-Mount Device Probe	Yes	Yes	No
34171A DMM Terminal Connector	Yes	No	No
34172A DMM Calibration Short	Yes	No	No
11053A Lug-Lug Jumper Set	No	Yes	No
11174A Lug-Banana Jumper Set	Yes	Yes	No
11058A Banana-Banana Jumper Set	Yes	Yes	No
E2307A Type-K Thermocouple Bead Temperature Probe	Yes ²	No ³	No
E2308A Thermistor Temp Probe	Yes ²	Yes	No
40653B Thermistor Surface Sensor Assembly	Yes ²	Yes	No
34134A AC/DC Current Probe	Yes	No	No
34135A AC/DC Current Probe	Yes	No	No
34330A 30 A Current Shunt	Yes	Yes	No
34131A Basic Instrument Transit Case	Yes	No	Yes
34161A Accessory Pouch	Yes	No	Yes

¹ Many accessories are listed as incompatible with 34420A because of the specialized termination. Many of these accessories may be rewired onto the low thermal input connector 34104A.

² Need 34812A BenchLink Meter or an external program to do temperature measurements.

³ Compatible with voltmeter inputs, however an external program would be needed for temperature calculations.

11059A
11060A
11062A
34132A/B
34133A

4



34132A



34133A



11060A



11059A

Test Leads

34132A/B Deluxe Test Lead Kits

The test leads in these kits feature a 1.4 m flexible cable and a soft Sanoprene over mold for a comfortable grip. They are rated at 1000 V CAT III. Each kit contains red and black test leads, needle point and alligator test lead tips, and red and black retractable hook test leads. Supplied in a reusable nylon pouch. The kits are available with the following banana plug configurations:

Model	Description
34132A	Deluxe test lead kit with straight fixed sheath banana plugs
34132B	Deluxe test lead kit with straight retractable sheath banana plugs

34133A Precision Electronic Test Leads

These precision electronic test leads are designed specifically for working with small components and in dense circuit boards. The test leads are small and light. The spring-loaded tip helps absorb those small movements and the crown point digs into solder. The test leads have a 1.2 m flexible cable, terminated in right angle shrouded banana plugs and have a Sanoprene over-mold for a comfortable grip. Each kit includes one black and one red test lead.

11060A Surface Mount Device Tweezers

The gold plated beryllium copper tweezer design provides an easy method to access and accurately measure SMD resistive networks. Length 1.2 m.

Kelvin Probe and Clips

11059A Kelvin Probe Set

This high quality Kelvin probe set is complete and ready to use for making 4-wire Ohm measurements. The 4 color coded banana jacks and Kelvin clips are both gold plated for maximum conductivity and resistance to corrosion. The probe assembly also includes a ground to guard connector to help remove any ground related errors for the ultimate in high accuracy measurement, ideal for use with the 3458A 8½ digit DMM. The wires are encased in a woven shroud for ease of use and to protect the cables.

11062A Kelvin Clip Set

These silver plated Kelvin clips are ideal for constructing your own Kelvin Probe set for 4-wire Ohm measurements. Each set contains 2 clips.

34131A
34134A
34135A
34161A
34171A
34172A
34330A
40653B
E2307A
E2308A



34134A



34135A



34171A



34172A



34161A



34131A



34330A

Low Thermal Cables

These cables are used to minimize error in low voltage measurements. Each kit contains one red and one black cable. Length 1.2 m

- 11053A Low Thermal Lug to Lug Cable
- 11174A Low Thermal Lug to Banana Cable
- 11058A Low Thermal Banana to Banana Cable

Current Measurement

34134A DC Coupled Current Probe

A clamp on probe for a wide range of applications such as measuring ground currents, powers ripple or current distribution in systems. Output signals: 1 V/A (1 mV/mA) and 10 mV/A. Frequency range: DC to 2 kHz.

34135A DC Coupled Current Probe

A clamp on probe idea for measuring high current electrical systems. Measurement range 1 to 600 A (Peak) AC and 1 to 600 A DC. Output signal: 1 mV/A, Frequency range: DC to 10 KHz.

34330A 30 A Current Shunt

This current shunt can be used to extend the current measurement range. Precision 0.001 Ohm resistor. Output is 1 mV per amp of current passing through the shunt. 15 A continuous; 30 A for 15 min continuous.

Temperature Measurement

40653B Thermistor Surface Assembly

10,000 Ohm thermistor with fast response gives real time measurements. Temperature range: -10°C to 100°C. Accuracy: ±1°C. termination: bare wire.

E2307A Type-K Thermocouple Bead Temperature Probe

General-purpose thermocouple temperature probe. Accuracy: -260°C to 110°C, ±2% of reading. Length: 0.9 m. Terminated in dual banana plug.

E2308A Thermistor Temperature Probe

General purpose temperature probe. 5 KOhm @ 25°C, encapsulated in a stainless steel case. Temperature range: -80°C to 150°C. Accuracy: 0°C to 70°C, ±2%. Time constant: 3 seconds typical.

Miscellaneous DMM Accessories

34171A DMM Terminal Connector

Provides a convenient and reliable method to connect wires to all five input terminals on the 34401A. Qty 2.

34172A DMM Calibration Short

Provides a convenient and secure method to apply a short to the input connectors of the 34401A for calibration purposes. Qty 2.

34161A Accessory Pouch

Cordura pouch fits on top of the 34401A and 34420A voltmeters as well as the 54131/32/81A counter and the 33120A and 33250A function/arb generators.

34131A Basic Instrument Transit Case

Heavy-duty hard-cover carrying case is constructed from rugged A.B.S. and has rubber-grip steel handles and steel latches. The case can be padlocked. For use with 34401A and 34420A voltmeters as well as the 53131/32/81A counter and the 33120A function/arb generator.

- 3-slot data acquisition and switching mainframe
- 6½-digit (22 bit) internal DMM

- 11 built-in measurement functions
- 8 switch and control plug-in modules
- BenchLink data logger software included

34970A



34970A (Front Panel)



34970A (Back Panel)

34970A Data Acquisition/Switch Unit

The Agilent 34970A is a high performance, low-cost data acquisition and switching mainframe ideal for data logging, data acquisition, and general-purpose switching and control applications. It consists of a half-rack mainframe with an internal 6½-digit (22 bit) digital multimeter. Three module slots are built into the rear of the unit to accept a combination of switch and control modules. Whether you need a few channels of simple data logging or a hundred channels of ATE performance, the 34970A meets your data acquisition needs at a price that meets your budget.

Measurements You Can Trust

The 34970A incorporates the measurement engine from our best-selling benchtop digital multimeter (DMM). You get the benefit of proven Agilent performance, universal inputs with built-in signal conditioning, and modular flexibility, all in a low-cost, compact data acquisition package. The 34970A features 6½ digits (22 bits) of resolution, 0.004% basic dcV accuracy, and ultra-low reading noise. Combine that with scan rates of up to 250 channels/sec, and you've got the speed and accuracy you need to get the job done.

Powerful Flexibility

The 34970A's unique design allows per-channel configurability for maximum flexibility and quick, easy setup. The internal autoranging DMM measures 11 different functions directly, eliminating the need for expensive external signal conditioning. Temperature conversion routines are built-in to display raw thermocouple, RTD, or thermistor inputs in degrees C, F, or Kelvin. Use Mx+B scaling to convert linear transducer outputs directly into engineering units. You can even set high/low alarm limits to warn you of out-of-tolerance conditions.

Custom Configurations That Grow With You

Three module slots and eight switch and control modules allow you to customize the 34970A to meet your unique requirements. Buy only what you need, and add more modules later as your application grows. Measure up to 120 inputs with a single half-rack unit.

Free BenchLink Software Simplifies Your Data Gathering

If you want PC-based data logging capabilities, but don't want to spend hours programming, BenchLink Data Logger is the answer. Use it to set up your test, acquire and archive measurement data, and perform real-time display and analysis of the incoming measurements.

A familiar spreadsheet environment makes it easy to configure and control your tests. A rich set of colorful graphics provides many options for displaying your data – all with point-and-click ease. Set up multiple graphics using strip charts, histograms, X-Y scatter charts, alarm lights and more. Also use HP BenchLink Data Logger to easily move data to other applications for further analysis, or for inclusion in your presentations and reports.



Free BenchLink Data Logger makes PC-based setup and analysis easy.

Applications

Data Logging

Configured with the 34901A 20-channel relay multiplexer, the 34970A becomes a rugged, low-cost data logger that's ideal for quick tests in the lab or in the field. An intuitive front panel with self-guiding menus and a bright, easy-to-read vacuum fluorescent display make standalone set-up fast and easy. All readings are automatically time stamped and stored in a 50,000 reading memory – enough memory to hold a week's worth of data (20 channels scanned every five minutes). The non-volatile memory holds your data even after power is removed, so you can use the 34970A to collect data at a remote location for later uploading to a PC. The system configuration is also held in non-volatile memory, so in the event of a power failure the unit automatically resumes scanning when power is returned. And for PC-based testing, HP BenchLink Data Logger software is included to simplify your test configurations, data analysis and data management.

Automated Testing

For automated test and benchtop automation applications, the 34970A's three slots and choice of eight plug-in switch and control modules allow easy customization. The 6½-digit internal DMM brings you the power and performance of a world-class standalone DMM, but in a fraction of the space and at a fraction of the cost. Software drivers that support Agilent VEE and National Instruments LabVIEW are available to make an easy integration of the 34970A into your test system. Standard RS-232 and GPIB interfaces and SCPI programming language make integration even easier. A three-year warranty is also standard, as is our proprietary relay maintenance system which automatically counts and stores every individual switch closure to help you predict relay end-of-life and avoid costly production line downtime.

Switching

For test applications that don't require the built-in measurements of the 34970A, the unit can be ordered without the internal DMM. This provides an ultra low-cost solution for routing test signals to and from your device-under-test and assorted instruments, including external DMMs, scopes, counters and power supplies. Plus, you can add the DMM later if your needs change.

Module Overview

Up to three modules, in any combination, can be inserted into a single mainframe. The 34970A's internal DMM connections are accessible only through the 34901A, 34902A, and 34908A multiplexers. The 34970A accuracy specifications already include the switching offset and reference junction errors shown in the table below; these errors are listed separately for determining system error with external measurement devices.

Module Specifications

Module Description	Type	Connects to Internal DMM	Speed (ch./sec.)	Maximum Input Voltage, Current, Power	Offset Voltage	Bandwidth	Comments
34901A 20-ch. Multiplexer	2-wire armature (4-wire selectable)	yes	60	300 V 1 A 50 W	<3 μV	10 MHz	2 current channels (22 ch. total) Built-in cold junction reference
34902A 16-ch. Multiplexer	2-wire reed (4-wire selectable)	yes	250	300 V 50 mA 2 W	<6 μV	10 MHz	Built-in cold junction reference
34903A 20-ch. Actuator/GP Switch	SPDT / form C	no	120	300 V 1 A 50 W	<3 μV	10 MHz	—
34904A 4 x 8 Matrix	2-wire armature	no	120	300 V 1 A 50 W	<3 μV	10 MHz	Full crosspoint
34905A Dual 1: 4 RF Mux, 50 Ω	Common Low (unterminated)	no	60	42 V 0.7 A 20 W	<6 μV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34906A Dual 1: 4 RF Mux, 75 Ω	Common Low (unterminated)	no	60	42 V 0.7 A 20 W	<6 μV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34907A Multifunction Module	Two 8-bit digital I/O ports	no	—	42 V 400 mA —	—	—	Open drain
	26-bit event counter	no	—	42 V — —	—	100 kHz	Gated; selectable input threshold
	Two analog outputs	no	—	±12 V 10 mA —	—	dc	16-bit, earth referenced
34908A 40-ch. single-ended Mux	1-wire armature (common low)	yes	60	300 V 1 A 50 W	<3 μV	10 MHz	No 4-wire measurements



The **34901A** 20-channel multiplexer is the most versatile module for general-purpose scanning. It combines dense, multi-function switching with 60 channel/second scan rates to address a broad spectrum of data acquisition applications.



The **34902A** 16-channel high-speed multiplexer employs reed relays to achieve scan rates of up to 250 channels-per-second. This module is ideal for high-throughput automated test applications, as well as high-speed data logging and monitoring tasks.



Use the **34903A** 20-channel general-purpose switch module to cycle power to products-under-test, control indicator and status lights, actuate external relays requiring large drive signals, and to build custom switch configurations.



The **34904A** is a two-wire, 4 x 8 full cross-point matrix that gives you the most flexible connection path between your device-under-test and your test equipment, allowing different instruments to be connected to multiple points on your DUT at the same time.



The **34905A** and **34906A** RF multiplexers offer broadband switching capabilities for high-frequency and pulsed signals to 2 GHz. Use them to route test signals between your device-under-test and your signal generator, oscilloscope, spectrum analyzer, video amplifier, or receiver.



The **34907A** multifunction module allows great flexibility for a variety of sense and control applications. It combines two 8-bit ports of digital input and output, a 100 kHz gated totalizer, and two ±12 V analog outputs – all on a single module.



Use the **34908A** 40-channel single-ended multiplexer for the greatest density in common-low applications, such as battery test, component characterization, and benchtop testing.

These are abbreviated specifications. For more detailed information on the 34970A, refer to publication number 5965-5290.

Accuracy Specifications ±(% of reading + % of range)¹

Includes measurement error, switching error and transducer conversion error

Function	Range ²	Frequency, etc.	1 Year 23°C ± 5°C
DC Voltage	100.0000 mV		0.0050 + 0.0040
	1.000000 V		0.0040 + 0.0007
	10.00000 V		0.0035 + 0.0005
	100.0000 V		0.0045 + 0.0006
	300.000 V		0.0045 + 0.0030
True RMS AC Voltage ³	100.0000 mV to 100.0000 V	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.35 + 0.04
		10 Hz – 20 kHz	0.06 + 0.04
		20 kHz – 50 kHz	0.12 + 0.05
		50 kHz – 100 kHz	0.60 + 0.08
		100 kHz – 300 kHz ⁴	4.00 + 0.50
	300.0000 V	3 Hz – 5 Hz	1.00 + 0.08
		5 Hz – 10 Hz	0.35 + 0.08
		10 Hz – 20 kHz	0.06 + 0.08
		20 kHz – 50 kHz	0.12 + 0.12
50 kHz – 100 kHz		0.60 + 0.20	
	100 kHz – 300 kHz ⁴	4.00 + 1.25	
Resistance ⁵	100.0000 Ω	1 mA current source	0.010 + 0.004
		1 mA	0.010 + 0.001
		100 μA	0.010 + 0.001
	10.00000 kΩ	10 μA	0.010 + 0.001
		5.0 μA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
		500 nA 10 MΩ	0.800 + 0.010
Frequency and Period ⁶	100 mV to 300 V	3 Hz – 5 Hz	0.10
		5 Hz – 10 Hz	0.05
		10 Hz – 40 Hz	0.03
		40 Hz – 300 kHz	0.01
DC Current (34901A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current ³ (34901A only)	10.00000 mA to 1.00000 A	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.30 + 0.04
		10 Hz – 5 kHz	0.10 + 0.04
	100.0000 mA ⁷	3 Hz – 5 Hz	1.00 + 0.5
		5 Hz – 10 Hz	0.30 + 0.5
	10 Hz – 5 kHz	0.10 + 0.5	

Temperature	Type	Best Range Accuracy ⁸	
Thermocouple	B	1100°C to 1820°C	1.2°C
	E	-150°C to 1000°C	1.0°C
	J	-150°C to 1200°C	1.0°C
	K	-100°C to 1200°C	1.0°C
	N	-100°C to 1300°C	1.0°C
	R	300°C to 1760°C	1.2°C
	S	400°C to 1760°C	1.2°C
	T	-100°C to 400°C	1.0°C
RTD	R _i from 49 Ω to 2.1 kΩ	-200°C to 600°C	0.06°C
Thermistor	2.2 k, 5k and 10k	-80°C to 150°C	0.08°C

Measurement Characteristics⁹

DC Voltage	
Measurement Method	Continuously integrating multi-slope III A – D Converter
A – D Linearity	0.0002% of reading + 0.0001% of range
Input Resistance	
100 mV, 1 V, 10 V ranges	Selectable 10 MΩ or >10,000 MΩ
100 V, 300 V ranges	10 MΩ ± 1%
Input Bias Current	<30 pA at 25°C
Input Protection	300 V all ranges
True RMS AC Voltage	
Measurement Method	AC coupled True RMS – measures the AC component of the input with up to 300 Vdc of bias on any range
Crest Factor	Maximum of 5:1 at full scale
Additional Crest Factor Errors (non-sinewave)	Crest Factor 1 – 2 0.05 % of reading Crest Factor 2 – 3 0.15 % of reading Crest Factor 3 – 4 0.30 % of reading Crest Factor 4 – 5 0.40 % of reading
Input Impedance	1 MΩ ± 2% in parallel with 150 pF
Input Protection	300 Vrms all ranges
Resistance	
Measurement Method	Selectable 4-wire or 2-wire Ohms
Offset Compensation	Current source referenced to LO input
Maximum Lead Resistance	Selectable on 100 Ω, 1 kΩ, 10 kΩ ranges
Input Protection	10% of range per lead for 100 Ω and 1 kΩ ranges 1 kΩ on all other ranges 300 V on all ranges
Frequency and Period	
Measurement Method	Reciprocal counting technique
Voltage Ranges	Same as AC voltage function
Gate Time	1 s, 100 ms, or 10 ms
Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	
Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
Input Protection	1 A 250 V fuse on 34901A module
True RMS AC Current	
Measurement Method	Direct coupled to the fuse and shunt. AC coupled True RMS measurement (measures the ac component only)
Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
Input Protection	1 A 250 V fuse on 34901A module
Thermocouple	
Conversion Conformity	ITS-90 based software routines
Reference Junction Type	Internal, Fixed, or External
Open Thermocouple Check	Selectable per channel. Open >5 kΩ
RTD	
Thermistor	Type α = 0.00385 (DIN) and α = 0.00392 44004, 44007, 44006 series
Measurement Noise	
Rejection 60 (50) Hz ¹⁰	
dc CMRR	140 dB
ac CMRR	70 dB
Integration Time	Normal Mode Rejection¹¹
200 plc/3.33 s (4 s)	110 dB ¹²
100 plc/1.67 s (2 s)	105 dB ¹²
20 plc/334 ms (400 ms)	100 dB ¹²
10 plc/167 ms (200 ms)	95 dB
2 plc/33.3 ms (40 ms)	90 dB
1 plc/16.7 ms (20 ms)	60 dB
<1 plc	0 dB

¹ Specifications are for 1-hour warm-up and 6½ digits, slow ac filter.

² 20% over range on all ranges except 300 Vdc and ac ranges and 1 A dc and ac current ranges.

³ For sinewave input >5% of range. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error.

⁴ Typically 30% of reading error at 1 MHz, limited to 1 x 108 V Hz.

⁵ Specifications are for 4-wire ohms function or 2-wire ohms using scaling to remove the offset. Without scaling, add 1 Ω additional error in 2-wire ohms function.

⁶ Input >100 mV. For 10 mV inputs, multiply % of reading error x 10.

⁷ Specified only for inputs >10 mA.

⁸ 1 year accuracy. For total measurement accuracy, add temperature probe error.

⁹ 300 Vdc, ac rms isolation voltage (ch-ch, ch-Earth).

¹⁰ For 1 KΩ unbalance in LO lead.

¹¹ For power line frequency ±0.1%.

¹² For power line frequency ±1%, use 40 dB or ±3% use 30 dB.

34970A

Operating Characteristics¹

Single Channel Measurement Rates²

Function	Resolution	Reading/s
dcV, 2-wire Resistance	6½ digits (10 plc)	6 (5)
	5½ digits (1 plc)	57 (47)
	4½ digits (0.02 plc)	600
Thermocouple	0.1°C (1 plc) (0.02 plc)	57 (47) 220
RTD, Thermistor	0.01°C (10 plc)	6 (5)
	0.1°C (1 plc)	57 (47)
	1°C (0.02 plc)	220
acV	6½ Slow (3 Hz)	0.14
	6½ Med (20 Hz)	1
	6½ Fast (200 Hz)	8
	6½ ³	100
Frequency, Period	6½ digits (1s gate)	1
	5½ digits (100 ms)	9
	4½ digits (10 ms)	70

System Speeds⁴

	Channel/s
INTO Memory	
Single channel dcV	600
34902A scanning dcV	250
34907A scanning digital in	250
34902A scanning dcV with scaling and 1 alarm fail	220
34907A scanning totalize	170
34902A scanning temperature	160
34902A scanning acV ⁵	100
34902A scanning dcV/Ohms on alternate channels	90
34901A/34908A scanning dcV	60
INTO and OUT of Memory to GPIB or RS-232 (init/fetch)	
34902A scanning dcV	180
34902A scanning dcV with timestamp	150
OUT of Memory to GPIB	
Readings	800
Readings with timestamp	450
Readings with all format options ON	310
OUT of Memory to RS-232	
Readings	600
Readings with timestamp	320
Readings with all format options ON	230
DIRECT to GPIB or RS-232	
Single channel dcV	440
34902A scanning dcV	200
Single channel MEAS DCV10/MEAS DCV 1	25
Single channel MEAS DCV/ MEAS OHMS	12
HP BenchLink Performance	
Scan and save to disk with 2 strip-charts displayed	100

System Characteristics

Scanning Inputs	
Analog	34901A, 34902A, and 34908A multiplexer channels
Digital	34907A digital in and totalize
Scan list	Scans channels in ascending order
Triggering	
Source	Interval, external, button press, software, or on monitor channel alarm
Scan count	1 to 50,000 or continuous
Scan interval	0 to 99 hours; 1 ms step size
Channel delay	0 to 60 seconds per channel; 1 ms step size
External trig delay	<2 ms. With monitor on <200 ms
External trig jitter	<2 ms
Alarms	
Analog inputs	Hi, Lo, or Hi + Lo evaluated each scan
Digital inputs	34907A digital in: maskable pattern match or state change 34907A totalize: Hi limit only
Monitor channel	Alarm evaluated each reading
Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail
Latency	5 ms (typical)

Memory (Battery backed, 4 year typical life ⁶)	
Readings	50,000 with timestamp Readable during scan
States	5 instrument states with user label
Alarm queue	Up to 20 events with channel number, reading, and timestamp

System Features	
Per-channel math	Individual Mx + B scaling and Min/Max/Average calculated real time
Power fail recovery	Resumes scanning automatically
Relay maintenance	Counts each relay closure and stores on module. User resettable.
Real time clock	Battery-backed, 4 year typical life ⁵

BenchLink Data Logger Software (not included with Option 001)

System Requirements⁶	
PC Hardware	486, 66 MHz, 16 MB RAM, 12 MB disk space
Operating Systems	Windows 3.1/95/98/Me/NT/2000/XP
Computer Interfaces⁷	
GPIB	82335B, 82340A/B/C, 82341A/B/C/D National Instruments AT-GPIB/TNT, PCI-GPIB E5810A (Windows 98/Me/NT/2000/XP)
LAN-to-GPIB	82357A (Windows 98/Me/NT/2000/XP)
USB-to-GPIB	82357A (Windows 98/Me/NT/2000/XP)
RS-232 (Serial Port)	PC COM 1-4

General

Power Supply: 100 V/120 V/220 V/240 V ± 10%
Power Line Frequency: 45 Hz to 66 Hz automatically sensed
Power Consumption: 12 W (25 VA peak)
Operating Environment:
 Full accuracy for 0°C to 55°C
 Full accuracy to 80% R.H. at 40°C
Storage Environment: -40°C to 70°C
Weight: Net: 3.6 kg (8.0 lbs)
Safety: Conforms to CSA, UL-1244, IEC 1010 Cat I
RFI and ESD: CISPR 11, IEC 801/2/3/4
Warranty: 3 years

Ordering Information

34970A Data Acquisition/Switch Unit
 Includes internal 6½ digit DMM, operating and service manuals, test report, power cord, and Quick Start package (includes HP Benchlink Data Logger software, RS-232 cable, thermo-couple, and screwdriver). Modules are purchased separately and are required to operate.

- 34970A-001 Delete Internal DMM**
Same as above but deletes DMM and quick start package
Order 34970-80010 to retrofit DMM at a later time
- 34970A-1CM Rackmount Kit**
- 34970A-0B0 Delete Manual Set**

- 34901A 20-Channel Armature Multiplexer**
- 34902A 16-Channel Reed Multiplexer**
- 34903A 20-Channel Actuator/General Purpose Switch**
- 34904A 4 x 8 Two-Wire Matrix Switch**
- 34905A Dual 4-Channel RF Multiplexer, 50 Ohms**
Includes (10) SMB-to-BNC(f) 50 Ω adapter cables
- 34906A Dual 4-Channel RF Multiplexer, 75 Ohms**
Includes (10) SMB-to-BNC(f) 75 Ω adapter cables
- 34907A Multifunction Module**
- 34908A 40-Channel Single-Ended Multiplexer**

Accessories

- 34161A Accessory Pouch**
- 34131A Hard Carrying Case**
- E5810A LAN/GPIB Gateway**
- 82357A USB to GPIB Converter**
- 34970-80010 DMM Field Installation Kit**
Fully calibrated with Test Report and Quick Start Kit

¹ Reading speeds for 60 Hz and (50 Hz) operation.
² For fixed range and function, readings to memory, scaling and alarms off, autozero off.
³ Maximum limit with default settling delays defeated.
⁴ Speeds are for 4½ digits, delay 0, display off, autozero off. Using 115 kB RS-232 setting.
⁵ Storage at temperatures above 40°C will decrease battery life.
⁶ Software provided on CD-ROM and includes utility to create floppy disks for installation.
⁷ Interface and driver must be purchased separately.



The 33120A, 33220A and 33250A function and arbitrary waveforms are accurate and convenient to set up. Also, available software makes it easy to download modeled or captured waveforms.

Find Your Fit in the Agilent Technologies Family

Besides producing sine waves accurate in frequency and amplitude, function generators are versatile signal sources that can produce some or all of the following waveforms: square, triangle, ramp and pulse. Tuning is continuous over wide bands, and many models can modulate these waveforms and sweep them across a range of frequencies. Some function generators use frequency synthesis techniques to generate their outputs. Applications for these general purpose signal sources are diverse. Examples include speed sensor characterization, communications receiver design and test, and earthquake testing.

Some waveform generators can also produce arbitrary waveforms, programmable at the front panel or on a PC and downloaded. This capability allows creating signals that mimic noise, vibration, control pulses, whatever signal is needed for realistic tests. A typical use for arbitrary waveforms is to simulate specific ECG waveforms to verify that an electronic hospital patient monitor responds in the proper manner.

From complex signals to simple waveforms, there is an Agilent generator that is right for the job. See the table and the individual product pages for more detail.

33120A

The 33120A uses the latest direct digital synthesis techniques to bring you a full-featured 15 MHz function generator that also has arbitrary waveform capability built in. The 33120A offers both linear and log sweep, internal AM, FM, FSK, and burst modulation, and a 12-bit, 40 MSa/s, 16,000 point deep arb generator. 33120A-001 phase lock/timebase increases the 33120A frequency stability and allows multiple 33120A's to produce precise phase-offset signals. Fully programmable, the 33120A includes both GPIB and RS-232 interfaces standard. The included Agilent IntuiLink software facilitates creating, modifying, and downloading arbitrary waveform to the 33120A.

33220A

The Agilent 33220A function/arbitrary waveform generator uses direct digital synthesis (DDS) techniques to create stable, low-distortion output signals so you get

accurate results. The 33220A provides easy access to standard sine, square, ramp, triangle, and pulse waveforms plus you can create custom waveforms using the 50 MSa/s, 14 bit, 64 K-point arbitrary waveform function. The variable-edge pulse function, along with PWM gives you unmatched flexibility for your design, verification, and test applications. The 33220A also includes USB, LAN and GPIB interfaces standard and comes with free IntuiLink software to enable simple generation of custom waveforms with your PC – all at an attractive price.

33250A

For a higher-performance solution, the 33250A provides a full-featured 80 MHz Function/Arbitrary waveform generator with 50 MHz pulse capabilities. It not only provides a wide variety of standard waveforms, but also arbitrary waveforms with 12-bit resolution, 64 K-point deep memory, and a sample rate of 200 MSa/s. In addition, it has both linear and logarithmic sweep, burst, as well as internal and external AM, FM, and FSK modulation capabilities all in a half-width package. External clock reference allows multiple 33250A's to be used with precise phase-offset signals, or with an external 10 MHz system clock. With GPIB and RS-232 provided standard, the 33250A is fully programmable, and perfectly suited for stand-alone bench and system applications. The included Agilent IntuiLink software facilitates creating, modifying, and downloading arbitrary waveforms to the 33250A.

Selection Guide for Agilent Function/Arbitrary Waveform Generators

	33120A	33220A	33250A
Frequency Range (sine, square)	15 MHz	20 MHz	80 MHz
Standard Waveforms	Sine, square, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, dc volts	Sine, square, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, dc volts	Sine, square, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, dc volts
Arbitrary Waveforms	8 to 16,000 points	1 to 64 K points	1 to 64 K point
Sample Rate	40 MSa/s	50 MSa/s	200 MSa/s
Modulation	AM (int/ext), FM (int), FSK (int/ext), burst (int/ext)	AM, FM, PM, FSK, PWM, sweep and burst (all internal/external)	AM, FM, FSK, burst, (all internal/external)
Sweep	Linear or logarithmic; up or down	Linear or logarithmic; up or down	Linear or logarithmic; up or down
External Clock Reference	Optional External lock range: 10 MHz ±50 Hz Internal frequency: 10 MHz	Optional External lock range: 10 MHz ±35 kHz Internal frequency: 10 MHz	Standard External lock range: 10 MHz ±35 kHz Internal frequency: 10 MHz
Connectivity (IntuiLink SW included)	GPIB/RS-232	GPIB, USB, LAN	GPIB/RS-232
Warranty	3 years	3 years	3 years

33120A

- 15 MHz sine- and square-wave outputs
- Sine, triangle, square, ramp, noise, and more
- 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveforms
- Direct digital synthesis for excellent stability
- Linear and log sweeps built-in
- AM, FM, FSK, and burst modulation built-in
- GPIB and RS-232 interfaces both standard
- IntuiLink software included



33120A

4

33120A Function/Arbitrary Waveform Generator

The Agilent 33120A is a high-performance, full-function 15 MHz synthesized function generator. It features sine, triangle, square, ramp, and noise waveforms, a 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveform generator, and both internal sweep and modulation capabilities. The 33120A is ideal for both bench and system applications. Both GPIB and RS-232 interfaces are standard, as is a full three-year warranty. All this is available for a surprisingly affordable price.

Unprecedented Functionality

The 33120A will fill all your basic signal source needs by giving you a full complement of standard functions. But this source goes beyond the basics. You get both linear and log sweeps to 15 MHz, plus full-modulation capabilities. AM, FM, FSK, and burst modulation are just a button push away. You can internally modulate with any of the standard waveforms as well as Arb. You can even use an external source for AM, FSK, and burst modulation, if desired. Finally, you get near-infinite custom waveform capability with the inclusion of a 12-bit, 40 MSa/s, 16,000 point deep arbitrary waveform generator.

Superb Performance

The performance of the 33120A was designed in, not left out. This means that you get clean, low-distortion sine waves, fast rise- and fall-time squarewaves, and linear triangle and ramp waveforms. Further, due to the latest direct digital synthesis techniques utilized in the 33120A, you can get down to 10 μ Hz frequency resolution.

Built-In Versatility

You will find that the 33120A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the 33120A from the front panel is straightforward and intuitive. The inclusion of a knob makes adjusting frequency, amplitude, and offset extremely convenient. Or enter these values directly. You can even enter amplitude values directly in V peak-to-peak, V rms, or dBm. For system applications, the 33120A includes both GPIB and RS-232 interfaces standard, and uses commands that are in total compliance with the Standard Commands for Programmable Instrumentation (SCPI).

Quality and Reliability

Not only does the 33120A offer you performance and features unheard of at this price, you also get the advantages of owning Agilent Technologies. A full three-year warranty is standard with the 33120A. The rugged construction and conservative design of the 33120A ensures many years of trouble-free operation. Just as price was designed out of the 33120A, quality and reliability were designed in.

33120A-001 External Clock Reference

33120A-001 adds a high-stability timebase, the ability to lock to an external timebase, and the ability to phase lock two or more 33120As together. This option is especially useful if your application requires higher-frequency stability and accuracy, if you need to lock to an external-frequency standard, or if you need two or more phase-locked outputs.

Link the Agilent 33120A to your PC

The included Agilent IntuiLink software allows you to easily create, edit, and download complex waveforms using the IntuiLink Arbitrary Waveform Editor. Or you can capture a waveform using IntuiLink Oscilloscope or DMM, and send it to the 33120A for output. For programmers, ActiveX components can be used to control the instrument using SCPI commands. IntuiLink provides the tools to easily create, download and manage waveforms for your 33120A. To find out more about IntuiLink, visit www.agilent.com/find/intuilink



33120A-001

Abbreviated Technical Specifications

Waveforms

Standard: Sine, square, triangle, ramp, noise, sin(x)/x, exponential rise, exponential fall, heartbeat, dc volts

Arbitrary

- Waveform Length: 8 to 16,000 points
- Amplitude Resolution: 12 bits (including sign)
- Sample Rate: 40 MSa/s
- Non-Volatile Memory: Four (4) 16,000 point waveforms

Frequency Characteristics

Sine: 100 μ Hz to 15 MHz

Square: 100 μ Hz to 15 MHz

Triangle: 100 μ Hz to 100 kHz

Ramp: 100 μ Hz to 100 kHz

Noise (Gaussian): 10 MHz bandwidth

Resolution: 10 μ Hz or 10 digits

Accuracy: 10 ppm in 90 days, 20 ppm in 1 year, 18°C to 28°C

• Temp. Co-eff.: <2 ppm/°C

• Aging: <10 ppm/yr.

Sine-wave Spectral Purity

Harmonic Distortion:

- DC to 20 kHz: -70 dBc
- 20 kHz to 100 kHz: -60 dBc
- 100 kHz to 1 MHz: -45 dBc
- 1 MHz to 15 MHz: -35 dBc

Spurious (non-harmonic):

- DC to 1 MHz: <-65 dBc
- 1 MHz to 15 MHz: <-65 dBc + 6 dB/octave

Total Harmonic Distortion: <0.04% (dc to 20 kHz)

Phase Noise: <-55 dBc in a 30 kHz band

Signal Characteristics

Squarewave

- Rise/Fall Time: <20 ns
- Overshoot: <4%
- Asymmetry: <1% + 5 ns
- Duty Cycle:
 - 20% to 80% (to 5 MHz)
 - 40% to 60% (to 15 MHz)

Triangle, Ramp, Arb

- Rise/Fall Time: 40 ns (typical)
- Linearity: <0.1% of peak output
- Settling Time: <250 ns to 0.5% of final value
- Jitter: <25 ns

Output Characteristics

Amplitude (into 50 Ω): 50 mV p-p to 10 V p-p

- Accuracy (at 1 kHz): 1% of specified output
- Flatness (sine wave relative to 1 kHz)
 - <100 kHz: $\pm 1\%$ (0.1 dB)
 - 100 kHz to 1 MHz: $\pm 1.5\%$ (0.15 dB)
 - 1 MHz to 15 MHz: $\pm 2\%$ (0.2 dB) Ampl ≥ 3 Vrms
 - $\pm 3.5\%$ (0.3 dB) Ampl <3 Vrms

Output Impedance: 50 Ω (fixed)

Offset (into 50 Ω): ± 5 Vpk ac + dc

- Accuracy: $\pm 2\%$ of setting + 2 mV

Resolution: 3 digits, amplitude and offset

Units: V pp, V rms, dBm

Isolation: 42 Vpk maximum to earth

Protection: Short circuit protected, ± 15 Vpk overdrive <1 minute

Modulation

AM

- Carrier 3dB Freq.: 10 MHz (typical)
- Modulation: Any internal waveform including Arb
- Frequency: 10 mHz to 20 kHz
- Depth: 0% to 120%
- Source: Internal/external

FM

- Modulation: Any internal waveform including Arb
- Frequency: 10 mHz to 10 kHz
- Peak Deviation: 10 mHz to 15 MHz
- Source: Internal only

FSK

- Internal Rate: 10 mHz to 50 kHz
- Frequency Range: 10 mHz to 15 MHz
- Source: Internal or external (1 MHz max)

Burst

- Carrier Freq.: 5 MHz max.
- Count: 1 to 50,000 cycles or infinite
- Start Phase: -360° to +360°
- Internal Rate: 10 mHz to 50 kHz $\pm 1\%$
- Gate Source: Internal or external gate
- Trigger Source: Single, external, or internal rate

Sweep

Type: Linear or logarithmic

Direction: Up or down

Start F/Stop F: 10 mHz to 15 MHz

Speed: 1 ms to 500 s $\pm 0.1\%$

Trigger: Internal, external, single

Rear Panel Inputs

Ext. AM Modulation: ± 5 Vpk = 100% modulation, 5 k Ω input resistance

External Trigger/FSK/Burst Gate: TTL low true

General Specifications

State Storage Memory: Power off state automatically saved.

3 user-configurable stored states.

Interface: IEEE-488 and RS-232 standard

Language: SCPI-1991

Warranty: 3 years standard

33120A-001 External Clock Reference/TCXO Timebase

Stability: ± 1 ppm, 0° to 50°C

Aging: <2 ppm in first 30 days (continuous operation);
0.1 ppm/month (after first 30 days)

Ext. Reference Input Lock Range: 10 MHz \pm 50 Hz

Int. Reference Output Frequency: 10 MHz

Phase Offset: -360° to +360°, 0.001° resolution

For more information, visit our web site: www.agilent.com/find/source

Ordering Information

33120A Function Generator

33120A-001 External Clock Reference

33120A-A6J ANSI Z540 Compliant Calibration

33120A-1CM Rackmount Kit

34131A Hard Transit Case

34161A Accessory Pouch

Function/Arbitrary Waveform Generators

92

Function/Arbitrary Waveform Generators (cont.)

33220A

- 20 MHz Sine and Square waveforms
- Pulse, Ramp, Triangle, Noise, and DC waveforms
- 14-bit, 50 MSa/s, 64 K-point Arbitrary waveforms
- AM, FM, PM, FSK, and PWM modulation types
- Linear & logarithmic sweeps and burst operation
- 10 mVpp to 10 Vpp amplitude range
- Graph mode for visual verification of signal settings
- Connect via USB, GPIB and LAN
- IntuiLink Waveform Editor Software



33220A

4

33220A Function/Arbitrary Waveform Generator

Uncompromising Performance for Functions and Waveforms

The Agilent Technologies 33220A Function/Arbitrary Waveform Generator uses direct digital synthesis (DDS) techniques to create a stable, accurate output signal for clean, low distortion sine waves. It also gives you square waves with fast rise and fall times up to 20 MHz and linear ramp waves up to 200 kHz.

Pulse Generation

The 33220A can generate variable-edge-time pulses up to 5 MHz. With variable period, pulse width, and amplitude the 33220A is ideally suited to a wide variety of applications requiring a flexible pulse signal.

Custom Waveform Generation

Use the 33220A to generate complex custom waveforms. With 14-bit resolution, and a sampling rate of 50 MSa/s, the 33220A gives you the flexibility to create the waveforms you need. It also lets you store up to four waveforms in nonvolatile memory.

The Agilent IntuiLink Arbitrary Waveform software allows you to easily create, edit, and download complex waveforms using the waveform editor. Or you can capture a waveform using IntuiLink for Oscilloscope and send it to the 33220A for output. To find out more about IntuiLink, visit www.agilent.com/find/intuilink

Easy-to-use Functionality

Front-panel operation of the 33220A is straight-forward and user friendly. You can access all major functions with a single key or two. The knob or numeric keypad can be used to adjust frequency, amplitude, offset, and other parameters. You can even enter voltage values directly in Vpp, Vrms, dBm, or as high and low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Internal AM, FM, PM, FSK, and PWM modulation make it easy to modulate waveforms without the need for a separate modulation source. Linear and logarithmic sweeps are also built in, with sweep rates selectable from 1 ms to 500 s. Burst mode operation allows for a user-selected number of cycles per period of time. GPIB, LAN, and USB interfaces are all standard, plus you get full programmability using SCPI commands.

External Frequency Reference (33220A-001)

The 33220A external frequency reference lets you synchronize to an external 10 MHz clock, to another 33220A, or to an Agilent 33250A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

Abbreviated Technical Specifications

Waveforms

Standard: Sine, square, ramp, triangle, pulse, noise, DC

Built-in Arbitrary: Exponential rise, exponential fall, negative ramp, $\sin(x)/x$, cardiac

Waveform Characteristics

Sine

- Frequency Range: 1 μ Hz to 20 MHz
- Amplitude Flatness^{1,2} (relative to 1 kHz)
 - <100 kHz: 0.1 dB
 - 100 kHz to 5 MHz: 0.15 dB
 - 5 MHz to 20 MHz: 0.3 dB
- Harmonic Distortion^{2,3}

	<1 Vpp	≥ 1 Vpp
DC to 20 kHz	–70 dBc	–70 dBc
20 kHz to 100 kHz	–65 dBc	–60 dBc
100 kHz to 1 MHz	–50 dBc	–45 dBc
1 MHz to 20 MHz	–40 dBc	–35 dBc
- Total Harmonic Distortion^{2,3} (DC to 20 kHz): 0.04%
- Spurious (non-harmonic)^{2,4}
 - DC to 1 MHz: –70 dBc
 - 1 MHz to 20 MHz: –70 dBc + 6 dB/octave
- Phase Noise (10 kHz offset): –115 dBc/Hz, typical

Square

- Frequency Range: 1 μ Hz to 20 MHz
- Rise/Fall Time: <13 ns
- Overshoot: <2%
- Variable Duty Cycle:
 - 20% to 80% (to 10 MHz)
 - 40% to 60% (to 20 MHz)
- Asymmetry (@ 50% duty): 1% of period + 5 ns
- Jitter (RMS): 1 ns + 100 ppm of period

Ramp, Triangle

- Frequency Range: 1 μ Hz to 200 kHz
- Linearity: <0.1% of peak output
- Variable Symmetry: 0.0% to 100.0 %

Pulse

- Frequency Range: 500 μ Hz to 5 MHz
- Pulse Width (period ≤ 10 s): 20 ns minimum, 10 ns resolution
- Variable Edge Time: <13 ns to 100 ns
- Overshoot: <2%
- Jitter (RMS): 300 ps + 0.1 ppm of period

Noise

- Bandwidth: 10 MHz typical

Amplitude

- Frequency Range: 1 μ Hz to 6 MHz
- Waveform Length: 2 to 64 K points
- Amplitude Resolution: 14 bits (including sign)
- Sample Rate: 50 MSa/s
- Min. Rise/Fall Time: 35 ns typical
- Linearity: <0.1% of peak output
- Setting Time: <250 ns to 0.5% of final value
- Jitter (RMS): 6 ns + 30 ppm
- Non-volatile Memory: Four waveforms

Output Characteristics

Amplitude

- Range
 - 10 mVpp to 10 Vpp into 50 Ω
 - 20 mVpp to 20 Vpp into open circuit
- Accuracy^{1,2} (at 1 kHz): $\pm 1\%$ of setting ± 1 mVpp
- Units: Vpp, Vrms, dBm
- Resolution: 4 digits

DC Offset

- Range (peak AC + DC)
 - ± 5 V into 50 Ω
 - ± 10 V into open circuit
- Accuracy^{1,2}
 - $\pm 2\%$ of offset setting
 - $\pm 0.5\%$ of amplitude ± 2 mV
- Resolution: 4 digits

Main Output

- Impedance: 50 Ω typical
- Isolation: 42 Vpk maximum to earth
- Protection: Short-circuit protected, overload automatically disables main output

External Clock Reference (33220A-001)

- Rear Panel Input Lock Range: 10 MHz \pm 500 Hz
- Rear Panel Output Frequency: 10 MHz
- Phase Offset: +360° to –360°, 0.001° resolution

Modulation

AM

- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Depth: 0.0% to 120.0%

FM

- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: DC to 10 MHz

PM

- Carrier Waveforms: Sine, square, ramp, Arb
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: 0.0 to 360.0 degrees

PWM

- Carrier waveforms: Pulse
- Source: Internal/external
- Internal Modulation: Sine, square, ramp, triangle, noise, Arb (2 mHz to 20 kHz)
- Deviation: 0% to 100% of pulse width

FSK

- Carrier waveforms: Sine, square, ramp, Arb
- Source: Internal or external
- Internal Modulation: 50% duty cycle square (2 mHz to 100 kHz)

External Modulation Input⁵ (for AM, FM, PM, PWM)

- Voltage Range: ± 5 V full scale
- Input Impedance: 5 k Ω typical
- Bandwidth: DC to 20 kHz

Sweep

Waveforms: Sine, square, ramp, Arb

Type: Linear or logarithmic

Direction: Up or down

Sweep Time: 1 ms to 500 s

Trigger: Single, external or internal

Marker: Falling edge of sync signal (programmable frequency)

Burst⁶

Waveforms: Sine, square, ramp, triangle, pulse, noise, Arb

Type: Counted (1 to 50,000 cycles), Infinite, Gated

Start/Stop Phase: –360° to +360°

Internal Period: 1 μ s to 500 s

Gate Source: External trigger

Trigger Source: Single, external or internal

General Specifications

State Storage Memory: Power off state automatically saved;

4 user-configurable stored states

Interface: USB, GPIB, and LAN standard

Language: SCPI-1993, IEEE-488.2

Dimensions

• Bench Top: 261.1 mm W x 103.8 mm H x 303.2 mm D

• Rackmount: 212.8 mm W x 88.3 mm H x 272.3 mm D

Weight: 3.4 kg (7.5 lbs)

Warranty: 3 years standard

For more information, visit our web site: www.agilent.com/find/33220A

Ordering Information

33220A Function/Arbitrary Waveform Generator

33220A-001 External Clock Reference

33220A-A6J ANSI Z540 Compliant Calibration

34161A Accessory Pouch

34131A Hard Transit Case

¹ Add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18°C to 28°C.

² Autorange enabled.

³ DC offset set to 0 V.

⁴ Spurious noise at low amplitude is limited by –75 dBm typical.

⁵ FSK uses trigger input (1 MHz maximum).

⁶ Sine and square waveforms above 6 MHz are allowed only with an “infinite” burst count.

33250A

- 80 MHz sine and square waveforms
- Sine, square, triangle/ramp, pulse, noise, and more
- 50 MHz pulse with variable edge times
- 200 MSa/s, 12-bit, 64K-point deep arbitrary waveforms
- Sweep (lin/log), burst (gated/counted/triggered) and modulation (AM/FM/FSK)
- GPIB and RS-232 interfaces standard
- IntuiLink software included



33250A

4

33250A Function/Arbitrary Waveform Generator

The Agilent Technologies 33250A uses direct digital-synthesis (DDS) techniques to create a stable, accurate output on all waveforms, down to 1 μ Hz frequency resolution. The benefits are apparent in every signal you produce, from the sine wave frequency accuracy to the fast rise/fall times of square waves to the ramp linearity.

Front-panel operation of the 33250A is straightforward and user friendly. The knob or numeric keypad can be used to adjust frequency, amplitude and offset. You can even enter voltage values directly in Vpp, Vrms, dBm, or high/low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Custom Waveform Generation

Why settle for a basic function generator when you can get arbitrary waveforms at no extra cost? With the 33250A, you can generate arbitrary waveforms with 12-bit vertical resolution, 64 K point memory depth, and a sample rate of 200 MSa/s. You can also store up to four 64 K-deep arbitrary waveforms in non-volatile memory with user-defined names to help you find the right waveform when you need it most. Included IntuiLink software lets you use your Windows-based PC to easily create, edit, and download complex arbitrary waveforms using the IntuiLink Arbitrary waveform editor.

Pulse Generation

The 33250A can generate simple pulses up to 50 MHz. Edge times can be set as low as 5 ns. Voltage levels can be set as amplitude and offset, or as high and low levels. With period and pulse width parameters, the 33250A is ideally suited to a wide variety of pulse applications.

Built-In Versatility

AM, FM, and FSK capabilities make it easy to modulate waveforms with or without a separate source. You can internally modulate with any of the standard waveforms as well as Arb or use an external source. Linear or logarithmic sweeps can be performed with an adjustable frequency marker signal. Programmable burst count (from 1 to 1,000,000 or infinite cycles) and gating allow you to further customize your signal.

For system applications, both GPIB and RS-232 interfaces are standard, and support full programmability using SCPI commands.

Color Graphical Display

The unique design of the 33250A combines a low-profile instrument with the benefits of a color graphical display. Now you can display an image of the output waveform with multiple parameters at the same time. The graphical interface also allows quick and easy modifications to arbitrary waveforms.

Quality and Reliability

The 33250A's TCXO timebase gives you frequency accuracy of 1 ppm for your most demanding applications. The external clock reference input/output lets you synchronize to an external 10 MHz clock.

A full three-year warranty is standard with the Agilent 33250A.

Abbreviated Technical Specifications

Waveforms

Standard: Sine, square, ramp/triangle, noise, sin(x)/x, exponential rise, exponential fall, cardiac, DC volts

Arbitrary

- Waveform Length: 1 to 64 K points
- Amplitude Resolution: 12 bits (including sign)
- Sample Rate: 200 MSa/s
- Non-Volatile Memory: Four (4) 64 K waveforms

Frequency Characteristics

Sine: 1 μ Hz to 80 MHz

Square: 1 μ Hz to 80 MHz

Pulse: 500 μ Hz to 50 MHz

Arb: 1 μ Hz to 25 MHz

Ramp: 1 μ Hz to 1 MHz

Noise (Gaussian): 50 MHz bandwidth

Resolution: 1 μ Hz; except pulse, 5 digits

Accuracy

- Stability: ± 0.3 ppm, 18°C to 28°C
- Aging: ± 1 ppm per 1 year

Sinewave Spectral Purity

Harmonic Distortion:

	≤ 3 Vpp1	> 3 Vpp
DC to 1 MHz	-60 dBc	-55 dBc
1 to 5 MHz	-57 dBc	-45 dBc
5 to 80 MHz	-37 dBc	-30 dBc

Total Harmonic Distortion: $< 0.2\% + 0.1$ mVrms (DC to 20 kHz)

Spurious (non-harmonic):¹

- DC to 1 MHz: -60 dBc
- 1 to 20 MHz: -50 dBc
- 20 to 80 MHz: -50 dBc + 6 dB/octave

Phase noise (30 kHz band):

- 10 MHz: < -65 dBc (typical)
- 80 MHz: < -47 dBc (typical)

Signal Characteristics

Square

- Rise/Fall Time: < 8 ns
- Overshoot: $< 5\%$
- Asymmetry: 1% of period + 1 ns
- Duty Cycle:
 - ≤ 25 MHz: 20.0% to 80.0%
 - 25 to 50 MHz: 40.0% to 60.0%
 - 50 to 80 MHz: 50.0% fixed

Pulse

- Period: 20.00 ns to 2000.0 s
- Pulse Width: 8.0 ns to 1999.9 ns
- Variable Edge Time: 5.00 ns to 1.00 ms
- Overshoot: $< 5\%$

Ramp

- Linearity: $< 0.1\%$ of peak output
- Symmetry: 0.0% to 100.0%

Arb

- Minimum Edge Time: < 10 ns
- Linearity: $< 0.1\%$ of peak output
- Settling Time: < 50 ns to 0.5% of final value

Output Characteristics

Amplitude (into 50 Ω): 10 mVpp to 10 Vpp

- Accuracy (at 1 kHz, > 10 mVpp, Autorange): $\pm 1\%$ of setting ± 1 mVpp
- Flatness (sinewave relative to 1 kHz, Autorange):
 - < 10 MHz $\pm 1\%$ (± 0.1 dB)
 - 10 to 50 MHz $\pm 2\%$ (± 0.2 dB)
 - 50 to 80 MHz $\pm 5\%$ (± 0.4 dB)

- Units: Vpp, Vrms, dBm, high and low level
- Resolution: 0.1 mV or 4 digits

Offset (into 50 Ω): ± 5 Vpk ac + dc

- Accuracy: 1% of setting + 2 mV + 0.5% of amplitude

Waveform Output

- Impedance: 50 Ω typical (fixed); > 10 M Ω (output disabled)
- Isolation: 42 Vpk maximum to earth
- Protection: Short-circuit protected; overload automatically disables main output

¹ Harmonic distortion at low amplitudes is limited by a -70 dBm floor.

² Spurious noise at low amplitudes is limited by a -74 dBm floor.

Modulation

AM

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveforms: Sine, square, ramp, noise, and Arb
- Modulation Frequency: 2 mHz to 20 kHz
- Depth: 0.0% to 120.0%
- Source: Internal/external

FM

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveforms: Sine, square, ramp, noise, and Arb
- Modulation Frequency: 2 mHz to 20 kHz
- Deviation Range: DC to 80 MHz
- Source: Internal/external

FSK

- Carrier Waveforms: Sine, square, ramp, and Arb
- Modulation Waveform: 50% duty cycle square
- Internal Rate: 2 mHz to 1 MHz
- Frequency Range: 1 μ Hz to 80 MHz
- Source: Internal/external

External Modulation Input

- Voltage Range: ± 5 V full scale
- Input Impedance: 10 k Ω
- Frequency: DC to 20 kHz

Burst

Waveforms: Sine, square, ramp, pulse, Arb, and noise

Frequency: 1 μ Hz to 80 MHz (> 25 MHz only with infinite burst count)

Burst Count: 1 to 1,000,000 cycles, or infinite

Start/Stop Phase: -360.0° to $+360.0^\circ$

Internal Period: 1 ms to 500 s

Trigger Source: Single manual trigger, internal, external trigger

Trigger Delay (N-cycle, infinite): 0.0 ns to 85.000 s

Sweep

Waveforms: Sine, square, ramp, and Arb

Type: Linear or logarithmic, up or down

Start F/Stop F: 100 μ Hz to 80 MHz

Sweep Time: 1 ms to 500 s

Trigger: Single manual trigger, internal, external trigger

Marker: Falling edge of sync signal (programmable)

Clock Reference

Phase Offset: -360.000° to $+360.000^\circ$

External Reference Input Lock Range: 10 MHz ± 35 kHz

Internal Reference Output Frequency: 10 MHz

General Specifications

State Storage Memory: Power off state automatically saved;

4 user configurable named stored states

Interface: IEEE-488 and RS-232 standard

Language: SCPI-1997, IEEE-488.2

Power Requirements: 100 – 240 V, 50 – 60 Hz; 100 – 127 V, 50 – 400 Hz

Size:

• Bench Top: 104 mm H x 254 mm W x 374 mm D
(4.16 in x 10.12 in x 14.96 in)

• Rackmount: 89 mm H x 213 mm W x 348 mm D
(3.56 in x 8.52 in x 13.92 in)

Weight: 4.6 kg (10.12 lb)

Warranty: 3 years standard

For more information, visit our web site:

<http://www.agilent.com/find/waveform>

Ordering Information

33250A Function/Arbitrary Waveform Generator

33250A-1CM Rackmount kit*

33250A-A6J ANSI Z540 Compliant Calibration

34131A Carrying case

34161A Accessory pouch

34190A Rackmount kit*

*For racking two 33250As side-by-side, order the following items:

Lock-link kit (p/n 5061-9694)

Flange kit (p/n 5063-9212)

6060B
6063B

- Convenient for lab bench use
- Built-in GPIB programming and measurement
- Continuous and pulse loading operation
- CC, CV, and CR operation
- Multiple input mainframe also available
- Trigger for external synchronization
- Three-year standard warranty



6060B and 6063B

4

Single Input dc Electronic Loads

The 6060B and 6063B dc electronic loads are suitable for applications where only one input is needed. They are particularly convenient for engineering lab bench use. They have built-in measurement features, so a dmm is not necessary to monitor the output voltage, current or power of the power supply under test.

Abbreviated Technical Specifications

Model	6060B	6063B
Amperes	0 to 60 A	0 to 10 A
Volts	3 to 60 V	3 to 240 V
Maximum Power (at 40°C)	300 W	250 W
Constant Current Mode		
Ranges	0 to 6 A, 0 to 60 A	0 to 1 A, 0 to 10 A
Accuracy	0.1% ±75 mA	0.15% ±10 mA
Regulation point	10 mA	8 mA
Constant Voltage Mode		
Accuracy	0.1% ±50 mV	0.12% ±120 mV
Regulation (w/remote sense)	10 mV	10 mV
Constant Resistance Mode		
Ranges	0.033 to 1.0 Ω 1 to 1,000 Ω 10 to 10,000 Ω	0.20 to 24.0 Ω 24 to 10,000 Ω 240 to 50,000 Ω
Readback Measurement		
Current Accuracy	±(0.05% ±65 mA)	±(0.12% ±10 mA)
Voltage Accuracy	±(0.05% +45 mV)	±(0.1% +150 mV)

Ordering Information

6060B Single-input, 300 W dc Electronic Load

6063B Single-input, 250 W dc Electronic Load

6063B-020 Front Panel Inputs

6063B-908 Rackmount Kit (p/n 5063-9212)

6063B-909 Rackmount Kit with Handles (p/n 5063-9219)

Standard Options (these options apply to all 60xx products)

60xx-100 87 to 106 Vac, 47 to 66 Hz (for Japan only)

60xx-120 104 to 127 Vac, 47 to 66 Hz

60xx-220 191 to 233 Vac, 47 to 66 Hz

60xx-240 209 to 250 Vac, 47 to 66 Hz

60xx-0L2 Additional Set of Standard Documentation

60xx-0B3 Service Manual

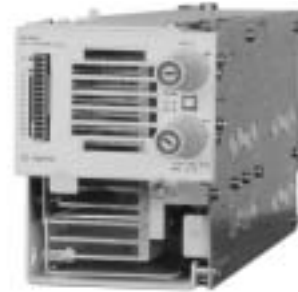
- Accurate programmable control in CC, CV, and CR modes
- Download lists of commands for fast execution
- Continuous and pulse loading
- Synchronize loading and measurement of all inputs
- Analog programming for waveform generation
- dc connection terminal for ATE applications

- Simultaneous measurement of voltage, current, and power
- Synchronize loading and measurements of all inputs
- Waveform digitization
- Parallel units for higher power
- Three-year standard warranty
- Increase test system throughput

N3300A to N3306A



N3300A



N3306A

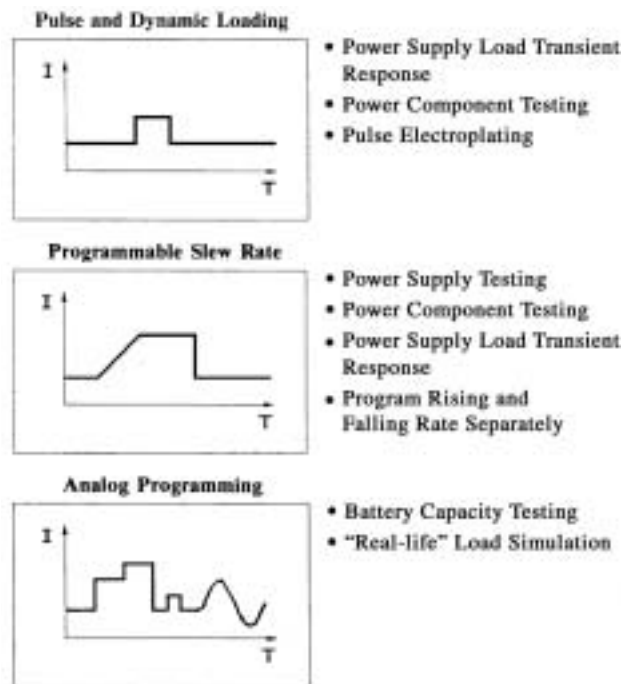
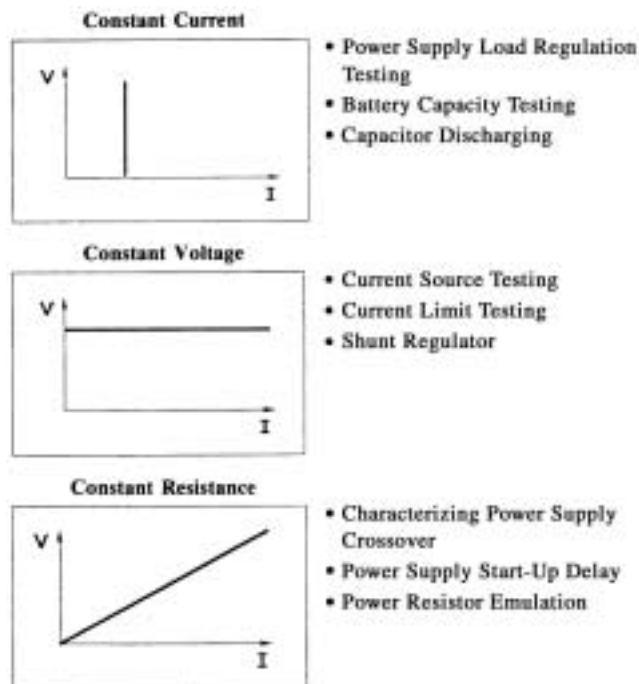
Optimized for High-Volume Manufacturing Test

These loads provide many tools to significantly reduce test time of dc power supplies in high-volume manufacturing environments. They execute all commands quicker than any other Agilent Technologies electronic load, and have many additional features to assist in further increasing system throughput. They also have greater accuracy in programming and measurement functions than any other Agilent electronic loads.

Everything You Need in a One-Box Solution

Agilent electronic loads form an integrated solution, which formerly required more instruments and more complex system configuration.

To monitor the outputs of the power supply under test, a dmm would have had to be switched to each power supply output using a multiplexer. Now, the dmm, the multiplexer, the cabling, and current shunts can all be replaced by the accurate measurement system inside each input of the N3300A Series loads. The built-in digitizer that each load module also has can similarly replace an oscilloscope, and associated multiplexer and cabling, for many measurement tasks. The result is a simpler, more reliable, and easier to service test system.



DC Electronic Load Applications

N3300A
N3301A
N3302A
N3303A
N3304A
N3305A
N3306A
N3307A

Flexible Programmable Features

GPIO, RS-232, and analog programming are all standard features. These electronic loads are compatible with the industry standard SCPI command set. Most features are also controllable from the front panel, to quickly set up engineering tests on the lab bench. Measurement data can be monitored on the LED front panel display, or read to a computer for further processing.

Download Program Sequences

A new feature called Lists allows you to download sequences of load input settings to the electronic load. They are then resident in memory, and will execute at maximum rate during runtime. This feature will provide reductions in test time for repetitively executed routines in manufacturing test. Up to four 50-step lists can be stored in non-volatile memory for each load input.

Powerful Built-in Measurement Features

The input voltage, current, and power of all load inputs can be accurately and simultaneously measured. Up to 4096 samples can be taken and averaged to provide a high level of accuracy and noise immunity. The 4096 long measurement buffer can be used as a digitizer with programmable sample rate. The measurement can be read to the computer as either one averaged number or a 4096 long array. This capability is available for both current and voltage measurements. It is also possible to store multiple measurements in the buffers to be read back to the computer at the completion of a test.

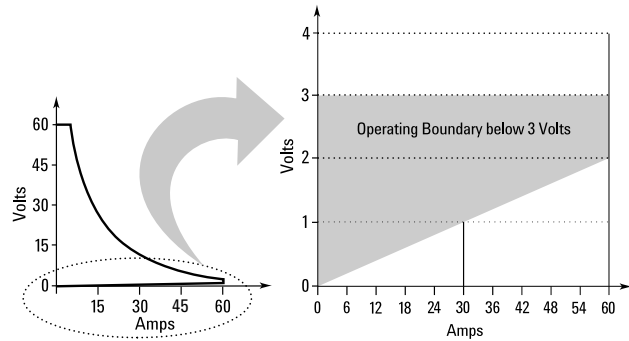
Mainframe Configuration

The N3300A is a full rack width mainframe. It has six slots. The N3301A is a half rack width mainframe and it has two slots. The 150-, 250- and 300-watt load modules each require one slot. The 500- and 600-watt load modules each require two slots.

Operation Below Three Volts

Agilent electronic loads meet all specifications when operated above 3 V; however, the dc operating characteristics also extend below this minimum input voltage for static tests. The figure below shows the operating range of a typical dc electronic load. Low voltage operation is possible at correspondingly reduced current levels, depending on the minimum resistance of the load. Agilent electronic loads can, therefore, be used in many applications that previously required zero-volt loads. However, transient performance may be degraded.

Another alternative for low voltage operation is to place a three-volt dc power supply in series with the device under test. Then the electronic load would always have at least three volts across it. The N3300A Series of electronic loads has a built-in protection circuit that will protect your power supply under test from being reversed biased by the external boost supply. The external boost power supply must be rated to provide up to the full rated current of the power supply under test.



Example of N3304A Input Characteristics

Key Literature

2002/03 Power Products Catalog p/n 5988-7834EN
Data Sheet p/n 5980-0232E
Increasing dc Power Supply Test System Throughput with Agilent Technologies N3300A dc Electronic Loads p/n 5980-0233E
Fuel Cell AC Impedance Measurements p/n 5988-5398EN

Supplemental Characteristics

- Analog Programming Bandwidth:**
10 kHz (-3 db frequency)
- Analog Programming Voltage:**
 - Voltage: 0 – 10 V, Current: 0 – 10 V
 - Analog Monitor Ports:
 - Voltage: 0 – 10 V, Current: 0 – 10 V
- Remote Sensing:** 5 V dc between sense and load input
- Net Weight:**
N3300A: 11.8 kg (26 lb); N3301A: 7.8 kg (17 lb)
N3302A, N3303A or N3304A: 3.2 kg (7 lb);
N3305A or N3306A: 5.4 kg (13 lb)
- Shipping Weight:**
N3300A: 15.9 kg (35 lb); N3301A: 9.8 kg (22 lb)
N3302A, N3303A, or N3304A: 4.5 kg (10 lb) N3305A or N3306A: 7.3 kg (16 lb)

Ordering Information

- N3300A** 1800 W dc Electronic load Mainframe
 - N3300A-908** Rackmount Kit (two p/n 5062-3974 for N3300A or p/n 5062-3960 for one N3301A). For the N3301A, the Kit includes a Blank Filler Panel
 - N3300A-909** Rackmount Kit with Handles for N3300A (two p/n 5062-3975)
 - N3300A-OB0** No manual included
 - N3300A-OL2** Extra Standard Documentation Package
 - N3300A-UJ1** 8 mm Screw Terminal Connector (available on all load modules N3302A – N3307A).
- N3301A** 600 W Half Rack Width dc Electronic Load Mainframe
 - N3301A-800** Rackmount Kit for two Units side-by-side, p/n 5061-9694 and 5062-3978
- N3302A** 150 W dc Electronic Load Module
- N3303A** 250 W dc Electronic Load Module
- N3304A** 300 W dc Electronic Load Module
- N3305A** 500 W dc Electronic Load Module
- N3306A** 600 W dc Electronic Load Module
- N3307A** 250 W dc Electronic Load Module

Specifications

Model	N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Amperes	0 to 30 A	0 to 10 A	0 to 60 A	0 to 60 A	0 to 120 A	0 to 30 A
Volts	0 to 60 V	0 to 240 V	0 to 60 V	0 to 150 V	0 to 60 V	0 to 150 V
Max. Power @ 40°C	150 W	250 W	300 W	500 W	600 W	250 W
Current at Low Voltage						
2.0 V	30 A	10 A	60 A	60 A	120 A	30 A
1.5 V	22.5 A	7.5 A	45 A	45 A	90 A	22.5 A
1.0 V	15 A	5 A	30 A	30 A	60 A	15 A
0.5 V	7.5 A	2.5 A	15 A	15 A	30 A	7.5 A
0 V	0 A	0 A	0 A	0 A	0 A	0 A
Constant Current Mode						
Low Range/High Range	3 A/30 A	1 A/10 A	6 A/60 A	6 A/60 A	12 A/120 A	3 A/30 A
Low Range Accuracy	0.1%+	5 mA	4 mA	7.5 mA	7.5 mA	15 mA
High Range Accuracy	0.1%+	10 mA	7.5 mA	15 mA	15 mA	37.5 mA
Regulation	10 mA	8 mA	10 mA	10 mA	10 mA	10 mA
Constant Voltage Mode						
Low Range/High Range	6 V/60 V	24 V/240 V	6 V/60 V	15 V/150 V	6 V/60 V	15 V/150 V
Low Range Accuracy	0.1%+	3 mV	10 mV	3 mV	10 mV	3 mV
High Range Accuracy	0.1%+	8 mV	40 mV	8 mV	20 mV	8 mV
Regulation	5 mV	10 mV	10 mV	10 mV	20 mV	10 mV
Constant Resistance Mode						
Range 1	0.067 to 4 Ω	0.2 to 48 Ω	0.033 to 2 Ω	0.033 to 5 Ω	0.017 to 1 Ω	0.067 to 10 Ω
Range 2	3.6 to 40 Ω	44 to 480 Ω	1.8 to 20 Ω	4.5 to 50 Ω	0.9 to 10 Ω	9 to 100 Ω
Range 3	36 to 400 Ω	440 to 4800 Ω	18 to 200 Ω	45 to 500 Ω	9 to 100 Ω	90 to 1000 Ω
Range 4	360 to 2000 Ω	4400 to 12000 Ω	180 to 2000 Ω	450 to 5000 Ω	90 to 1000 Ω	900 to 2500 Ω
Transient Generator						
Frequency Range	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz	0.25 Hz to 10 kHz
Pulse Width	50 μs ±1% to 4 seconds ±1%	50 μs ±1% to 4 seconds ±1%	50 μs ±1% to 4 seconds ±1%	50 μs ±1% to 4 seconds ±1%	50 μs ±1% to 4 seconds ±1%	50 μs ±1% to 4 seconds ±1%
Current Measurement						
Low Range	0.05%+	3 mA	2.5 mA	5 mA	5 mA	10 mA
High Range	0.05%+	6 mA	5 mA	10 mA	10 mA	20 mA
Voltage Measurement						
Low Range	0.05%+	3 mV	10 mV	3 mV	8 mV	3 mV
High Range	0.05%+	8 mV	20 mV	8 mV	16 mV	8 mV
Power Measurement						
Accuracy	0.1%+	0.5 W	1.2 W	0.5 W	1.5 W	1.2 W

Supplemental Characteristics

Programming Resolution						
Constant Current Mode	0.05 mA/0.5 mA	0.02 mA/0.2 mA	0.1 mA/1 mA	0.1 mA/1 mA	0.2 mA/2 mA	0.05 mA/0.5 mA
Constant Voltage Mode	0.1 mV/1 mV	0.4 mV/4 mV	0.1 mV/1 mV	0.25 mV/2.5 mV	0.1 mV/1 mV	0.25 mV/2.5 mV
Constant Resistance Mode	0.07/0.7/7/70 mΩ	0.82/8.2/82 mΩ	0.035/0.35/3.5/35 mΩ	0.085/0.85/8.5/85 mΩ	0.0175/0.175/1.75/17.5 mΩ	0.17/1.7/17/170 mΩ
Readback Resolution						
Current	0.05 mA/0.5 mA	0.02 mA/0.2 mA	0.1 mA/1 mA	0.1 mA/1 mA	0.2 mA/2 mA	0.05 mA/0.5 mA
Voltage	0.1 mV/1 mV	0.4 mV/4 mV	0.1 mV/1 mV	0.25 mV/2.5 mV	0.1 mV/1 mV	0.25 mV/2.5 mV
Programmable Slew Rate						
Current	0.5 A/ms to 2.5 A/μs	0.17 A/ms to 0.83 A/μs	1 A/ms to 5 A/μs	1 A/ms to 5 A/μs	2 A/ms to 10 A/μs	0.5 A/ms to 2.5 A/μs
Voltage	1 V/ms to 0.5 V/μs	4 V/ms to 2 V/μs	1 V/ms to 0.5 V/μs	2.5 V/ms to 1.25 V/μs	1 V/ms to 0.5 V/μs	2.5 V/ms to 1.25 V/μs
Ripple and Noise (20 Hz to 10 MHz)						
Current	2 mA rms 20 mA p-p	1 mA rms 10 mA p-p	4 mA rms 40 mA p-p	4 mA rms 40 mA p-p	6 mA rms 60 mA p-p	2 mA rms 20 mA p-p
Voltage	5 mV rms	12 mV rms	6 mV rms	10 mV rms	8 mV rms	10 mV rms

Note: Specifications subject to change.

* Special modifications are available to change input voltage, current, and accuracy specifications. Please ask.

1. Operating temperature range is 0°C to 55°C. All specifications apply for 25°C ±5°C unless otherwise noted.

2. Maximum continuous power available is derated linearly from 40°C to 75% of maximum at 55°C.

3. DC Current Accuracy specifications apply 30 seconds after input is applied.

Power Supplies

100

Selection Index

Overview

GPIB System Power Supplies

Single Output

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Output Operating Boundary	Model Number	Page
5	875	4400	Rectangular	6680A	115
6.7	30	200	Autoranging	6033A	117
7	120	1000	Autoranging	6031A	117
8	5	40	Rectangular	6611C	109
8	10	80	Rectangular	6631B	111
8	20	160	Rectangular	6641A	112
8	50	400	Rectangular	6651A	113
8	220	1760	Rectangular	6671A	114
8	580	4600	Rectangular	6681A	115
±10	0.5	5	Rectangular	N3280A	124
15	3	45	Rectangular	66321B/D	104
15	3	45	Rectangular	66311B/D	104
15/12	3/1.5	45/18	Rectangular	66309B/D	104
15/12	3/1.5	45/18	Rectangular	66319B/D	104
15	440	6600	Rectangular	6690A	116
20	2	40	Rectangular	6612C	109
20	5	100	Rectangular	6632B	111
20	5	100	Rectangular	66332A	108
20	10	200	Autoranging	6033A	117
20	10	200	Autoranging	6038A	117
20	10	200	Rectangular	6642A	112
20/8	1.5/3	30	Dual Range	E3640A	119
20/8	2.5/5	50	Dual Range	E3642A	119
20/8	4/8	80	Dual Range	E3644A	119
20/8	10/20	200/160	Dual Range	E3633A	121
20	25	500	Rectangular	6652A	113
20	50	1000	Autoranging	6031A	117
20	50	1200	Autoranging	6032A	117
20	100	2000	Rectangular	6672A	114
21	240	5000	Rectangular	6682A	115
30	220	6600	Rectangular	6691A	116
30/15	4/7	120/105	Dual Range	E3632A	121
32	160	5100	Rectangular	6683A	115
35	6	210	Rectangular	6643A	112
35	15	525	Rectangular	6653A	113
35	60	2100	Rectangular	6673A	114
40	128	5100	Rectangular	6684A	115
50	1	50	Rectangular	6613C	109
50	2	100	Rectangular	6633B	111
50/25	4/7	200/175	Dual Range	E3634A	121
60/35	0.5/0.8	30	Dual Range	E3641A	119
60	3.3	200	Autoranging	6038A	117
60	3.5	210	Rectangular	6644A	112
60	9	540	Rectangular	6654A	113
60	17	1200	Autoranging	6030A	117
60	17.5	1200	Autoranging	6032A	117
60	35	2100	Rectangular	6674A	114
60	110	6600	Rectangular	6692A	116
65	8	480	Rectangular	E4350B	107
80	30	2100	Rectangular	E4356A	106
100	0.5	50	Rectangular	6614C	109
100	1	100	Rectangular	6634B	111
120	1.5	180	Rectangular	6645A	112
120	4	540	Rectangular	6655A	113
120	18	2160	Rectangular	6675A	114
130	4	480	Rectangular	E4351B	107
200	5	1000	Autoranging	6035A	117
200	5	1200	Autoranging	6030A	117
500	2	1000	Autoranging	6035A	117

Available on Special Order

Single Output 100 to 5000 watts per output

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Output Operating Boundary	Model Number
3.3	1000	3300	Rectangular	6680A-J04
6	60	360	Rectangular	6651A-J03
10	50	500	Rectangular	6651A-J01
10	200	2000	Rectangular	6671A-J04
13	15.3	199	Rectangular	6641A-J04
14	150	2000	Rectangular	6671A-J03
15	120	1800	Rectangular	6671A-J17
17/20	30/15	510	Rectangular	6651A-J09
24	85	2000	Rectangular	6672A-J04
27	18.5	500	Rectangular	6652A-J03
30	3.3	100	Rectangular	66332A-J01
30	17.5	500	Rectangular	6653A-J17
37.5	45	1700	Rectangular	6673A-J03
40	5	200	Rectangular	6643A-J11
40	12.5	500	Rectangular	6653A-J04
40	50	2000	Rectangular	6673A-J08
50	10	500	Rectangular	6654A-J05
50	42	2000	Rectangular	6674A-J07
55	38	2000	Rectangular	6674A-J03
70	3	200	Rectangular	6644A-J09
70	7.5	500	Rectangular	6654A-J04
80	6	500	Rectangular	6654A-J12
100	22	2000	Rectangular	6675A-J08
110	20	2000	Rectangular	6675A-J09
135	16	2000	Rectangular	6675A-J06
150	1.2	150	Rectangular	6645A-J05
150	3.2	500	Rectangular	6655A-J05
150	15	2000	Rectangular	6675A-J11
156	3	500	Rectangular	6655A-J10
160	13	2000	Rectangular	6675A-J04
200	11	2000	Rectangular	6675A-J07
170	1	170	Rectangular	6645A-J06

Key Literature

2002/03 Agilent Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/power>

Multiple Output

Range 1		Range 2			Outputs for Each Model Number									
Max. Volts (dc)	Max. Amps (dc)	Max. Volts (dc)	Max. Amps (dc)	Max. Watts Output	6621A page 110	6622A page 110	6623A page 110	6624A page 110	6625A page 110	6626A page 110	6627A page 110	6628A page 110	6629A page 110	E3631A page 121
6	5	—	—	—	—	—	—	—	—	—	—	—	—	Output 3
7	0.015	50	0.5	25	—	—	—	—	Output 1	Outputs 1–2	—	—	—	—
7	5	20	2	40	—	—	Output 1	Outputs 1–2	—	—	—	—	—	—
7	10	20	4	80	Outputs 1–2	—	Output 3	—	—	—	—	—	—	—
8	20	20	10	200	—	—	—	—	—	—	—	—	—	—
15	7	30	4	120	—	—	—	—	—	—	—	—	—	—
16	0.2	16	2	50	—	—	—	—	Output 2	Outputs 3–4	—	—	Outputs 1–2	Outputs 1–4
16	0.2	50	1	50	—	—	—	—	Output 2	Outputs 3–4	—	—	Outputs 1–2	Outputs 1–4
20	2	50	0.8	40	—	—	Output 2	Outputs 3–4	—	—	—	Outputs 1–4	—	—
20	4	50	2	100	—	Outputs 1–2	—	—	—	—	—	—	—	—
±25	1	—	—	25	—	—	—	—	—	—	—	—	—	Outputs 1–2

Output Operating Boundary Rectangular

Manually-Controlled and Analog-Programmable Power Supplies

Single Output

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Type	Manually Controlled Analog-Prog	Model Number	Page
7	120	840	Autoranging	MC/AP	6011A	117
8	6	48	Rectangular	MC/AP	E3614A	123
8	20	160	Rectangular	MC/AP	6541A	112
8	50	400	Rectangular	MC/AP	6551A	113
8	220	1760	Rectangular	MC/AP	6571A	114
15/8	2/3	30	Dual-range	MC	E3610A	123
20	3	60	Rectangular	MC/AP	E3615A	123
20	10	200	Rectangular	MC/AP	6542A	112
20	25	500	Rectangular	MC/AP	6552A	113
20	50	1000	Autoranging	MC/AP	6011A	117
20	50	1000	Autoranging	MC/AP	6012B	117
20	100	2000	Rectangular	MC/AP	6572A	114
35/20	0.85/1.5	30	Dual-range	MC	E3611A	123
35	1.7	60	Rectangular	MC/AP	E3616A	123
35	6	210	Rectangular	MC/AP	6543A	112
35	15	525	Rectangular	MC/AP	6553A	113
35	60	2100	Rectangular	MC/AP	6573A	114
40	30	1200	Autoranging	MC/AP	6012B	117
60	1	60	Rectangular	MC/AP	E3617A	123
60	3.5	210	Rectangular	MC/AP	6544A	112
60	9	540	Rectangular	MC/AP	6554A	113
60	17	1020	Autoranging	MC/AP	6010A	117
60	17.5	1050	Autoranging	MC/AP	6012B	117
60	35	2100	Rectangular	MC/AP	6574A	114
120/60	0.25/0.5	30	Dual-range	MC	E3612A	123
120	1.5	180	Rectangular	MC/AP	6545A	112
120	4.5	540	Rectangular	MC/AP	6555A	113
120	18	2160	Rectangular	MC/AP	6575A	114
200	5	1000	Autoranging	MC/AP	6010A	117
200	5	1000	Autoranging	MC/AP	6015A	117
500	2	1000	Autoranging	MC/AP	6015A	117

Modules for 66000 Modular Power System

Up to 8 per mainframe

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Model Number	Page
8	16	128	66101A	102
20	7.5	150	66102A	102
35	4.5	150	66103A	102
60	2.5	150	66104A	102
120	1.25	150	66105A	102
200	0.75	150	66106A	102

Available on Special Order

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Model Number
5.7	20	114	66101A-J03
12	12	144	66101A-J05
15	10	150	66102A-J05
24	6	144	66103A-J12
28.5	5.5	157	66103A-J09
35	1.25	44	66105A-J01
37	4.5	167	66103A-J01
40	3.6	144	66103A-J02
55	3	165	66104A-J09

Multiple Output

Max. Volts (dc)	Max. Amps (dc)	Max. Watts per output	Outputs for Each Model Number	
			E3620A MC Page 122	E3630A MC Page 122
6	2.5	15		Output 1
±20	0.5	10		Outputs 2 & 3
25	1	25	Outputs 1 & 2	

*MC = Manually controlled. AP = Analog programmable.

Single Output

Available on Special Order

Max. Volts (dc)	Max. Amps (dc)	Max. Watts	Output Operating Boundary	Manually Controlled Analog-Prog	Model Number
6	60	360	Rectangular	MC/AP	6551A-J03
10	50	500	Rectangular	MC/AP	6551A-J01
10	200	2000	Rectangular	MC/AP	6571A-J04
13	15.3	200	Rectangular	MC/AP	6541A-J04
14	150	2000	Rectangular	MC/AP	6571A-J03
15	120	1800	Rectangular	MC/AP	6571A-J17
30	17.5	525	Rectangular	MC/AP	6553A-J17
30	65	2000	Rectangular	MC/AP	6573A-J09
37.5	45	1500	Rectangular	MC/AP	6573A-J03
40	5	200	Rectangular	MC/AP	6543A-J11
40	12.5	500	Rectangular	MC/AP	6553A-J04
40	50	2000	Rectangular	MC/AP	6573A-J08
50	10	500	Rectangular	MC/AP	6554A-J05
50	42	2000	Rectangular	MC/AP	6574A-J07
55	38	2000	Rectangular	MC/AP	6574A-J03
70	3	210	Rectangular	MC/AP	6544A-J09
70	7.5	500	Rectangular	MC/AP	6554A-J04
80	6	480	Rectangular	MC/AP	6554A-J12
100	22	2000	Rectangular	MC/AP	6575A-J08
110	20	2200	Rectangular	MC/AP	6575A-J09
135	16	2000	Rectangular	MC/AP	6575A-J06
150	1.2	150	Rectangular	MC/AP	6545A-J05
150	3	500	Rectangular	MC/AP	6555A-J10
150	15	2250	Rectangular	MC/AP	6575A-J11
160	13	2080	Rectangular	MC/AP	6575A-J04
200	11	2000	Rectangular	MC/AP	6575A-J07

For more information, visit our web site:
<http://www.agilent.com/find/power>

66000A
66001A
66101A
to 66106A

- High density 1200 W mainframe in 7 inches of rack space
- 8-slot modular power system
- Stable, low ripple and noise power source
- High-accuracy readback of voltage and current
- Advanced programmable voltage and current control
- Sequence up to 20 voltage and current setting per output
- Optional isolation and polarity-reversal relays
- Three-year standard warranty



66000 Modular Power System

66000 Modular Power System is ideal for automated testing environments for supplying bias power and stimulus to sub-assemblies and final products.

Key Features

- GPIB programmable voltage and current
- Series and parallel operation
- Programmable over-voltage and over-current protection
- Self-test initiated at power-up or from GPIB command
- Electronic calibration over GPIB or from keyboard
- Over-temperature protection
- Discrete fault indicator/remote inhibit (DFI/RI)
- Five nonvolatile store-recall states per output
- User-definable power-on state

4

Abbreviated Specification and Characteristics (Specifications at 0°C to 55°C unless otherwise noted)

		66101A	66102A	66103A	66104A	66105A	66106A
Output Ratings (at 40°C)	Output Voltage	0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V	0 to 200 V
	Output Current	0 to 16 A	0 to 7.5 A	0 to 4.5 A	0 to 2.5 A	0 to 1.25 A	0 to 0.75 A
	Output Power	128 W	150 W	157.5 W	150 W	150 W	150 W
Programming Accuracy (at 25°C ±5°C)	Voltage 0.03%+	3 mV	8 mV	13 mV	27 mV	54 mV	90 mV
	Current 0.03%+	6 mA	3 mA	2 mA	1.2 mA	0.6 mA	0.4 mA
Readback Accuracy (via GPIB or keyboard display at 25°C ±5°C)	Voltage 0.02%+	2 mV	5 mV	8 mV	16 mV	32 mV	54 mV
	Current 0.02%+	6 mA	3 mA	2 mA	1 mA	0.6 mA	0.3 mA
Ripple and Noise (20 Hz to 20 MHz)	Constant voltage rms	2 mV	3 mV	5 mV	9 mV	18 mV	30 mV
	Peak to Peak	5 mV	7 mV	10 mV	15 mV	25 mV	50 mV
	Constant Current rms	8 mA	4 mA	2 mA	1 mA	1 mA	1 mA
Line Regulation	Voltage	0.5 mV	0.5 mV	1 mV	2 mV	3 mV	5 mV
	Current	0.75 mA	0.5 mA	0.3 mA	0.1 mA	50 µA	30 µA
Load Regulation	Voltage	1 mV	1 mV	1 mV	2 mV	4 mV	7 mV
	Current	0.5 mA	0.2 mA	0.2 mA	0.1 mA	50 µA	30 µA
Transient Response Time: Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current							
Average Resolution	Voltage	2.4 mV	5.9 mV	10.4 mV	18.0 mV	36.0 mV	60.0 mV
	Current	4.6 mA	2.3 mA	1.4 mA	0.75 mA	0.39 mA	0.23 mA
	Over Voltage Protection (OVP)	50 mV	120 mV	200 mV	375 mV	750 mV	1.25 V
OVP Accuracy		250 mV	500 mV	800 mV	1 V	1.5 V	2.5 V

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped across each load lead. Add 2 mV to the voltage load regulation specification for each 1-V change in the negative output lead caused by a load current change

Command Processing Time: The average time for the output voltage to change after getting a GPIB command is 20 ms

Output Programming Response Time (with full resistive load): The rise time (10/90%) of the output voltage is less than 20 ms. The fall time (90/10%) of the output voltage is less than 20 ms (66101A – 66103A) or 50 ms for (66104A – 66106A). The output voltage change settles within 0.1% of the final value in less than 120 ms

Down Programming: An active down-programmer sinks approximately 10% of the rated output current

Calibration Interval: One year

ac Input of System Mainframe

Voltage	100 Vac	120 Vac	200 Vac	220 Vac	230 Vac	240 Vac
Maximum Current	29 A	25 A	16 A	16 A	15 A	15 A

Input Power of System Mainframe: 3200 VA (max.), 1800 W (max.), 1600 W (typ.)

Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2 No. 1010.1; complies with EN61010-1, carries the CE mark

RFI Suppression: Complies with CISPR-11, Group 1, Class A

Weight:

- **Net:** 66000A, 15 kg (33 lb); 66001A, 1.05 kg (2.3 lb); 66101 – 66106A, 2.7 kg (6 lb)
- **Shipping:** 66000A, 19 kg (41 lb); 66001A, 1.34 kg (2.95 lb); 66101 – 66106A, 4.1 kg (9 lb)

Size: 66000A: 192 mm H x 425.7 mm W x 677.93 mm D

(7.28 in x 16.76 in x 26.69 in), including feet and rear connectors

Warranty Period: Three years

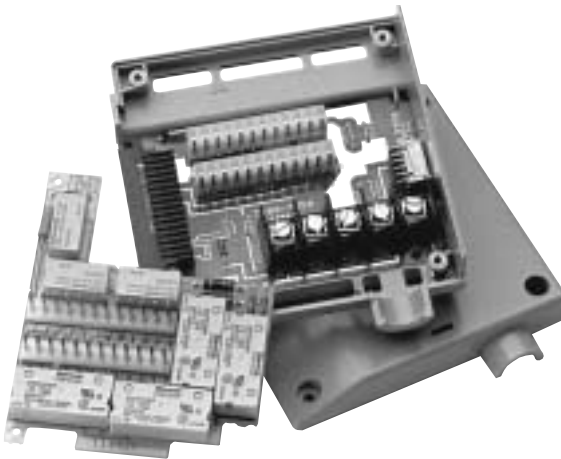
Key Literature

2002/03 Agilent Power Products Catalog, p/n 5988-7834EN
66000 Modular Power System Product Note, p/n 5988-2800EN

For more information, visit our web site:

<http://www.agilent.com/find/modularPS>

Korean URL www.agilent.co.kr/find/products



Isolation and polarity reversal relays are available as an option to the modules. The relay assembly fits into the module connector and can be fully controlled and sensed over the GPIB.

Simple Way to Integrate Multiple Power Sources

The Agilent serial link feature will allow you to control up to 16 outputs at one GPIB address by connecting an auxiliary mainframe. The serial link cable comes standard with the 66000 MPS mainframe. For applications with a broader range of power requirements, one 66000 mainframe can be connected with up to eight of the 6640, 6650, 6670, 6680, 6690 or 6030 series of system power supplies. This solution provides power ranges from 150 watts to 6,600 watts at one primary GPIB address.

System assembly is simplified thanks to a quick-disconnect connector assembly on each module. Once your wires are connected to the load, the connector design permits the modules to be removed from the front of the mainframe without disconnecting cabling or removing the mainframe from the rack. One connector assembly is shipped with each module.

No Compromise Performance with Modular Convenience

66000 MPS offers high performance and reliability and the advantages of modularity. The 66000 MPS offers high stability for applications that need precise output control, accurate readback measurements, and low output noise.

Advanced Programmable Control for Increased Throughput

66000 MPS features a powerful output capability, precise control of voltage and current, programmable protection features, user-definable power-on state, and five non-volatile store-recall states per output. An optional keyboard offers full control of all programmable features. GPIB interface is a standard feature fully compatible with the industry-standard SCPI command set.

Increase test throughput by using the output sequencing feature of the 66000 MPS. This powerful feature allows you to download up to 20 voltage, current, and dwell-time parameter sets per output. This sequence can be paced by the programmed dwell times. As an alternative, triggers can be used to step through the output list. The output sequences can be executed without controller intervention, thereby increasing overall test system throughput.

Ordering Information

66000A MPS Mainframe

66000A-908 Rackmount Kit (p/n 5062-3978)

66000A-909 Rackmount Kit with Handles (p/n 5062-3984)

Note: 66000A-908 and 66000A-909 require cabinet rails (p/n E3663AC) or a slide kit (p/n 1494-0059) to support the loaded mainframe's weight.

66000A-0L2 Extra Standard Documentation Package

66001A MPS Keyboard includes 2m (6 ft) Cables

66002A Rack Kit for 66001A Keyboard

Module Options

66101A dc Power Module 8 V, 16 A

66102A dc Power Module 20 V, 7.5 A

66103A dc Power Module 35 V, 4.5 A

66104A dc Power Module 60 V, 2.5 A

66105A dc Power Module 120 V, 1.25 A

66106A dc Power Module 200 V, 0.75 A

6610xA-760 Open/Close and Polarity Reversal Relays

6610xA-0L2 Extra Standard Documentation Package

Accessories

p/n 5060-3351 Field-Installable Relay Kit

p/n 5060-3386 Standard Connector Assembly

p/n 5060-3387 Standard Connector Assembly with installed relays (Option 760)

p/n 66000-90001 Mainframe Installation Guide

p/n 5959-3386 dc Power Module User's Guide

p/n 5959-3362 dc Power Module Programming Guide

p/n 66000-90003 Mainframe Service Manual

p/n 5959-3364 dc Power Module Service Manual

p/n 1252-1488 4-Pin FLT/Inhibit Connector

Line Cord Options

A line cord option must be specified. For details, refer to page 118.

66000A
66001A
66101A
to 66106A

66309B
66309D
66311B
66311D
66319B
66319D
66321B
66321D

- 5 A peak current
- Single and dual output models
- Fast transient voltage response
- Precision uA measurement
- Dynamic current pulse measurement
- Exceptional sourcing and current sinking
- Automatic detection of open sense connections
- VXI plug&play drivers
- Programmable output resistance (66319B/D, 66321B/D)



66319D

Solutions for Testing Battery-Powered Devices

Agilent's mobile communications dc sources are a family of 45 watt power supplies that functions as a power-source alternative to batteries and charger for testing mobile phones and portable devices. They offer up to 5 A peak current sourcing with improved output stability and superior voltage transient response, Fast Response Power Technology, that prevents device shutdowns due to significant voltage drops in the test wiring.

66319B/D, 66321B/D with Battery Emulation

Four new models, the 66319B, 66319D, 66321B, and 66321D have been added to this family of specialized dc power supplies. These new high performance models offer all the capabilities of the existing Mobile Communications dc Sources, plus they provide the following capabilities:

- Battery emulation (programmable output resistance)
- Very low transient voltage drop (typically <25 mV)
- Excellent output stability for either short or long load leads up to 6 meters
- Four programmable compensation modes to optimize output performance
- Programmable over-voltage soft limits to protect device under test

The new programmable output resistance capability allows you to test your phones under the same power conditions as in actual use; detecting early product failures. These new models can simulate the effects of the internal resistance in a battery, enabling them to accurately emulate the operation of various battery types, as well as batteries nearing end of life. Additionally, they provide the ability to simulate negative resistance that lets you compensate for the voltage drop in the wiring between the test fixture and battery contacts in the cell phone.

A Rack's Worth of Capability in a Single Box

From the dual output 66319D with battery emulation and built-in DVM to the 66311A, this family of solutions offers many capabilities in a single, half-rack box. They eliminate the cost and hassle of integrating and using oscilloscope or high-speed digital voltmeter, shunts, relays and multiplexers to make voltage and current measurements. Now you can catch and characterize those critical pulses using only a power supply.

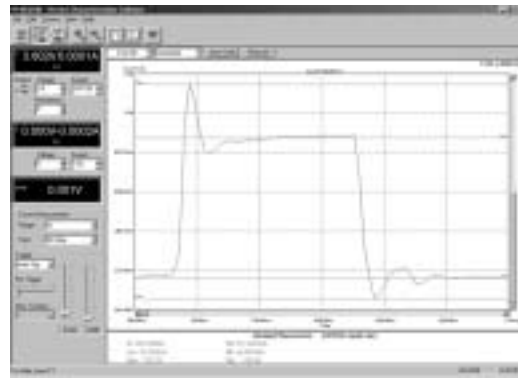
In addition to dynamic measurements, the mobile communications dc source solutions feature output programming response as fast as 400 μ s and command processing times of less than 4 ms; the reduced cycle times will boost your test throughput, too.

Maintaining Value

With a full set of device protection features and three-year warranties, the mobile communications dc source solutions will keep delivering superb results year after year. A new Agilent-developed technology that automatically detects open sense connections helps ensure you deliver quality products to your customers.

Simplify Test & Analysis

With the 14565A Device Characterization Software (Option 053), testing, analyzing, and troubleshooting mobile phone design and subsystem is made simple. The optional 14565A graphical user interface lets you easily control these power supplies. Plus it provides an oscilloscope-like view of the voltage or current waveform of the device under test, provides reference waveform save/recall, and oscilloscope-like waveform measurement and analysis (current or voltage measurements, triggering, markers, zoom control, and more).



Battery Drain Analysis

When coupled with the 66319B/D or 66321B/D, the 14565A software also provides battery current drain data logging and analysis for up to 1,000 hours operation. More than just measuring run time, this allows you to characterize battery drain to make design tradeoffs to optimize battery life.

Ordering Information

- Opt 120 104 to 127 Vac 47 to 63 Hz
- Opt 100 87 to 106 Vac, 47 to 63 Hz
- Opt 220 191 to 233 Vac, 47 to 63 Hz
- Opt 230 207 to 253 Vac, 47 to 63 Hz
- Opt 053 14565A Device Characterization Software
- Opt 521 Solid State relays (66309B/D and 66319 B/D only)
- Opt 1CM Rackmount Kit p/n 5063-9240
- Opt AXS Rackmount Kit for side-by-side mounting, Locking Kit p/n 5061-9494; Flange Kit p/n 5063-9212
- Opt 0L1 Standard Documentation Package
- Opt 8ZL Add Feet

Accessories
p/n 1494-0060 Rock Slide Kit
14565A Device Characterization Software and Documentation

Abbreviated Specifications and Characteristics

Model		66311B 66311D	66309B 66309D	66319B 66319D	66321B 66321D	66319B 66319D	66321B 66321D
Number of Outputs		1	2 Output 1 Output 2	2 Output 1 Output 2	2 Output 1 Output 2	2 Output 1 Output 2	1
Output Ratings	Voltage Current	0 to 15 V 0 to 3 A 5 A ¹	0 to 15 V 0 to 3 A 5 A ¹	0 to 12 V 0 to 1.5 A 2.5 A ²	0 to 15 V 0 to 3 A 5 A	0 to 12 V 0 to 1.5 A 2.5 A ²	0 to 15 V 0 to 3 A 5 A ¹
Programming Accuracy At 25°C ±5°C	Voltage Current	0.05% +10 mV 0.05% +1.33 mA	0.05% +10 mV 0.05% +1.33 mA	0.2% +40 mV 0.2% +4.5 mA	0.05% +10 mV 0.05% +1.33 mA	0.2% +40 mV 0.2% +4.5 mA	0.05% +10 mV 0.05% +1.33 mA
Ripple and Noise (20 Hz to 20 mHz)	Voltage (rms/p-p) Current (rms)	1 mV/ 6 mV ³ 2 mA	1 mV/ 6 mV ³ 2 mA	1 mV/ 6 mV ³ 2 mA	1 mV/ 6 mV ³ 2 mA	1 mV/ 6 mV ³ 2 mA	1 mV/ 6 mV ³ 2 mA
dc Measurement Accuracy (via GPIB or front panel meters with respect to actual output at 25°C ±5°C)	Voltage Current High Current Range +3 A to +5 A +20 mA to +rated I -20 mA to -rated I Medium Current Range -1 A to +1 A Low Current Range -20 mA to +20 mA	0.03% +5 mV see below — 0.2% + 0.5 mA ⁴ 0.2% + 1.1 mA — — 0.1% +2.5 uA	0.03% +5 mV see below — 0.2% + 0.5 mA ⁴ 0.2% + 1.1 mA — — 0.1% +2.5 uA	0.02% +15 mV 0.2% +3 mA — — — — —	0.03% +5 mV see below 0.2% +0.5 mA — — — 0.1% +0.2 mA — 0.1% +2.5 uA	0.2% +15 mV 0.2% +3 mA — — — — — — —	0.03% +5 mV see below 0.2% +0.5 mA — — — 0.1% +0.2 mA — 0.1% +2.5 uA
Transient Response Time		<35 us ⁵	<35 us ⁵	<400 us ⁶	<20 us ⁵	<400 us ⁶	<20 us ⁵
Programmable Output Resistance	Range Resolution Accuracy	— — —	— — —	— — —	-0.04 to 1 Ω 0.001 Ω 0.5% +2 mΩ	— — —	-0.04 to 1 Ω 0.001 Ω 0.5% +2 mΩ
		66311B 66311D	66309B 66309D	66319B 66319D	66321B 66321D	66319B 66319D	66321B 66321D

¹ Peak current for up to a 7 ms time period. Average current cannot exceed 3 A² Peak current for up to a 1 ms time period. Average current cannot exceed 1.5 A³ For phone capacitance higher than 6 uF⁴ Applies with current detector set to dc⁵ Time for the output voltage to recover to within 20 mV of its final value following a 0.1 A to 1.5 A load change in the High Mode compensation range⁶ Time for the output voltage to recover to within 20 mV of its final value following a 0.75 A to 1.5 A load change

Voltmeter Input (66309D, 66311D, 66319D, and 66321D only)

Input Range	Max differential voltage between input terminals ±25 V
dc Readback Accuracy At 25°C ±5°C	0.04% +5 mV
(ac + dc) rms Readback Accuracy @25°C ±5°C with dc plus a sinewave input >25 mV rms	1% +5 mV at 10 KHz sinewave 60 Hz to 10 KHz: 1% +5 mV ¹ 45 – 60 Hz and 10 – 20 KHz: 4% +5 mV ¹
Common Mode Voltage Range (from either DVM input with respect to the negative output terminal of Output #1)	-4.5 V pk to 25 V pk
¹ 1+15 mV for dc plus sinewave input <25 mV rms	

dc Floating Voltage: Output terminals can be floated up to ±50 Vdc maximum from chassis ground**Remote Sensing:** Up to 4 V can be dropped across each load lead, add 2 mV to the voltage load regulation specification for each 1 V change in the positive output lead due to load current change. For the auxiliary output on the 66319B/D, 66321B/D add 3 V to the voltage load regulation for each 1 V change in the negative output lead**Command Processing Time:** Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB (Display disabled)**Output Programming Response Time:** The rise and fall time (10/90% and 90/10%) of the output voltage for 66311B/D, 66321B/D, Output 1-66309B/D, 66319B/D is <200 μs. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in 2 ms**Measurement Time:** Average time to process query, calculate measurement parameter and return data is 50 ms (includes the default time of 30 ms for acquiring data, and a 20 ms data processing overhead)**GPIB Interface Capabilities:** IEEE-488.2, SCPI command set, and 6630A series programming capability (except 66309B/D, 66319B/D, 66321B/D)**Input (full load):** 47 – 63 Hz @ 100 Vac mains: 66311B/D, 66321B/D: 1.7 A, 125 W; 66309B/D, 66319B/D: 2 A, 170 W**Regulatory Compliance:** Complies with EMC directive 89/336/EEC (ISM 1B). List pending to UL 3111-1**Warranty Period:** 3 years**Size:** 66309B/D, 66311B/D, 66319B/D, 66321B/D:

88.1 mm H x 212.8 mm W x 435 mm D (3.5 in x 8.4 in x 17.13 in)

Weight: 66309B/D, 66311B/D, 66319B/D, 66321B/D: 9.07 kg (20 lb) net, 11.1 kg (24.5 lb) shipping

E4356A

- Low ripple and noise
- Fast up- and down- programming
- SCPI (Standard Commands for Programmable Instruments)
- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Over-voltage and over-current protection
- VXI plug&play drivers
- Also suitable for non-telecom applications



E4356A

4

E4356A Telecom dc Power Supply

The E4356A telecom dc power supply is a one-box solution that delivers the reliable capabilities of an integrated system. This power supply provides power at up to 80 Vdc and up to 30 A in two ranges. When programmed to operate between 0 V and 70 V, the E4356A is automatically placed in the low output range, offering its full 30 A maximum current and 2100 W. When programmed between 70 V and 80 V, the E4356A switches into the high output range, where it is able to provide up to 26 A and 2100 W. Thus, the E4356A's automatic ranging means that you get the most power possible, whether you are operating at 70 V or 80 V.

Since noise elimination is critical for telecom applications, the telecom dc power supply offers low noise output, so that power supply noise does not interfere with testing of telecom devices.

The E4356A is ideal for manufacturing and R&D engineers who build equipment for the telecom industry that operates from a 48 V or higher dc rail. This telecom equipment includes: base stations, switches, public and private telephone network equipment, PBX systems, and dc/dc power supplies that provide power to this equipment.

Although targeted at the telecom industry where 80 V is a common requirement, the E4356A can also be used for other applications requiring 80 Vdc. The E4356A has all of the features found on our general purpose system dc power supplies, such as the 6670 Series of 2000 W system dc power supplies. Therefore it is well suited for both R&D and ATE applications where the features and performance of a one-box solution provide a complete test solution at the price of a single instrument.

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
For more information, visit our web site: www.agilent.com/find/power

Ordering Information

E4356A-230 191 to 250 Vac, 47 to 63 Hz
E4356A-200 174 to 220 Vac, 47 to 63 Hz (Japan only)
E4356A-908 Rackmount Kit (p/n 5062-3977)
E4356A-909 Rackmount Kit w/Handles (p/n 5062-3983)

Accessories

p/n 1494-0059 Accessory Slide Kit
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support Rails for Rack Cabinet

Abbreviated Specifications and Characteristics

Model	E4356A	
Number of Outputs	1	
Output Ratings	Voltage	0 to 70 V/0 to 80 V
	Current	0 to 30 A/0 to 26 A
Programming Accuracy	Voltage	0.04% +80 mV
At 25°C ±5°C	Current	0.1% +25 mA
Ripple and Noise	Voltage (rms/p-p)	2 mV/16 mV
(20 Hz to 20 mHz)	Current (rms)	25 mA
dc Measurement Accuracy	Voltage	0.05% +120 mV
(via GPIB or front panel meters)	Current	0.1% +35 mA
with respect to actual output at 25°C ±5°C)		
Transient Response Time	<900 us ¹	

¹ Time for the output voltage to recover 20 mV following a change in load current of up to 50% of the output current rating of the supply

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB

Output Programming Response Time: The rise time (from 10% to 90% of output current) of the output voltage is less than 100 ms. The fall time (90% to 10%) is 200 ms

Modulation: Analog programming of output voltage and current.

- Input signal: 0 to -4 V for voltage, 0 to +6.75 V for current

- Input impedance: 30 k Ohm or greater

Input Power: 3,800 VA 2,600 W at full load, 170 W at no load

GPIB Interface Capabilities: SH1, AH1, TE6, LE6, SR1, RL1, PP0, DC1, DT1, E1 and C0. IEE-448.2 and SCPI-compatible command set

Regulatory Compliance: Listed to UL 1244; certified to CSA556B, conforms to EN61010

Warranty Period: 3 years

Size: 132.6 mm H x 425.5 mm W x 640 mm D (5.22 in. x 16.75 in. x 25.2 in.)

Weight: 27.7 kg (61 lb) net, 31.4 kg (69lb) shipping



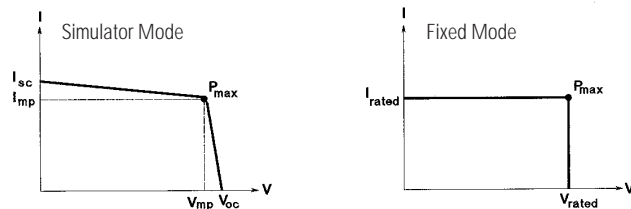
The E4350B/E4351B simulates the output characteristic of a satellite's solar panels as it moves from darkness to light.

Solar Array Simulator

The Agilent one-box Solar Array Simulator (SAS) is a dc power source that simulates the output characteristics of a solar array. The SAS is primarily a current source with very low output capacitance and is capable of simulating the I-V curve of different arrays under different conditions (i.e., temperature, age, etc.). The I-V curve is programmable over the IEEE-488.2 bus and is conveniently generated within the SAS.

The SAS provides three current operating modes:

1. Simulator Mode: An internal algorithm is used to approximate a SAS I-V curve. Four input parameters: Voc (open circuit voltage), Isc (short circuit current), Imp and Vmp (current and voltage at the peak power point on the curve) are needed to establish a curve in this mode.



2. Table Mode: For a fast and accurate I-V simulation, the SAS provides a table mode. The I-V curve is set by a user-defined table of points. A table can have any length up to 4000 points (a point corresponds to a specific value of I and V). As many as 30 tables may be stored in each SAS built-in volatile and non-volatile memory.

Non-volatile memory can store a maximum of 3500 points. The tables (I-V curves) are easily stored and recalled with an IEEE-488.2 command. The table(s) stored in this memory will be retained when the power is turned off.

Volatile memory greatly increases the flexibility by saving up to 30,000 points. Multiple tables are easily accessed with IEEE-488.2 command. These tables will be erased after power is removed.

In Table Mode, current and voltage offsets can be applied to the selected table to simulate a change in the operating conditions of the solar array.

3. Fixed Mode: This is the default mode when the unit is powered on. The unit has the rectangular I-V characteristics of a standard power supply, when an output capacitor is added in this mode.

Specifications

	E4350B	E4351B
For Simulator and Table Modes		
Max. Power	480 W	480 W
Voc, Max.*	65 V	130 V
Isc, Max.*	8 A	4 A
For Fixed Mode		
Max. Power	480 W	480 W
V rated*	0–60 V	0–120 V
I rated*	0–8 A	0–4 A

* Other voltage/current combinations may be configured to meet your unique requirements.

Programming Accuracy: at 25°C +5°C (SAS and Table Mode)

Voltage: (Fixed Mode)

0.075% +10 mV (E4350B)

0.075% +20 mV (E4351B)

Current: (Simulator and Fixed Mode)

0.2% +20 mA (E4350B)

0.2% +10 mA (E4351B)

Ripple and Noise: (20 Hz to 20 MHz) with outputs ungrounded or with either terminal grounded (Simulator and Table Mode)

Voltage: RMS: 16 mV (E4350B)

24 mV (E4351B)

P-P: 125 mV (E4350B)

195 mV (E4351B)

Current: RMS: 4 mA

Load/Line Regulation: Change in output voltage or current for any load or line change within ratings (Fixed Mode)

Voltage: 2 mV

Current: 1 mA

ac Input: 104 to 127 Vac

	100 Vac	120 Vac	220 Vac	240 Vac
Voltage				
Current	12 A	10 A	5.7 A	5.3 A

Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the Agilent SAS by describing nonwarranted performance that has been determined by design or type testing.

Load Switching Recovery Time: <5 μ s when switched from short circuit to variable load to within 1.5 A of an operating point on the I-V curve
Remote Sensing: Up to 2 V+(Voc–Vmp). Add 3 mV to the voltage load regulation specification for each 1 volt change in the positive output lead due to load current change

Analog Programming of Output Current

- Input Signal: 0 to –4 V

- Input Impedance: 20 k Ohms nominal

Shunt Regulation: Switching frequency up to 50 kHz

Series Regulation: Switching frequency up to 50 kHz

OVP and OCP: Overvoltage and overcurrent protection triggers in <100 μ s

Capacitive Load: In fixed mode, the maximum load capacitance (without causing instability) is 2000 μ F. In simulator and table mode, it is unconditionally stable at all capacitive loads

Inductive Load: The maximum load inductance (without causing instability) is 200 μ H

Regulatory Compliance: Listed to UL3101, certified to CSA 22.2 NO.

1010.1, complies with EMC 61010-1

Complies with EMC directive 89/336/EEC

Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.25 in x 16.75 in x 19.6 in)

Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)

Warranty: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/solarsimulator>

Ordering Information

Simulators can be ordered as individual modules or as a fully customized system.

E435xB-OB3 Service Manual

E435xB-OBO Delete Manual

E435xB-100 87 to 106 Vac, 47 to 63 Hz

E435xB-120 104 to 127 Vac, 47 to 63 Hz

E435xB-220 191 to 233 Vac, 47 to 63 Hz

E435xB-240 209 to 250 Vac, 47 to 63 Hz

E435xB-908 Rackmount Kit, p/n 5062-3977

E435xB-909 Rackmount Kit with Handles, p/n 5063-9221

E435xB-0L2 Extra Standard Documentation Package

Accessories

p/n 1252-3698 7-pin Analog Plug

p/n 1252-1488 4-pin Digital Plug

p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

E366AC Support Rails for Agilent Rack Cabinets

66332A

- Ideal for portable product test
- Dynamic pulse measurement
- Precision low current measurement
- Low-output noise
- High-speed programming
- SCPI (Standard Commands for Programmable Instruments)
- GPIB and RS-232 interface
- VXI *plug&play* drivers



66332A

Abbreviated Specifications and Characteristics

Model	66332A		
Output Ratings	Voltage/Current	0 to 20 V/0 to 5 A	
Programming Accuracy at 25°C ±5°C	Voltage/+Current	0.05%+	10 mV/2 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with other terminal grounded)	Voltage normal mode	(rms/p-p)	0.3 mV/3 mV
	Voltage fast mode	(rms/p-p)	1 mV/10 mV
	Current (rms)		2 mA
DC Measurement Accuracy via GPIB or front-panel meters with respect to actual output at 25°C ±5°C	Voltage	0.03%+	3 mV
	Low current range -20 mA to +20 mA	0.1%+	2.5 µA
	High current range +20 mA to +rated I	0.2%+	0.5 mA
	-20 mA to -rated I	0.2%+	1.1 mA
Load Regulation	Voltage/Current	2 mV/1 mA	
Line Regulation	Voltage/Current	0.5 mV/0.5 mA	
Transient Response Time: Less than 100 µs (50 µs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV), following any step change in load current of up to 50% of the output current rating of the supply			
Average Programming Resolution	Voltage/Current	5 mV/1.25 mA	
OVP Accuracy		2.4%+	240 mV
Sink Current		5 A	
Sink Current Tracking	SCPI mode:	0.4% +2mA	
	Compatibility mode:	-250 mA	

4

Dynamic Measurements: Accuracy of the instantaneous voltage measurement is 0.03% +5 mV. Accuracy of the instantaneous current measurement is 0.6% +2 mA. The dc, rms, maximum, minimum, high-level and low-level voltage and current measurements are calculated from the instantaneous voltage and current readings. Up to 4096 data points can be acquired. The sampling interval can be varied from 15.6 µs to 31,200 s. The instantaneous data points can also be read back from the storage buffer. Dynamic measurements on current waveforms with frequency content up to 10 kHz can be made on the low- or high-current range. Above 10 kHz, accurate current measurements can only be made in the high range.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change

Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB (Display disabled)

Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 µs for the fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode)

Measurement Time: Average time to process query, calculate measurement parameter and return data is 50 ms. (Includes the default time of 30 ms for acquiring data, and a 20 ms data processing overhead)

Input Power (full load): 350 VA, 250 W

Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2. No. 1010-1, complies with EN61010-1, complies with EMC directive 89/336/EEC (ISM Group 1, Class B)

Warranty Period: Three years

Size: 88.1 mm H x 425.5 mm W x 364.4 mm D (3.5 in x 16.75 in x 14.3 in)

Weight: 12.7 kg (28 lb) net, 15.0 kg (33 lb) shipping

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/power>

Ordering Information

- 66332A-100 87 to 106 Vac, 47 to 63 Hz
- 66332A-120 104 to 127 Vac, 47 to 63 Hz
- 66332A-220 191 to 233 Vac, 47 to 63 Hz
- 66332A-230 207 to 253 Vac, 47 to 63 Hz
- 66332A-020 Front-panel Binding Posts
- 66332A-760 Isolation and Reversal Relays
- 66332A-8ZJ Delete instrument feet
- 66332A-1CM Rackmount Kit, p/n 5063-9212
- 66332A-1CP Rackmount Kit with Handles, p/n 5063-9219
- 66332A-8ZL Add Feet
- 66332A-020 Front Panel Binding Posts
- 66332A-0L1 Standard Documentation Package
- 66332A-0B3 Service Manual

Accessories

- p/n 1494-0060 Rack Slide Kit
- 14565A Device Characterization Software and Documentation

- Precision low current measurement
- Low-output noise
- High-speed programming
- GPIB and RS-232 interface
- SCPI (Standard Commands for Programmable Instruments)
- VXI plug&play drivers



6611C
6612C
6613C
6614C

Abbreviated Specifications and Characteristics

		6611C	6612C	6613C	6614C
Output Ratings	Voltage/Current	0 to 8 V/0 to 5 A	0 to 20 V/0 to 2 A	0 to 50 V/0 to 1 A	0 to 100 V/0 to 0.5 A
Programming Accuracy at 25°C ±5°C	Voltage/+Current	0.05%+	5 mV/2 mA	10 mV/1 mA	20 mV/0.75 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage (rms/p-p) Current (rms)	0.5 mV/3 mV 2 mA	0.5 mV/3 mV 1 mA	0.5 mV/4 mV 1 mA	0.5 mV/5 mV 1 mA
DC Measurement Accuracy via GPIB or front-panel meters with respect to actual output at 25°C ±5°C	Voltage	0.03%+	2 mV	3 mV	6 mV
	Low current range –20 mA to +20 mA	0.1%+	2.5 μA	2.5 μA	2.5 μA
	High current range +20 mA to +rated I	0.2%+	0.5 mA	0.25 mA	0.2 mA
	–20 mA to –rated I	0.2%+	1.1 mA	0.85 mA	0.8 mA
Load Regulation	Voltage/Current	2 mV/1 mA	2 mV/0.5 mA	4 mV/0.5 mA	5 mV/0.5 mA
Line Regulation	Voltage/Current	0.5 mV/0.5 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 μs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of the output current rating of the supply					
Average Programming Resolution	Voltage/Current	2 mV/1.25 mA	5 mV/0.5 mA	12.5 mV/0.25 mA	25 mV/0.125 mA
Sink Current (does not track the programmed current)		3 A	1.2 A	0.6 A	0.3 A

4

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change

Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB

Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms

Measurement Time: Average time to make a voltage or current measurement is 50 ms

Input Power: (full load) 1.6 A, 100 W (6611C: 2.2 A, 120 W)

Regulatory Compliance: Listed to UL 3111-1; certified to CSA 22.2 No. 1010.1; complies with EN61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)

Warranty Period: Three years

Size: 88.1 mm H x 212.8 mm W x 368.3 mm D (3.5 in x 8.4 in x 14.5 in)

Weight: 8.2 kg (18.16 lb) net; 10.6 kg (23.5 lb) shipping

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/singlePS>

Ordering Information

661xC-100 87 to 106 Vac, 47 to 63 Hz

661xC-120 104 to 127 Vac, 47 to 63 Hz

661xC-220 191 to 233 Vac, 47 to 63 Hz

661xC-230 207 to 253 Vac, 47 to 63 Hz

661xC-760 Isolation and Reversal Relays

661xC-8ZJ Delete instrument feet

661xC-1CM Rackmount Kit, p/n 5063-9240

661xC-0B3 Service Manual, p/n 5962-8200

(Standard unit is shipped with operating guide and programming guide only.)

661xC-OL2 Extra Standard Documentation Package

6621A
6622A
6623A
6624A
6625A
6626A
6627A
6628A
6629A

- Multiple sources in an integrated one-box solution
- 2, 3 or 4 independent isolated outputs
- Precision models available, 14-bit programming and readback
- Stable, low ripple and noise power source
- Faster testing with fast up- and down-programming
- Full protection features
- Three-year standard warranty



Agilent's multiple-output power supplies are an ideal solution for automated testing environments that require multiple voltage sources.

Abbreviated Specifications and Characteristics

		25-watt Output	40-watt Output	40-watt Output	50-watt Output	80-watt Output	80-watt Output
Output Power	Low-range volts, amps	0 to 7 V, 0 to 15 mA	0 to 7 V, 0 to 5 A	0 to 20 V, 0 to 2 A	0 to 16 V, 0 to 200 mA	0 to 7 V, 0 to 10 A	0 to 20 V, 0 to 4 A
	High range volts, amps	0 to 50 V, 0 to 500 mA	0 to 20 V, 0 to 2 A	0 to 50 V, 0 to 0.8 A	0 to 50 V, 0 to 1 A or 0 to 16 V, 0 to 2 A	0 to 20 V, 0 to 4 A	0 to 50 V, 0 to 2 A
Output Combinations for each model (total number of outputs)	6621A (2)	—	—	—	—	2	—
	6622A (2)	—	—	—	—	—	2
	6623A (3)	—	1	1	—	1	—
	6624A (4)	—	2	2	—	—	—
	6625A (2) Precision	1	—	—	1	—	—
	6626A (4) Precision	2	—	—	2	—	—
	6627A (4)	—	—	4	—	—	—
	6628A (2) Precision	—	—	—	2	—	—
6629A (4) Precision	—	—	—	4	—	—	
Programming Accuracy (at 25°C ±5°C)	Voltage	1.5 mV +0.016% (low) 10 mV +0.016% (high)	19 mV +0.06%	50 mV +0.06%	3 mV +0.016% (low) 10 mV +0.016% (high)	19 mV +0.06%	50 mV +0.06%
	Current	15 µA +0.04% (low) 100 µA +0.04% (high)	50 mA +0.16%	20 mA +0.16%	185 µA +0.04% (low) 500 µA +0.04% (high)	100 mA +0.16%	40 mA +0.16%
Ripple and Noise (peak-to-peak, 20 Hz to 20 MHz; rms, 20 Hz to 10 MHz)	Constant voltage rms peak-to-peak	500 µV 3 mV	500 µV 3 mV	500 µV 3 mV	500 µV 3 mV	500 µV 3 mV	500 µV 3 mV
	Constant current rms	0.1 mA	1 mA	1 mA	0.1 mA	1 mA	1 mA
Load Regulation	Voltage	0.5 mV	2 mV	2 mV	0.5 mV	2 mV	2 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Load Cross Regulation	Voltage	0.25 mV	1 mV	2.5 mV	0.25 mV	1 mV	2.5 mV
	Current	0.005 mA	1 mA	0.5 mA	0.01 mA	2 mA	1 mA
Line Regulation	Voltage	0.5 mV	0.01% +1 mV	0.01% +1 mV	0.5 mV	0.01% +1 mV	0.01% +1 mV
	Current	0.005 mA	0.06% +1 mA	0.06% +1 mA	0.01 mA	0.06% +1 mA	0.06% +1 mA
Transient Response Time: Less than 75 µs for the output to recover to within 75 mV of nominal value following a load change within specifications							
Average Programming Resolution	Voltage	460 µV (low)/ 3.2 mV (high)	6 mV	15 mV	1 mV (low)/ 3.2 mV (high)	6 mV	15 mV
	Current	1 µA (low)/ 33 µA (high)	25 mA	10 mA	13 µA (low)/ 131 µA (high)	50 mA	20 mA
	OVP	230 mV	100 mV	250 mV	230 mV	100 mV	250 mV
Output Setting Time		6 ms	2 ms	2 ms	6 ms	2 ms	6 ms

dc Floating Voltage: All outputs can be floated up to ±240 Vdc from chassis ground
Remote Sensing: Up to 1 V (6621–24A, 6627A); up to 10 V (6625A, 6626A, 6628A, 6629A) drop per load lead
Command Processing Time: 7 ms typical
Down Programming: Current sink approximately 110% of the rated output current for operating voltage above 2.5 V (6621A, 6622A, 6623A, 6624A, 6627A)
Input Power: 550 W max., 720 VA max.
Regulatory Compliance: Listed to UL-1244; certified to CSA 222.2#10.1; complies with IEC61010-1; carries the CE mark; Complies with EMC directive 89/336/EEC
Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.22 in x 16.75 in x 19.6 in)
Weight:
 • 6621A–24A, 6626A, 6627A, 6629A
 Net: 17.4 kg (38 lb); Shipping: 22.7 kg (50 lb)
 • 6625A, 6628A
 Net: 15.5 kg (34 lb); Shipping: 20.8 kg (46 lb)

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/multiplePS>

Ordering Information

- 6621A Dual-Output System Power Supply
- 6622A Dual-Output System Power Supply
- 6623A Triple-Output System Power Supply
- 6624A Quad-Output System Power Supply
- 6625A Precision Dual-Output System Power Supply
- 6626A Precision Quad-Output System Power Supply
- 6627A Quad-Output System Power Supply
- 6628A Precision Dual-Output System Power Supply
- 6629A Precision Quad-Output System Power Supply
- 662xA-100 87 to 106 Vac, 47 to 66 Hz Input, 6.3 A (Japan only)
- 662xA-120 104 to 127 Vac, 47 to 66 Hz, 5.4 A
- 662xA-220 191 to 233 Vac, 47 to 66 Hz, 3.0 A
- 662xA-240 209 to 250 Vac, 47 to 66 Hz, 3.0 A
- 662xA-750 Relay Control and DFI/RI
- 662xA-908 Rackmount Kit (p/n 5062-3977)
- 662xA-909 Rackmount Kit w/Handles (p/n 5062-3983)
- 662xA-OB3 Service Manual
- 662xA-OB0 Delete Manual
- 662xA-OL2 Extra Standard Documentation Package

Accessories

- Rack Slide Kit (p/n 1494-0059)
- E3363AC Support Rails for Agilent Cabinets

- Precision low current measurement
- Low-output noise
- High-speed programming
- GPIB and RS-232 interface
- SCPI (Standard Commands for Programmable Instruments)
- VXI *plug&play* drivers



6631B
6632B
6633B
6634B

Abbreviated Specifications and Characteristics

		6631B	6632B	6633B	6634B
Output Ratings	Voltage/Current	0 to 8 V/0 to 10 A	0 to 20 V/0 to 5 A	0 to 50 V/0 to 2 A	0 to 100 V/0 to 1 A
Programming Accuracy at 25°C ±5°C	Voltage/+Current	0.05%+	5 mV/4 mA	10 mV/2 mA	20 mV/1 mA
Ripple and Noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)	Voltage Normal mode (rms/p-p)	0.3 mV/3 mV	0.3 mV/3 mV	0.5 mV/3 mV	0.5 mV/3 mV
	Voltage Fast mode rms/p-p	1 mV/10 mV	1 mV/10 mV	1 mV/15 mV	2 mV/25 mV
	Current (rms)	3 mA	2 mA	2 mA	2 mA
DC Measurement Accuracy: via GPIB or front-panel meters with respect to actual output at 25°C ±5°C	Voltage	0.03%+	2 mV	3 mV	6 mV
	Low current range –20 mA to +20 mA	0.1%+	2.5 µA	2.5 µA	2.5 µA
	High current range +20 mA to +rated I	0.2%+	1 mA	0.5 mA	0.25 mA
	–20 mA to –rated I	0.2%+	1.6 mA	1.1 mA	0.85 mA
Load Regulation	Voltage/Current	2 mV/2 mA	2 mV/1 mA	4 mV/1 mA	5 mV/1 mA
Line Regulation	Voltage/Current	0.5 mV/1 mA	0.5 mV/0.5 mA	1 mV/0.25 mA	1 mV/0.25 mA
Transient Response Time: Less than 100 µs (50 µs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV) following any step change in load current of up to 50% of the output current rating of the supply					
Average Programming Resolution	Voltage/Current	2 mV/2.5 mA	5 mV/1.25 mA	12.5 mV/0.5 mA	25 mV/0.25 mA
Sink Current		10 A	5 A	2 A	1 A
Sink Current Tracking	SCPI mode:	0.4% +4mA	0.4% +2mA	0.4% +1mA	0.4% +0.5mA
	Compatibility mode:	–500mA	–250 mA	–100 mA	–50 mA
Minimum Current in Constant Current Mode*		40 mA	20 mA	8 mA	4 mA

* When programming in the 6630A Series language compatibility mode.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change

Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB (display disabled)

Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 µs in fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode)

GPIB Interface Capabilities: IEEE-488.2, SCPI command set, and 6630A Series programming compatibility

Measurement Time: Average time to make a voltage or current measurement is 50 ms

Input Power (Full load): 3 – 5 A, 250 W

Regulatory Compliance: Listed to UL-3111-1; certified to CSA 22.2 No. 1010.1; complies with EN 61010-1; complies with EMC directive 89/336/EEC (ISM Group 1, Class B)

Warranty Period: Three years

Size: 88.1 mm H x 425.5 mm W x 364.4 mm D (3.5 in x 16.8 in x 14.3 in)

Weight: 12.7 kg (28 lb) net; 15.0 kg (33 lb) shipping

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/singlePS>

Ordering Information

663xB-100 87 to 106 Vac, 47 to 63 Hz

663xB-120 104 to 127 Vac, 47 to 63 Hz

663xB-220 191 to 233 Vac, 47 to 63 Hz

663xB-230 207 to 253 Vac, 47 to 63 Hz

663xB-020 Front-panel Binding Posts

663xB-760 Isolation and Reversal Relays (N/A on 6631B)

663xB-8ZJ Delete instrument feet

663xB-1CM Rackmount Kit, p/n 5062-3974

663xB-1CP Rackmount Kit with Handles, p/n 5062-3975*

663xB-0B3 Service Manual

662xA-0L2 Extra Standard Documentation Package

(Standard unit is shipped with operating guide and programming guide only.)

Accessories

p/n 1494-0060 Rack Slide Kit

E3663AC Support Rails for Agilent Cabinets

* Support rails required.

6641A
6642A
6643A
6644A
6645A
6641A
6642A
6643A
6644A
6645A

- Proven reliability
- Fast up- and down-programming
- SCPI (Standard Commands for Programmable Instruments)
- Complete front-panel control calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Low ripple and noise
- Over-voltage and over-current protection



Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)		6641A	6642A	6643A	6644A	6645A
Manually Controlled Power Supplies (w/o GPIB)		6541A	6542A	6543A	6544A	6545A
Output Ratings	Output voltage	0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
	Output current (40°C)	0 to 20 A	0 to 10 A	0 to 6 A	0 to 3.5 A	0 to 1.5 A
	Maximum current (50°C/55°C)	18 A/17 A	9 A/8.5 A	5.4 A/5.1 A	3.2 A/3 A	1.4 A/1.3 A
Programming Accuracy (at 25°C ±5°C)	Voltage	0.06%+	5 mV	10 mV	15 mV	26 mV
	Current	0.15%+	26 mA	13 mA	6.7 mA	4.1 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage	rms	300 µV	300 µV	400 µV	500 µV
		peak-peak	3 mV	3 mV	4 mV	5 mV
	Current	rms	10 mA	5 mA	3 mA	1.5 mA
Readback Accuracy at 25°C ±5°C (percent of reading plus fixed) System models only	Voltage	0.07%+	6 mV	15 mV	25 mV	40 mV
	+Current	0.15%+	18 mA	9.1 mA	5 mA	3 mA
	-Current	0.35%+	40 mA	20 mA	12 mA	6.8 mA
Load Regulation	Voltage		1 mV	2 mV	3 mV	4 mV
	Current		1 mA	0.5 mA	0.25 mA	0.25 mA
Line Regulation	Voltage		0.5 mV	0.5 mV	1 mV	1 mV
	Current		1 mA	0.5 mA	0.25 mA	0.25 mA
Transient Response Time: Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current						
Average Resolution	Voltage		2 mV	5 mV	10 mV	15 mV
	Current		6 mA	3 mA	2 mA	1.2 mA
	OVP		13 mV	30 mV	54 mV	93 mV
OVP Accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (GPIB)		6641A/	6642A/	6643A/	6644A/	6645A/
Manually Controlled (w/o GPIB)		6541A/	6542A/	6543A/	6544A/	6545A/

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load

Command Processing Time (6641A, 6642A, 6643A, 6644A, 6645A only): Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)

Input Signal: 0 to -5 V

Input Impedance: 10 k Ohm nominal

ac Input: (ac input frequency 47 to 63 Hz)

	100 Vac	120 Vac	220 Vac	230 Vac	240 Vac
Voltage					
Current	4.4 A	3.8 A	2.2 A	2.1 A	2.0 A

Input Power: 480 VA, 400 W at full load; 60 W at no load

Regulatory Compliance: Complies with IEC 61010-1; certified to CSA 22.2 No. 1010.1; carries the CE mark; complies with EMC directive 89/336/EEC

Size: 88.1 mm H x 425.5 mm W x 439 mm D (3.5 in x 16.75 in x 17.3 in)

Weight: Net, 14.2 kg (31.4 lb); shipping, 16.3 kg (36 lb)

Warranty Period: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/singlePS>

Ordering Information

For 664xA & 654xA

Option-100 87 to 106 Vac, 47 to 63 Hz

Option-120 104 to 127 Vac, 47 to 63 Hz

Option-220 191 to 233 Vac, 47 to 63 Hz

Option-240 209 to 250 Vac, 47 to 63 Hz

Option-908 Rackmount Kit (p/n 5063-9212) (support rails required)

Option-909 Rackmount Kit w/Handles (p/n 5063-9219)

(support rails required)

Option-0B3 Service Manual

Option-0L2 Extra Standard Documentation Package

Accessories

p/n 1494-0060 Accessory Slide Kit

The following accessories for 6641A, 6642A, 6643A,

6644A and 6645A only:

p/n 1252-3698 7-pin Analog Plug

p/n 1252-1488 4-pin Digital Plug

p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

E3663AC Support Rails for Agilent Rack Cabinets

- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Low ripple and noise
- Over-voltage and over-current protection
- Proven reliability
- Fast up- and down-programming
- SCPI (Standard Commands for Programmable Instruments)



6651A
6652A
6653A
6654A
6655A
6651A
6652A
6653A
6654A
6655A

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)		6651A	6652A	6653A	6654A	6655A
Manually Controlled Power Supplies (w/o GPIB)		6551A	6552A	6553A	6554A	6555A
Output Ratings	Output voltage	0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
	Output current (40°C)	0 to 50 A	0 to 25 A	0 to 15 A	0 to 9 A	0 to 4 A
	Maximum current (50°C/55°C)	45 A/42.5 A	22.5 A/21.3 A	13.5 A/12.8 A	8.1 A/7.7 A	3.6 A/3.4 A
Programming Accuracy (at 25°C ±5°C)	Voltage	0.06%+	5 mV	10 mV	15 mV	26 mV
	Current	0.15%+	60 mA	25 mA	13 mA	8 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage	rms	300 µV	300 µV	400 µV	500 µV
		peak-peak	3 mV	3 mV	4 mV	5 mV
	Current	rms	25 mA	10 mA	5 mA	3 mA
Readback Accuracy at 25°C ±5°C (percent of reading plus fixed) System models only	Voltage	0.07%+	6 mV	15 mV	25 mV	40 mV
	+Current	0.15%+	67 mA	26 mA	15 mA	7 mA
	-Current	0.35%+	100 mA	44 mA	24 mA	15 mA
Load Regulation	Voltage	1 mV	2 mV	3 mV	4 mV	5 mV
	Current	2 mA	1 mA	0.5 mA	0.5 mA	0.5 mA
Line Regulation	Voltage	0.5 mV	0.5 mV	1 mV	1 mV	2 mV
	Current	2 mA	1 mA	0.75 mA	0.5 mA	0.5 mA
Transient Response Time: Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply, or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current						
Average Resolution	Voltage	2 mV	5 mV	10 mV	15 mV	30 mV
	Current	15 mA	7 mA	4 mA	2.5 mA	1.25 mA
	OVP	12 mV	30 mV	54 mV	93 mV	190 mV
OVP Accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V
System Power Supplies (GPIB)		6651A/	6652A/	6653A/	6654A/	6655A/
General Purpose (w/o GPIB)		6551A/	6552A/	6553A/	6554A/	6555A/

4

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load

Command Processing Time (6651A, 6652A, 6653A, 6654A, 6655A only): Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)

Input signal: 0 to -5 V

Input impedance: 10 k Ohm nominal

ac Input: (ac input frequency 47 to 63 Hz)

	100 Vac	120 Vac	220 Vac	240 Vac
Voltage				
Current	12 A	10 A	5.7 A	5.3 A

Input Power: 1,380 VA, 1,100 W at full load; 120 W at no load

Regulatory Compliance: Listed to UL-1244; certified to CSA 22.2

No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC

Size: 132.6 mm H x 425.5 mm W x 497.8 mm D (5.22 in x 16.75 in x 19.6 in)

Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)

Warranty Period: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/singlePS>

Ordering Information

For 665xA & 655xA

Option-100 87 to 106 Vac, 47 to 63 Hz

Option-120 104 to 127 Vac, 47 to 63 Hz

Option-220 191 to 233 Vac, 47 to 63 Hz

Option-240 209 to 250 Vac, 47 to 63 Hz

Option-908 Rackmount Kit (p/n 5062-3977) (support rails required)

Option-909 Rackmount Kit w/ Handles (p/n 5063-9221)

(support rails required)

Option-0B3 Service Manual

Option-0L2 Extra Standard Documentation Package

Accessories

Rack Slide Kit (p/n 1494-0059)

The following accessories for 6651A, 6652A, 6653A,

6654A and 6655A only:

p/n 1252-3698 7-pin Analog Plug

p/n 1252-1488 4-pin Digital Plug

p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

E663AC Support Rails for Agilent Rack Cabinets

6571A
6572A
6573A
6574A
6575A
6671A
6672A
6673A
6674A
6675A

- Low ripple and noise
- Fast up- and down-programming
- SCPI (Standard Commands for Programmable Instruments)
- Complete front-panel control, calibration and display
- Remote programming and sensing
- Fan-speed control to minimize acoustic noise
- Proven reliability
- Over-voltage and over-current protection



Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)		6671A	6672A	6673A	6674A	6675A
General Purpose Power Supplies (w/o GPIB)		6571A	6572A	6573A	6574A	6575A
Output Ratings	Output voltage	0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
	Output current (40°C)	0 to 220 A	0 to 100 A	0 to 60 A	0 to 35 A	0 to 18 A
Programming Accuracy (at 25°C ±5°C)	Voltage	0.04%+	8 mV	20 mV	35 mV	60 mV
	Current	0.11%+	125 mA	60 mA	40 mA	25 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Voltage	rms	650 µV	750 µV	800 µV	1.25 mV
		peak-peak	7 mV	9 mV	9 mV	11 mV
	Current	rms	200 mA	100 mA	40 mA	25 mA
						1.9 mV
Readback Accuracy at 25°C ±5°C (percent of reading plus fixed) System models only	Voltage	0.05%+	12 mV	30 mV	50 mV	90 mV
	±Current	0.1%+	150 mA	100 mA	60 mA	35 mA
Load and Line Regulation	Voltage	0.002%+	300 µV	650 µV	1.2 mV	2 mV
	Current	0.005%+	10 mA	7 mA	4 mA	2 mA
Transient Response Time: Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply						
Typical Resolution	Voltage		2 mV	5 mV	10 mV	15 mV
	Current		55 mA	25 mA	15 mA	8.75 mA
	OVP		15 mV	35 mV	65 mV	100 mV
Output Voltage Programming Response Time* (excluding command processing time) System models only			30 ms	60 ms	130 ms	130 ms
System Power Supplies (GPIB)		6671A/	6672A/	6673A/	6674A/	6675A/
General Purpose (w/o GPIB)		6571A/	6572A/	6573A/	6574A/	6575A/

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

dc Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground
Output Common-Mode Noise Current: (to signal ground binding post) 500 µA rms, 4 mA peak-to-peak
Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load
Command Processing Time: (6671A, 6672A, 6673A, 6674A, 6675A only) Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB
Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to -4 V for voltage, 0 to 7 V for current
Input Impedance: 60 K Ohm, nominal
Input Power: 3,800 VA, 2,600 W at full load; 170 W at no load
Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2 No. 1010.1; complies with EN 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC
Size: 132.6 mm H x 425.5 mm W x 640 mm D (5.22 in x 16.75 in x 25.2 in)
Weight: Net, 27.7 kg (61 lb); shipping, 31.4 kg (69 lb)
Warranty Period: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/singlePS>

Ordering Information

For 667xA & 657xA

- Option-200 174 to 220 Vac, 47 to 63 Hz (Japan only)
 - Option-230 191 to 250 Vac, 47 to 63 Hz
 - Option-908 Rackmount Kit (p/n 5062-3977) (support rails required)
 - Option-909 Rackmount Kit w/ Handles (p/n 5063-9221) (support rails required)
 - Option-083 Service Manual
 - Option-0L2 Extra Standard Documentation Package
- A line cord option must be specified. See page 118 for ordering information.

Accessories

Rack Slide Kit (p/n 1494-0059)
 The following accessories for 6671A, 6672A, 6673A, 6674A and 6675A only:
 p/n 1252-3698 7-pin Analog Plug
 p/n 1252-1488 4-pin Digital Plug
 p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support Rails for Agilent Rack Cabinets

- Low ripple and noise
- Fast up- and down-programming
- High-accuracy current programming and read back
- SCPI (Standard Commands for Programmable Instruments)
- Selectable compensation for inductive loads
- Proven reliability
- Complete front panel control, calibration and display



6680A
6681A
6682A
6683A
6684A

Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)		6680A	6681A	6682A	6683A	6684A
Output Ratings	Voltage	0 to 5 V	0 to 8 V	0 to 21 V	0 to 32 V	0 to 40 V
	Current (derated linearly 1%/°C from 40°C to 55°C)	0 to 875 A	0 to 580 A	0 to 240 A	0 to 160 A	0 to 128 A
Programming Accuracy (at 25°C ±5°C)	Voltage	0.04%+	5 mV	8 mV	21 mV	32 mV
	Current	0.1%+	450 mA	300 mA	125 mA	85 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Constant voltage rms	1.5 mV	1.5 mV	1.0 mV	1.0 mV	1.0 mV
	peak-to-peak	10 mV	10 mV	10 mV	10 mV	10 mV
	Constant current rms	290 mA	190 mA	40 mA	28 mA	23 mA
Readback Accuracy at 25°C ±5°C (percent of reading plus fixed)	Voltage	0.05%+	7.5 mV	12 mV	32 mV	48 mV
	Current	0.1%+	600 mA	400 mA	165 mA	110 mA
Load and Line Regulation	Voltage	0.002%+	190 μV	300 μV	650 μV	1.1 mV
	Current	0.005%+	65 mA	40 mA	17 mA	12 mA
Transient Response Time: Less than 900 μs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply						
Average Programming Resolution	Voltage	1.35 mV	2.15 mV	5.7 mV	8.6 mV	10.8 mV
	Current	235 mA	155 mA	64 mA	43 mA	34 mA
	OVP	30 mV	45 mV	120 mV	180 mV	225 mV
Output Voltage Programming Response Time (excludes command-processing time)	Full-load programming rise or fall time (10/90% or 90/10%, resistive load)	9 ms	12 ms	45 ms	60 ms	60 ms
Output Common-Mode Noise Current (to signal-ground binding post)	rms	1.5 mA	1.5 mA	3 mA	3 mA	3 mA
	peak-to-peak	10 mA	10 mA	20 mA	20 mA	20 mA

dc Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB

Modulation (analog programming of output voltage and current)

Input Signal: 0 to -5 V for voltage, 0 to +5 V for current

Input Impedance: 30 k Ohm or greater

ac Input (47 to 63 Hz): 180 to 235 Vac (line-to-line, 3 phase), 27.7 A rms maximum; 360 to 440 Vac, 14.3 A rms maximum (maximum line current includes 5% unbalanced phase voltage condition.) Output voltage derated at 50 Hz and below 200 Vac

Input Power: 7350 VA and 6000 W maximum; 160 W at no load

Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2

No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC

Size: 220 mm H x 425.5 mm W x 675.6 mm D (8.75 in x 16.75 in x 26.6 in)

Weight: Net, 51.3 kg (113 lb); shipping, 63.6 kg (140 lb)

Warranty Period: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/singlePS>

Ordering Information

668xA-208 180 to 235 Vac, 3 phase, 47 to 63 Hz

668xA-400 360 to 440 Vac, 3 phase, 47 to 63 Hz

668xA-602 Two Bus-Bar Spacers for paralleling power supplies

(p/n 5060-3514)

668xA-908 Rackmount Kit (p/n 5062-3977 and p/n 5063-9212)

668xA-909 Rackmount Kit with Handles (p/n 5063-9221 and

p/n 5063-9219). Support rails required for Option 908 and 909 Rack

668xA-0B3 Service Manual

668xA-0L2 Extra Standard Documentation Package

Accessories

p/n 5060-3513 Three 30-A Replacement Fuses for 180 to 235 Vac line

p/n 5060-3512 Three 16-A Replacement Fuses for 360 to 440 Vac line

E3663AC Support Rails for Agilent Rack Cabinets

p/n 5080-2148 Serial Link Cable 2 m (6.6 feet)

6690A
6691A
6692A

- Low ripple and noise
- Fast up- and down-programming
- High-accuracy current programming and read back
- SCPI (Standard Commands for Programmable Instruments)
- Selectable compensation for inductive loads
- Complete front panel control, calibration and display
- Proven reliability



Abbreviated Specifications and Characteristics

System Power Supplies (GPIB)			6690A	6691A	6692A
Output Ratings	Voltage		0 to 15 V	0 to 30 V	0 to 60 V
	Current (derated linearly 1%/°C from 40°C to 55°C)		0 to 440 A	0 to 220 A	0 to 110 A
Programming Accuracy (at 25°C ±5°C)	Voltage	0.04%+	15 mV	30 mV	60 mV
	Current	0.1%+	230 mA	125 mA	65 mA
Ripple and Noise (from 20 Hz to 20 MHz)	Constant voltage	rms	2.5 mV	2.5 mV	2.5 mV
		peak-to-peak	15 mV	25 mV	25 mV
	Constant current	rms	200 mA	50 mA	30 mA
Readback Accuracy at 25°C ±5°C (percent of reading plus fixed)	Voltage	0.05%+	22.5 mV	45 mV	90 mV
	Current	0.1%+	300 mA	165 mA	80 mA
Load and Line Regulation	Voltage	0.002%+	650 µV	1.1 mV	2.2 mV
	Current	0.005%+	40.5 mA	17 mA	9 mA
Transient Response Time: Less than 900 µs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply					
Average Programming Resolution	Voltage		4.1 mV	8.1 mV	16 mV
	Current		118.5 mA	59 mA	30 mA
	OVP		90 mV	170 mV	330 mV
Output Voltage Programming Response Time (excludes command-processing time)	Full-load programming rise or fall time (10/90% or 90/10%, resistive load)		45 ms	60 ms	100 ms
Output Common-Mode Noise Current (to signal-ground binding post)		rms	3 mA	3.5 mA	4 mA
		peak-to-peak	20 mA	20 mA	25 mA

dc Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB

Modulation (analog programming of output voltage and current)

Input Signal: 0 to -5 V for voltage, 0 to +5 V for current

Input Impedance: 30 k Ohm or greater

ac Input (47 to 63 Hz): 180 to 235 Vac (line-to-line, 3 phase), 36 A rms maximum; 28 A rms nominal, 360 to 440 Vac, 18 A rms maximum (maximum line current includes 5% unbalanced phase voltage condition.)

Output voltage derated at 50 Hz and below 200 Vac

Input Power: 9000 VA and 7950 W maximum; 175 W at no load

Regulatory Compliance: Listed to UL-3111.1; certified to CSA 22.2

No. 1010.1; complies with IEC 61010-1; carries the CE mark; complies with EMC directive 89/336/EEC

Size: 220 mm H x 425.5 mm W x 675.6 mm D (8.75 in x 16.75 in x 26.6 in)

Weight: Net, 51.3 kg (113 lb); shipping, 63.6 kg (140 lb)

Warranty Period: Three years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/singlePS>

Ordering Information

669xA-208 185 to 235 Vac, 3 phase, 47 to 63 Hz

669xA-400 360 to 440 Vac, 3 phase, 47 to 63 Hz

669xA-602 Two Bus-Bar Spacers for paralleling power supplies (p/n 5060-3514)

669xA-908 Rackmount Kit (p/n 5062-3977 and p/n 5063-9212)

669xA-909 Rackmount Kit with Handles (p/n 5063-9221 and p/n 5063-9219). Support rails required for 669xA-908 and 669xA-909 Rack

669xA-OB3 Service Manual

669xA-OL2 Extra Standard Documentation Package

Accessories

p/n 5065-6934 Three Replacement Fuses for 180 to 235 Vac line

p/n 5065-6935 Three Replacement Fuses for 360 to 440 Vac line

p/n 5080-2148 Serial Link Cable 2 m (6.6 feet)

E3663AC Support Rails for Agilent Rack Cabinets



6010A, 6011A, 6012B and 6015A



6030A, 6031A, 6032A, and 6035A



6033A and 6038A (Option 001 on right)

Abbreviated Specifications and Characteristics

System Autorangers (GPIB)		6030A	6031A	6032A	6033A	6035A	6038A	
Autorangers (w/o GPIB)		6010A	6011A	6012B	6023A	6015A	6028A	
Output Ratings	Voltage	0 to 200 V	0 to 20 V	0 to 60 V	0 to 20 V	0 to 500 V	0 to 60 V	
	Current	0 to 17 A	0 to 120 A	0 to 50 A	0 to 30 A	0 to 5 A	0 to 10 A	
Maximum Power	Watts	1,200 W	1,072 W	1,200 W	240 W	1,050 W	240 W	
Autoranging Output	V1, P1	200 V, 5 A	20 V, 50 A	60 V, 17.5 A	20 V, 10 A	500 V, 2 A	60 V, 3.3 A	
	V2, P2	120 V, 10 A	14 V, 76 A	40 V, 30 A	14 V, 17.2 A	350 V, 3 A	40 V, 6 A	
	V3, P3	60 V, 17 A	7 V, 120 A	20 V, 50 A	6.7 V, 30 A	200 V, 5 A	20 V, 10 A	
Programming Accuracy (at 25°C ±5°C)	Voltage	0.035% +145 mV	0.035% +15 mV	0.035% +40 mV	0.035% +9 mV	0.25% +400 mV	0.035% +40 mV	
	Current	0.2% +25 mA	0.25% +250 mA	0.2% +85 mA	0.15% +20 mA	0.3% +63 mA	0.09% +10 mA	
System models only								
Ripple and Noise, (20 Hz to 20 MHz)	Voltage	rms	22 mV	8 mV	5 mV	3 mV	50 mV	3 mV
		p-p	50 mV	50 mV	40 mV	30 mV	160 mV	30 mV
	Current	rms	15 mA	120 mA	25 mA	30 mA	50 mA	5 mA
Readback Accuracy (at 25°C ±5°C)	Voltage	0.08% +80 mV	0.08% +7 mV	0.08% +20 mV	0.07% +6 mV	0.5% +200 mV	0.07% +50 mV	
	Current	0.36% +15 mA	0.4% +100 mA	0.36% +35 mA	0.3% +25 mA	0.5% +50 mA	0.2% +11 mA	
System models only								
Load Regulation	Voltage	0.01%+	5 mV	3 mV	5 mV	40 mV	3 mV	
	Current	0.01%+	10 mA	15 mA	10 mA	9 mA	0.03+34 mA	5 mA
Line Regulation	Voltage	0.01%+	5 mV	2 mV	3 mV	1 mV	13 mV	2 mV
	Current	0.01%+	5 mA	25 mA	10 mA	6 mA	0.03+17 mA	2 mA
System models only								
Transient Response Time 10% step change	Time	2 ms	2 ms	2 ms	1 ms	5 ms	1 ms	
	Level	150 mV	100 mV	100 mV	50 mV	200 mV	75 mV	
dc Floating Voltage (either terminal can be grounded or floated from chassis ground)		±550 V	±240 V	±240 V	±240 V	±550 V	±240 V	
ac Input Current	100 Vac (system only)	24 A	24 A	24 A	6.0 A	24 A	6.0 A	
	120 Vac	24 A	24 A	24 A	6.5 A	24 A	6.5 A	
	220 Vac	15 A	15 A	15 A	3.8 A	15 A	3.8 A	
	240 Vac	14 A	14 A	14 A	3.6 A	14 A	3.6 A	
Weight	Net	16.3 kg (36 lb)	16.3 kg (36 lb)	16.3 kg (36 lb)	9.6 kg (21 lb)	16.3 kg (36 lb)	9.6 kg (21 lb)	
	Shipping	21.7 kg (48 lb)	21.7 kg (48 lb)	21.8 kg (48 lb)	11.4 kg (25 lb)	21.7 kg (48 lb)	11.4 kg (25 lb)	
System Autorangers (GPIB)		6030A/	6031A/	6032A/	6033A/	6035A/	6038A/	
Autorangers (w/o GPIB)		6010A/	6011A/	6012B/	6023A/	6015A/	6028A/	

6010A
6011A
6012B
6015A
6023A
6028A
6030A
6031A
6032A
6033A
6035A
6038A

Remote Sensing: Up to 2 V drop in each lead. Voltage regulation degrades for greater than 0.5 V drop

Regulatory Compliance: Listed to UL-1244; certified to CSA 556B; complies with EN 61010-1, carries the CE mark

RFI Suppression: Complies with CISPR-11, Group 1, Class A

Inductive Load: 6023A, 6028A are stable in CC mode for loads up to 1 H.

6010A–6012B, 6015A are stable in CC mode for loads up to 100 mH

Size:

6030A–32A, 6035A: 132.6 mm H x 425.5 mm W x 503.7 mm D

(5.25 in x 16.75 in x 19.83 in)

6033A, 6038A, 6023A, 6028A: 177.0 mm H x 212.3 mm W x 516.4 mm D

(6.97 in x 8.36 in x 17.87 in)

6010A–12B, 6015A: 132.6 mm H x 425.5 mm W x 516.4 mm D

(5.25 in x 16.75 in x 20.33 in)

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:

<http://www.agilent.com/find/autorangingPS>

Ordering Information

603xA-001 Front panel has only line switch, line indicator, and OVP adjust (6030A – 33A and 6038A only)

603xA-100 87 to 106 Vac, 48 to 63 Hz (power supply output is derated to 75%) 6030A – 33A, 6035A, 6038A only

603xA-120 104 to 127 Vac, 48 to 63 Hz

603xA-220 191 to 233 Vac, 48 to 63 Hz

603xA-240 209 to 250 Vac, 48 to 63 Hz

603xA-800 Rackmount Kit for Two Half-rack Units Side by Side.

p/n 5061-9694 and 5063-9215

603xA-908 Rackmount Kit for a Single Half-rack Unit Models 6023A,

6028A, 6033A and 6038A (with blank filler panel); p/n 5062-3960

Models 6010A – 12B, 6015A, 6030A – 32A and 6035A; p/n 5062-3977

603xA-909 Rackmount Kit with Handles. For 6010A – 12B, 6015A,

6030A – 32A, 6035A; p/n 5062-3983

603xA-0L2 Extra Standard Documentation Package

A line cord option must be specified for 6010A – 12B, 6015A,

6030A – 32A, 6035A. See page 118 for ordering information.

Accessories

5080-2148 Serial Link Cable, 2 m (6.6 ft) for 6030A, 6031A,

6031A, 6032A, 6033A, 6035A, and 6038A

1494-0060 Rack Slide Kit

Power-Supply AC Line Cord Options

Power distribution regulations and techniques vary greatly among geographic regions. For this reason, line cord type must be specified for high-power (1000- to 5000-W) dc power supplies at the time of ordering. The 66000A modular power system mainframe is included because one line cord might supply ac power for up to eight 150-W modules. If no line cord option is specified for these models, an unterminated cable will be shipped with the unit.

Terminated Line Cords

Line cords with plugs

Option 841

12 AWG; UL-listed, CSA-certified; with NEMA 6-20P, 20-A, 250-V plug. Suggested for use in North and South America and Japan. Note for 6670 and 6570 Series: not intended for use in Canada. Intended for use on a dedicated branch circuit.



Option 842

4-mm² wire size; harmonized cordage with IEC 309, 32-A, 220-V plug. Suggested for use in Europe and other areas not listed.



Option 844

10 AWG; UL-listed, CSA-certified; with NEMA L6-30P, 30-A, 250-V locking plug. Suggested for use in North and South America.



Option 845

1.5-mm² wire size; harmonized cordage with IEC 309, 16-A, 220-V plug. Suggested for use in Denmark, Switzerland, Austria, China, and other countries not listed.



Option 846

10 AWG; UL-listed, CSA-certified; with NEMA L5-30P, 30-A, 120-V locking plug. Suggested for use in North America.



Option 847

1.5-mm² wire size; harmonized cordage with CEE 7/7, 16-A, 220-V plug. Suggested for use in continental Europe.



Option 848

1.5-mm² wire size; harmonized cordage with BS 546, 15-A, 240-V plug. Suggested for use in India and South Africa.



Option Descriptions

Order the correct option according to local electrical codes. All the cords listed are 2.5 m (about 8.2 ft) long.

Unterminated Line Cords (user supplies plug)

Option 831: 12 AWG; UL-listed, CSA-certified; unterminated. Suggested for use in North and South America. Note for 6670 and 6570 Series: intended for use on a dedicated branch circuit and not intended for use in Canada. Note for 6030 and 66000 Series: intended for connection to 200- to 240-Vac service.

Option 832: 4-mm² wire size; harmonized cordage; unterminated. Suggested for use in Europe and other areas not listed.

Option 833: 1.5-mm² wire size; harmonized cordage; unterminated. For use in Europe and other areas not listed. Note for 6030 and 66000 Series: intended for connection to 200- to 240-Vac service.

Option 834: 10 AWG; UL-listed, CSA-certified; unterminated. Suggested for use in North and South America. Note for 6030 and 66000 Series: intended for connection to 100- to 120-Vac service.

Options Available

Options	6010A Series 6030A Series (1000 W only)	6570A 6670A Series	66000A Mainframe	6812A 6841A	6813A 6842A
831	•	•	•	•	•
832		•			•
833	•		•	•	
834	•	•	•	•	•
841	•	•	•	•	•
842		•			•
844		•			•
845	•		•	•	
846	•		•	•	
847	•		•	•	
848	•		•	•	

* available

- 30 – 100 W single and dual output
- Dual output ranges
- Front and rear terminal outputs
- Over-voltage protection (for all output)
- Remote sense
- Standard GPIB and RS-232 with SCPI



E3640A – E3649A

E3640A – 49A Single and Dual Output

Agilent's E364xA-series programmable DC power supplies are 30 W/50 W/80 W single output and 60 W/100 W dual output power supplies with standard GPIB & RS-232 interface. For general-purpose use, these programmable power supplies offer the performance of system power supplies at a surprisingly affordable price.

Clean and Stable Output

All models deliver clean and reliable power, and dependable regulation. With 0.01% load and line regulation, the E364xA power supplies keep output steady when power line and load changes occur. These linear supplies specify both normal mode voltage noise and common mode current noise to assure less interference with your DUT.

Standard remote interface

Standard GPIB and RS-232 interfaces, SCPI programming and *plug&play* drivers for Agilent VEE and NI LabView make it easy to program and integrate into automated test system. You can monitor the output terminals for voltage and current and a query command lets you read the programmed voltage and current.

Versatile Power

E364xA power supplies give you the flexibility to select from dual output ranges. Both front and rear output terminals are standard and output load is protected by over-voltage protection. Remote sense is available to eliminate the errors in voltage regulation due to voltage drops in the load leads. New front panel binding posts offer flexibility to use safety test leads, banana plugs or stripped wires. Store and recall key enables you to save and recall up to 5 frequently used operating states. For dual output models, the two outputs are electrically isolated to each other.

E3640A
E3641A
E3642A
E3643A
E3644A
E3645A
E3646A
E3647A
E3648A
E3649A

4

Abbreviated Specifications and Characteristics (at 0°C to 55°C unless otherwise specified)

Model Number	E3640A	E3641A	E3642A	E3643A	E3644A	E3645A
Maximum Power	30 W	30 W	50 W	50 W	80 W	80 W
# of Output	1	1	1	1	1	1
Output Ratings	0 to 8 V/3 A or 0 to 20 V/1.5 A	0 to 35 V/0.8 A or 0 to 60 V/0.5 A	0 to 8 V/5 A or 0 to 20 V/2.5 A	0 to 35 V/1.4 A or 0 to 60 V/0.8 A	0 to 8 V/8 A or 0 to 20 V/4 A	0 to 35 V/2.2 A or 0 to 60 V/1.3 A

Model Number	E3646A	E3647A	E3648A	E3649A
Maximum Power	60 W	60 W	100 W	100 W
# of Output	2	2	2	2
Output Ratings	0 to 8 V/3 A or 0 to 20 V/1.5 A	0 to 35 V/0.8 A or 0 to 60 V/0.5 A	0 to 8 V/5 A or 0 to 20 V/2.5 A	0 to 35 V/1.4 A or 0 to 60 V/0.8 A

Common to All Models

Load and Line Regulation ±(% of output +offset)	Voltage	<0.01% +3 mV
	Current	<0.01% +250 µA
Ripple and Noise (20 Hz to 20 MHz)	Normal Mode Voltage	<5 mVpp/0.5 mVrms for 8 V/20 V models; <8 mVpp/1 mVrms for 35 V/60 V models
	Normal Mode Current	<4 mArms
	Common Mode Current	<1.5 µArms
Accuracy 12 Months (@ 25°C ±5°C), ±(% output +offset)	Programming Voltage	<0.05% +10 mV (<0.1% +25 mV for output 2 of E3646/47/48/49A)
	Programming Current	<0.2% +10 mA
	Readback Voltage	<0.05% +5 mV (<0.1% +25 mV for output 2 of E3646/47/48/49A)
	Readback Current	<0.15% +5 mA (<0.15% +10 mA for output 2 of E3646/47/48/49A)
Resolution	Program	<5 mV/1 mA
	Readback	<2 mV/1 mA
	Meter	10 mV/1 mA

Transient Response: Less than 50 usec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa

E3640A
E3641A
E3642A
E3643A
E3644A
E3645A
E3646A
E3647A
E3648A
E3649A

Product Regulation

Designed to comply with UL3111-1; certified to CSA 22.2 No. 1010.1; conforms to IEC 1010-1; complies with EMC directive 89/336/EEC (Group1, Class A)

Size:

104 mm H x 254 mm W x 374 mm D (4.1 in x 10 in x 14.8 in),
(For E3640A – E3645A)

146 mm H x 228 mm W x 374 mm D (5.2 in x 8.9 in x 14.7 in),
(For E3646A – E3649A)

Warranty: 3 years

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
Agilent GP Instruments Catalog, p/n 5988-7165ENN

For more information, visit our web site:
<http://www.agilent.com/find/power>

Ordering Information

E364xA-OEM 115 Vac $\pm 10\%$ at 47 Hz to 63 Hz

E364xA-OE9 100 Vac $\pm 10\%$ at 47 Hz to 63 Hz

E364xA-OE3 230 Vac $\pm 10\%$ at 47 Hz to 63 Hz

E364xA-1CM Rackmount Kit

For E3640A – E3645A, Agilent p/n 5063-9240

For E3646A – E3649A, Agilent p/n 5063-9243

E364xA-0L2 Extra Standard Documentation Package

E3631A Triple-output Features

- 80 watts of power
- Triple outputs
- GPIB/RS-232 standard
- Dual voltage and current meters
- SCPI (Standard Commands for Programmable Instruments)

E3632A – E3634A Single-output Features

- Single output, dual range
- Front and rear panel terminals
- Low noise/excellent regulation
- GPIB/RS-232 standard
- Remote sense, OVP and OCP capability
- 16-bit programming resolution and high accuracy



Above: E3632A, Below: E3631A

E3633A/34A

E3631A – E3634A

The E3631A is a triple-output programmable dc power supply designed to meet the most exacting engineering requirements with traditional quality and reliability designed in.

The E3632A (120 W) and E3633A, E3634A (200 W) are single output, dual range programmable dc power supplies designed to deliver reliable and high quality operation at a very attractive price.

Low Noise/Excellent Regulation

0.01% load and line regulation keep the output steady. The linear supply specifies both normal-mode voltage noise and common-mode current noise. The low normal-mode specification assures clean power for precision circuitry and the low common-mode current provides isolation from power line current injection.

Front Panel Operation

Both voltage and current can be monitored simultaneously for output from the front panel on an easy-to-read vacuum fluorescent display. A knob allows you to set the output at the resolution you need for the most exacting adjustments. Store and recall key enables you to save and recall up to three frequently-used states. The output on/off button enables/disables the output.

Isolated

All the outputs are isolated from the chassis ground and from the remote interface. In the E3631A, 6 V supply is isolated from the ± 25 V supply to minimize any interference between circuits-under-test.

For more information, visit our web site:
<http://www.agilent.com/find/power>

E3631A
 E3632A
 E3633A
 E3634A

4

Abbreviated Specifications and Characteristics (at 0°C to 55°C unless otherwise specified)

		E3631A			E3632A Low Range/ High Range	E3633A Low Range/ High Range	E3634A Low Range/ High Range
dc Outputs	Voltage	0 to +25 V/	0 to -25 V/	0 to 6 V/	0 to 15 V, 7 A/	0 to 8 V, 20 A/	0 to 25 V, 7 A/
	Current	0 to 1 A	0 to 1 A	0 to 5 A	0 to 30 V, 4 A	0 to 20 V, 10 A	0 to 50 V, 4 A
Load and Line Regulation	Voltage	<0.01% +2 mV	<0.01% +2 mV	<0.01% +2 mV	<0.01% +2 mV	<0.01% +2 mV	<0.01% +2 mV
	Current	<0.01% +250 μ A	<0.01% +250 μ A	<0.01% +250 μ A	<0.01% +250 μ A	<0.01% +250 μ A	<0.01% +250 μ A
Ripple and Noise (20 Hz to 20 MHz)	Normal-mode voltage	<350 μ V rms/ 2 mV p-p	<350 μ V rms/ 2 mV p-p	<350 μ V rms/ 2 mV p-p	<350 μ V rms/ 2 mV p-p	<350 μ V rms/ 3 mV p-p	<500 μ V rms/ 3 mV p-p
	Normal-mode current	<500 μ A rms	<500 μ A rms	<2 mA rms	<2 mA rms	<2 mA rms	<2 mA rms
	Common-mode current	<1.5 μ A rms	<1.5 μ A rms	<1.5 μ A rms	<1.5 μ A rms	<1.5 μ A rms	<1.5 μ A rms
Programming Accuracy (25°C \pm 5°C)	Voltage	0.05% +20 mV	0.05% +20 mV	0.1% +5 mV	0.05% +10 mV	0.05% +10 mV	0.05% +10 mV
	Current	0.15% +4 mA	0.15% +4 mA	0.2% +10 mA	0.2% +10 mA	0.2% +10 mA	0.2% +10 mA
Readback Accuracy (25°C \pm 5°C)	Voltage	0.05% +10 mV	0.05% +10 mV	0.1% +5 mV	0.05% +5 mV	0.05% +5 mV	0.05% +5 mV
	Current	0.15% +4 mA	0.15% +4 mA	0.2% +10 mA	0.15% +5 mA	0.15% +5 mA	0.15% +5 mA
Resolution	Program/ readback	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA	1.5 mV, 0.1 mA/ 1.5 mV, 0.1 mA	0.5 mV, 0.5 mA/ 0.5 mV, 0.5 mA	1 mV, 0.5 mA/ 0.5 mV/0.1 mA	1 mV, 1 mA/ 0.5 mV, 1 mA	3 mV, 0.5 mA/ 1.5 mV, 0.5 mA
	Meter	10 mV/1 mA	10 mV/1 mA	1 mV/1 mA	1 mV/1 mA	1 mV, 1 mA (<10 A), 10 mA (\geq 10 A)	1 mV/1 mA (<10 A), 10 mA (\geq 10 A)

Transient Response Time: 50 μ sec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa

Product Regulation: Certified to CSA 22.2 No. 231 (E3631A), No. 1010.1 (E3632A/33A/34A); conforms to IEC 1010.1; carries CE mark; complies with CISPR-11, Group 1, Class A

Warranty: Three years

Size: E3631A, 32A, 33A, 34A 132 mm H x 213 mm W x 348 mm D (5.2 in x 8.4 in x 13.7 in)

Weight: E3631A 8.2 kg (18 lb); E3632A, E3633A, E3634A 9.5 kg (21 lb)

Ordering Information

E363xA-OEM 115 Vac \pm 10%, 47 to 63 Hz

E363xA-OE3 230 Vac \pm 10% 47 to 63 Hz

E363xA-OE9 100 Vac \pm 10% 47 to 63 Hz

E363xA-1CM Rackmount Kit

E363xA-0L2 Extra Documentation Package

E3620A
E3630A

E3620A Features

- Low noise, excellent regulation
- Two isolated power supplies
- Two digital meters
- Linear power supply
- 10-turn potentiometer

E3630A Features

- Triple output
- Low noise, excellent regulation
- Auto-tracking
- Two digital meters
- Linear power supplies



E3620A, E3630A

These multiple-output power supplies have 0.01% load and line regulation which keeps the outputs steady with changes of the power line and load. These supplies specify both normal-mode voltage noise and common-mode current noise. The low normal-mode noise specification of 350 μV rms assures clean power for precision circuitry, and the low common-mode current specification of 1 μA rms minimizes line frequency current injection.

Both power supplies have separate digital panel meters to monitor both the voltage and current of any output simultaneously. An LED indicator for each output lets the user know when any supply is overloaded. All the outputs on these models are protected against overload and short-circuit damage. Protection circuits prevent output voltage overshoot when supply is turned on and off. The +6 V output of E3630A employs current foldback; all others are current limited.

E3630A

This general-purpose power supply provides three outputs, one 0 to 6 V output to power logic or other circuitry and one 0 to +20 V and 0 to -20 V to power linear circuits. The 0 to +20 V and 0 to -20 V outputs track to within 1%. The 0 to -20 V output can be set to any value less than the 0 to +20 V output. One voltage control may be used to vary both simultaneously.

The E3630A is 88 mm H x 213 mm W x 213 mm D (3.6 in x 8.4 in x 12.6 in) and weighs 3.8 kg (8.4 lbs).

E3620A

This general-purpose power supply provides two separate, independent and isolated power supplies in one small package. Each output has a ten-turn potentiometer for fine adjustment. Convenient meter selection allows the user to read voltage and current of either output. Each output can deliver up to 25 watts.

The E3620A is 88 mm H x 213 mm W x 400 mm D (3.6 in x 8.4 in x 15.8 in) and weighs 5.5 kg (12.1 lb).

Specifications (at 0°C to 55°C unless otherwise specified)

	E3620A	E3630A	
Number of Outputs	2	3	
Number of Output Ranges	1	1	
Output Ratings	Output 1 Output 2 Output 3 Power (max.)	0 to 25 V, 0 to 1 A 0 to 25 V, 0 to 1 A 50 W	0 to 6 V, 0 to 2.5 A* 0 to +20 V, 0 to 0.5 A 0 to -20 V, 0 to 0.5 A 35 W
Load and Line Regulation		0.01% +2 mV	0.01% +2 mV
Ripple and Noise	rms peak-to-peak	350 μV 1.5 mV	350 μV 1.5 mV
Control Mode		CV/CL	CV/CL (± 20 V) CV/CF (+6 V)
Resolution (minimum change using front-panel controls)	Voltage Current	10 mV (0 - 20V) 1 mA 100 mV (>20 V)	10 mV 10 mA

* Maximum current is derated 3.3% per °C from 40°C to 55°C.

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
2002/03 Agilent General Purpose Test Instruments Catalog, p/n 5988-7165ENUS

For more information, visit our web site:
<http://www.agilent.com/find/power>

Ordering Information

- E36x0A-OEM 115 Vac $\pm 10\%$, 47 to 63 Hz Input
- E36x0A-OE3 230 Vac $\pm 10\%$, 47 to 63 Hz Input
- E36x0A-OE9 100 Vac $\pm 10\%$, 47 to 63 Hz Input
(For use in Japan)
- E36x0A-0L2 Extra Standard Documentation Package
- E36x0A-1CM Rackmount Kit

E3610A, E3611A, and E3612A Features

- Dual ranges
- Digital voltage and current meters
- 10-turn potentiometer
- Linear power supply

E3614A, E3615A, E3616A and E3617A Features

- Digital voltage and current meters
- Front and rear output terminals
- Over-voltage protection
- Remote sensing
- Remote analog programming
- Linear power supply



E3610A – E3617A

E3614A, E3615A, E3616A, E3617A

These flexible single range CV/CC power supplies can be used as either voltage sources or current sources. The CC-set button allows you to quickly set the current limit when operating in the CV mode, without shorting the output. 10-turn controls allow accurate adjustment of voltage and current output settings. The output voltage and current can also be controlled with external 0 to 10 volt analog signals or variable resistance.

Output connections can be made on either the front or rear panel. Remote sensing is available to eliminate the errors in voltage regulation due to voltage drops in the load leads. Either the positive or negative output terminal may be connected to ground to provide positive or negative output voltage. Either terminal can also be floated to a maximum of 240 volts. Multiple units can be combined in auto-parallel, auto-series and auto-tracking configurations to obtain more voltage or current output.

The load is protected with the over-voltage protection feature, which is easily monitored and adjusted from the front panel. The digital voltage and current meters provide continuous and accurate readings of the output levels. The E3614A – E3617A are 88 mm H x 212 mm W x 373 mm D (3.5 in x 8.5 in x 14.7 in).

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN
 2002/03 Agilent General Purpose Test Instruments Catalog, p/n 5988-7165ENUS

For more information, visit our web site:
<http://www.agilent.com/find/power>

Ordering Information

- E361xA-OEM** 115 Vac $\pm 10\%$, 47 to 63 Hz
- E361xA-OE3** 230 Vac $\pm 10\%$ 47 to 63 Hz
- E361xA-OE9** 100 Vac $\pm 10\%$ 47 to 63 Hz
- E361xA-OL2** Additional Standard Documentation Package

E3610A, E3611A, E3612A

These popular low-cost CV/CC bench supplies are designed for general laboratory use. The constant-voltage, constant-current output allows operation as either a voltage source or current source. The changeover occurs automatically, based on the load. This feature also provides an adjustable current limit, allowing you to set the safest current limit level for a particular DUT. Also, a CC-set button lets you set the current limit without having to short the output.

Each model has two ranges, allowing more current at a lower voltage. For a higher-output voltage, supplies can be connected in series. Either the positive or negative terminal can be connected to ground, providing a positive or negative voltage output. Either terminal can also be floated up to 240 V from ground.

Dual digital meters monitor current and voltage simultaneously. Adjustments are made with the 10-turn voltage control and the 10-turn current control. Each power supply is 88 mm H x 212 mm W x 318 mm D (3.5 in x 8.4 in x 12.5 in) and weights 3.8 kg (8.4 lb).

Specifications (at 0°C to 55°C unless otherwise specified)

Single-Output Models		E3610A	E3611A	E3612A	E3614A	E3615A	E3616A	E3617A
Number of Output Ranges		2	2	2	1	1	1	1
Output Ratings ¹	Range 1	0 to 8 V, 0 to 3 A ¹	0 to 20 V, 0 to 1.5 A ¹	0 to 60 V, 0 to 0.5 A ¹	0 to 8 V, 0 to 6 A	0 to 20 V, 0 to 3 A	0 to 35 V, 0 to 1.7 A	0 to 60 V, 0 to 1 A
	Range 2	0 to 15 V, 0 to 2 A ¹	0 to 35 V, 0 to 0.85 A ¹	0 to 120 V, 0 to 0.25 A ¹	—	—	—	—
	Power (max.)	30 W	30 W	30 W	48 W	60 W	60 W	60 W
Load and Line Regulation		0.01% +2 mV	0.01% +2 mV	0.01% +2 mV	0.01% +2 mV	0.01% +2 mV	0.01% +2 mV	0.01% +2 mV
Ripple and Noise (from 20 Hz to 20 MHz)	rms	200 μ V	200 μ V	200 μ V	200 μ V	200 μ V	200 μ V	200 μ V
	peak-to-peak	2 mV	2 mV	2 mV	1 mV	1 mV	1 mV	1 mV

Supplemental Characteristics Non-warranted characteristics determined by design and useful in applying the product

Control Mode		CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC	CV/CC
Resolution	Voltage	10 mV	100 mV	100 mV	10 mV	10 mV (0 – 20 V) 100 mV (20 V)	10 mV (0 – 20 V) 100 mV (20 V)	10 mV (0 – 20 V) 100 mV (20 V)
	Current	10 mA	10 mA	1 mA	10 mA	10 mA	1 mA	1 mA

¹Maximum current is derated 1% per °C between 40°C to 55°C.

E3610A to
E3617A

4

N3280A

- Precision low-level (nA) measurement
- Save valuable rack space with 4 outputs in a ½-rack box
- Increase system throughput with fast command processing time
- Synchronize measurements to an external event using the trigger system



N3280A

N3280A

The N3280A dc source offers semiconductor ATE manufacturers a reduction in test time, integration time and rack space. It is a fast, low-power four-output (± 10 V/ ± 0.5 A) bipolar power supply optimized for testing RF and mixed signal semiconductors.

Valuable rack space is saved, by providing four bipolar outputs that eliminates the need for four separate sources and an external polarity reversal relay.

The N3280A helps maximize test system throughput with at least 5 times faster performance than any previous Agilent dc source. It provides reduced command processing time both for setting output levels and for acquiring measurements. Plus, any combination of outputs can be grouped in one programming command, further reducing test time.

Specifications (applies to each of the four identical outputs (at 25° $\pm 5^\circ$ C))

	Voltage Priority Mode	Current Priority Mode
Number of Outputs	4	
GPIOB	Yes	Yes
Output Ratings¹		
Voltage	-10.25 V to +10.25 V	-8 V to +8 V (full load) -11.25 V to +11.25 V (no load)
Current	-0.5125 A to +0.5125 A	-0.5125 mA to +0.5125 mA
Programming Accuracy at 25°C $\pm 5^\circ$C		
Voltage	0.1% ± 2 mV	N/A
+Current	0.1% ± 50 μ A	N/A
-Current limit	0.1% ± 50 μ A	N/A
Current	N/A	0.1% ± 1 μ A
Measurement Accuracy²		
Voltage	0.1% ± 2 mV	0.1% ± 2 mV
0.5 A current range	0.1% ± 200 μ A	0.1% ± 200 nA
15 mA current range	0.1% ± 5 μ A	0.1% ± 200 nA
0.5 mA current range	0.1% ± 200 nA	0.1% ± 200 nA
Ripple and Noise from 20 Hz to 20 MHz		
Voltage rms	0.380 mV	N/A
Peak-to-peak	4 mV	N/A
\pm Current limit rms	40 μ A	N/A
Current rms	N/A	1.5 μ A
Load Regulation (A change from no load to full load or full load to no load by varying a resistive load)		
Voltage	± 400 μ V	N/A
+Current limit	± 30 μ A	N/A
-Current limit	± 30 μ A	N/A
Current	N/A	± 25 nA
Line Regulation (A change in output voltage or current for any line change within ratings)		
Voltage	± 200 μ V	N/A
+Current limit	± 10 μ A	N/A
-Current limit	± 10 μ A	N/A
Current	N/A	± 10 nA
Output Transient Response		
Voltage ³	BW = 10 kHz 60 μ s BW = 20 kHz 45 μ s BW = 30 kHz 35 μ s	N/A N/A N/A
Current ⁴	N/A	90 μ s

¹ Full current at 40°C. Linearly derated to 50% of full current at 55°C.

² Measurement default is 5 measurement samples 30.4 microseconds apart. 0.5 mA range measured with the number of samples equivalent to one power line cycle.

³ Time for output voltage to recover to within 40 mV of former value after a change from 0.25 A to 0.5 A or 0.5 A to 0.25 A.

⁴ Time for output current to recover to within 1 mA of former value after a change from -1 V to +1 V or +1 V to -1 V.

Supplemental Characteristics

dc Floating Voltage: Output terminals can be floated up to ± 50 Vdc maximum from chassis ground and ± 100 Vdc from output to output

Remote Sensing: Up to 1/2 the maximum output voltage may be dropped across each load lead. Add 1/2 mV to the load regulation for each 1 V change in the HI output lead

Command Processing Time: The time to set an output parameter is 0.6 ms for a single output (0.7 ms for all outputs simultaneously). Time to query a setting is 1.0 ms (1.5 ms for all outputs simultaneously)

Dynamic Measurement System

- Buffer Size = 4096 points
- Sampling rate increments = 30.4 μ s

Regulatory Compliance: Complies with EMC directive 89/336/EEC (ISM group 1 Class A)

Warranty Period: 18 months

Size: 212.7 mm W x 88.9 mm H x 497.8 mm D (8.4 in x 3.5 in x 19.6 in)

Weight: 10 kg (22 lbs) net; 11.8 kg (26 lbs) shipping

English URL www.agilent.com/find/products

Ordering Information

N3280A-100 87 to 106 Vac, 47 to 63 Hz

N3280A-120 104 to 127 Vac, 47 to 63 Hz

N3280A-220 191 to 233 Vac, 47 to 63 Hz

N3280A-230 207 to 253 Vac, 47 to 63 Hz

N3280A-OL2 Extra Standard Documentation Package

N3280A-8ZL Add feet – for bench use, p/n 5041-9167

N3280A-1CM Rackmount Kit, p/n 5063-9240

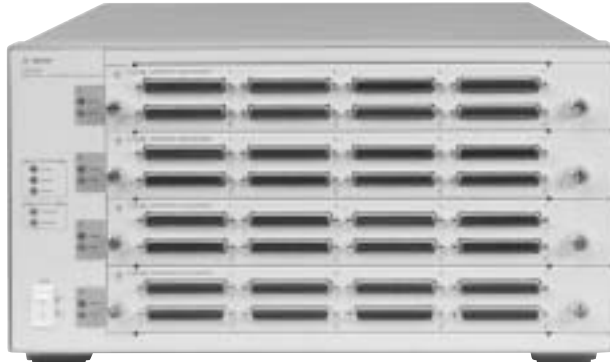
N3280A-AXS Rackmount Kit for side-by-side mounting, Lock-link kit p/n 5061-9694; Flange Kit p/n 5063-9212; Tie Bracket Kit p/n 5965-6947

Accessories

p/n N3280A-10001 Virtual Front Panel Software

Korean URL www.agilent.co.kr/find/products

- Easy system integration
- Integrated safety and protection features
- Accurate measurements
- Grouping capability
- Fully programmable



E4370A

The Multi-Cell Charger/Discharger (MCCD) is a cost effective solution specifically designed for manufacturers to charge and discharge secondary lithium-ion and lithiumpolymer cells. It has 256 charging and discharging channels each rated at up to 5 V and 3 A.

The E4371A Powerbus Load is used for discharging purposes within a formation system and can dissipate power from two fully loaded MCCD mainframes. For the discharging cycle, it is required to dissipate excess power from discharging cells. Additional electricity savings are realized because energy removed from discharging cells is automatically used to simultaneously charge other cells. This energy recycling contributes to cooling and ventilation savings because all of the energy removed from cells is not dissipated in unwanted heat.

E4370A

4

Specifications (at 0° to 40°C)

	Condition	Value for E4370A with E4374A	Value for E4370A with E4375A
Maximum Programmable Output Voltage	charging	5 V	5 V
Maximum Compliance Voltage (cell voltage + fixture/wiring voltage drops)	charging	5.5 V	6 V
Maximum Programmable Output Current	charging or discharging, per channel	2 A	3 A
Minimum Output current ¹	constant voltage charging and discharging	0 A	0 A
Maximum Output Leakage Current	disabled, per channel, with an external voltage of -5 V to +5 V	±25 µA	±25 µA
Maximum Power	charging, per channel discharging, per channel	11 W 9 W	18 W 13.5 W
Maximum Input Voltage	discharging	4.5 V	4.5 V
Voltage Programming and Readback Accuracy	measured at sense connector input with remote sensing	±1 mV	±1 mV
Current Programming and Readback Accuracy	% of reading +offset ≤1 A 1 A to ≤2 A >2 A	±(0.05% + 1 mA) ±(0.1% + 1 mA)	±(0.05% + 1.5 mA) ±(0.1% + 1.5 mA) ±(0.15% + 1.5 mA)
dc and ac Resistance Measurement Accuracy	% of reading +offset	±(1% + 1 mΩ)	±(1% + 1 mΩ)
Minimum Programmable Constant Current Limit	constant current charging and discharging	25 mA	25 mA

¹ There is a minimum programmable current limit when operating in constant current (CC) mode. In CC, the output cannot be set to run below the minimum programmable constant current limit specified in the minimum programmable constant current limit. In constant voltage (CV) charge or discharge, the MCCD will regulate current down to 0 A.

6800
Series
6811B
6812B
6813B

- Versatile ac power test solutions
- Generate stable or distorted ac and dc power
- 50/60 Hz power up to 300 Vrms
- 400 Hz avionics power up to 300 Vrms
- Arbitrary waveform generation
- Built-in precision power analyzer
- Easy to integrate into ATE systems
- VXI *plug&play* drivers available
- SCPI (standard commands for programming instruments)
- Drop-in replacement – Elgar PIP9012 code built in
- Electronic calibration
- Full protection features (OV, OI, OP, OT)
- Three year warranty
- CE mark
- FREE graphical user interface
- Dual power analyzer option



6811B, 6812B, 6813B

6800 AC Power Solutions AC Power Sources/Analyzers

6811B	300 V _{rms} , 375 VA Single phase model
6812B	300 V _{rms} , 750 VA Single phase model
6813B	300 V _{rms} , 1750 VA Single phase model

Agilent Technologies ac power source/analyzers are designed for applications which require precise control, accurate measurement, and analysis of single-phase ac power. The feature set and performance levels of this product family provide the flexibility necessary to power and test a wide variety of devices. These products are ideal for applications such as power supply testing, AC Mains CE Mark Testing UPS testing, avionics, air traffic control equipment, testing power-factor-corrected equipment and telecom equipment.

The 6800 series utilizes a low noise switching topology, which delivers high performance and reduced size. These products can output dc, ac complex, and user-defined waveforms for exceptional application flexibility over the bus.

Key Features

- High peak current capability
- Programmable voltage, frequency, phase, output impedance, distortion, and current limit
- Voltage and frequency slew control
- Power line disturbance simulation
- Avionics power disturbance simulation
- Measurement of Vrms, Irms, Ipeak, frequency, phase, VA, watts, PF, and THD
- Two current measurement ranges. Low range increases sensitivity 10:1
- Harmonic analysis of V and I
- Built-in GPIB and RS-232 interfaces
- Built-in output isolation relays
- MIL-STD 704 and RTCA DO160 testing capability
- Built-in 26 Vrms AUX output option
- Remote shutdown via TTL signal
- Autoranging dc output
- Application specific options

Powerful Direct Digital Synthesis (DDS) Waveform Generation

The 6800 series offers the ultimate in waveform generation versatility. For testing products under ac line distortion conditions, clipped sine waves can be generated with 0% to 43% distortion. There are a number of methods for creating waveforms; some include inputting harmonic content, phase angles, and data points. These waveforms can be used to generate steady state outputs or can be combined for more complex transient generation schemes.

Flexible Transient Generation

When testing requires precise synchronization between waveform generation and measurement of the device under test, the 6800 series transient generation capability provides a powerful tool. The output voltage amplitude, frequency, phase, waveform shape, voltage slew rate, and frequency slew rate can be controlled in response to an input trigger generated from an internal or external event. The Step and Pulse modes offer an easy and convenient method of executing single-step and continuous-output changes. The List transient mode further extends this capability for more complex waveform generation needs. Up to 100 sets of output settings can be precisely executed in response to a trigger or paced by programmed dwell times without computer intervention.

Extensive Measurement and Analysis

The 6800 series has measurement functionality equivalent to commercially available high-accuracy power analyzers. This eliminates the need for this standalone instrument for most applications, and lowers systems cost, increases available rack space, and simplifies cabling. All measurements are made with 16-bit resolution, suitable for even the most demanding applications.

The 6800 series has built-in voltage and current waveform digitization combined with harmonic analysis capability. Amplitude, phase, and total harmonic distortion results up to the 50th harmonic are provided for output frequencies equal to or less than 250 Hz. This measurement feature, accessible via the front panel, graphical user interface software, or over the bus, provides a sophisticated solution for testing during product development.

The dual power analyzer option (020) adds an additional built-in power analyzer to the standard ac power source/analyzer with inputs accessible from the rear of the instrument. The standard instrument's built-in power analyzer monitors its own output voltage and current, while the dual power analyzer option (also built-in) enables the user to simultaneously analyze the power of any external power source, like the output of a UPS.

Multiple Interfaces

The 6800 series ac power solutions offer multiple programming interfaces for convenience. The front panel offers access to most commonly used commands, SCPI can be sent via GPIB or RS-232. The graphical user interface (GUI) that is shipped with every ac power solution provides easy access to the capabilities of the instrument. Key tests such as inrush characterization are set-up in templates to facilitate testing. In addition to saving waveforms in non-volatile memory, they can be saved in the GUI and quickly downloaded to the source.

Key Literature

2002/03 Agilent Technologies Power Products Catalog, p/n 5988-7834EN

For more information, visit our web site:
<http://www.agilent.com/find/acpower>

Specification¹ (at 0 to 40°C unless otherwise noted)

	6811B	6812B	6813B
Number of Phases	1	1	1
Output Ratings			
Power	375 VA	750 VA	1750 VA
Maximum rms voltage	300 V	300 V	300 V
Maximum rms current	3.25 A	6.5 A	13 A
Maximum repetitive peak current	40 A	40 A	80 A
Crest factor	12	6	6
Output frequency range	dc; 45 Hz to 1 kHz	dc; 45 Hz to 1 kHz	dc; 45 Hz to 1 kHz
dc power (watts)	285 W	575 W	1350 W
dc voltage	±425 V	±425 V	±425 V
dc current	2.5 A	5 A	10 A

Measurement Accuracy ((25 ±5°C) from 45 – 100 Hz in High range where applicable)

	6811B	6812B	6813B
Output Ratings			
Rms voltage	0.03% +100 mV	0.03% +100 mV	0.03% +100 mV
Rms current	0.05% +10 mA	0.05% +10 mA	0.05% +10 mA
Power (VA)	0.1% +1.5 VA +12 mVA/V	0.1% +1.5 VA +12 mVA/V	0.1% +1.5 VA +12 mVA/V
Power (Watts)	0.1% +0.3 W +1.2 mW/V	0.1% +0.3 W +1.2 mW/V	0.1% +0.3 W +1.2 mW/V

¹For a sinewave with a resistive load.

Remote Sensing: Up to 1 Vrms can be dropped across each load lead
Command Processing Time: The average time for the output rms voltage to start to change after receiving a GPIB command is 10 milliseconds
Calibration Interval: One year
GPIB Capabilities: SH1, AH1, T6, L4, SR1, RL1 PPO, DC1, DT1, E1, and CO, and a command set compatible with IEEE-488.2 and SCPI
Regulatory Compliance: Safety: UL3111-1, CSA C22.2 No 1010.1, IEC 61010-1; EMC: Complies with EMC directive 89/336/EEC

Ordering Information

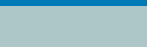
6813B-019 2000 VA ac Power Source/Analyzer
681xB-020 Dual Power Analyzer Option
681xB-026 26 volt, 0.1 A Auxiliary Reference Output (6812B, 6813B only)
681xB-1CM Rackmount Kit, p/n 5062-3977 (support rails required)
681xB-1CP Rackmount Kit with Handles, p/n 5062-3983 (support rails required)
Support Rails p/n E3663AC required when rackmounting the 6811B, 6812B, and 6813B Opt 1CM and Opt 1CP
681xB-100 (6811B and 6812B only) 87 to 106 Vac (100 Vac nominal), 47 to 63 Hz, Japan only
681xB-120 (6811B and 6812B only) 104 to 127 Vac (120 Vac nominal), 47 to 63 Hz
681xB-200 (6813B only) 174 to 220 Vac (200 Vac nominal), 47 to 63 Hz, Japan only
681xB-208 (6811B and 6812B only) 174 to 220 Vac (208 Vac nominal), 47 to 63 Hz
681xB-230 191 to 254 Vac (230 Vac nominal), 47 to 63 Hz
 A line cord option must be specified. For details, refer to page 118.

6800
Series
6811B
6812B
6813B

4

5 RF & Microwave

128



Signal Generators	130
Signal Analyzers	167
Millimeter Mixers	198
Amplifiers	199
EMI/EMC Test Systems	200
Cable TV Regulatory Test Equipment	203
Network Analyzers	205
Power Meters	242
Noise Figure Analyzers	247
Impedance Measuring Instruments	256
Materials Test Equipment	258
LCR & Resistance Meters	262
VCO/PLL Signal Test System	269
RF & Microwave Test Accessories	272



Agilent Technologies offers the widest selection of high-performance signal sources from dc to 110 GHz. They cover every application range from low-frequency navigation signals, through cellular mobile radio, to millimeter wave satellite systems. Each offers synthesized frequency accuracy and stability as well as calibrated level and remote programmability.

Modulation capabilities range from general purpose AM, Φ M, FM, pulse, and I/Q modulation to specific formats such as GSM, EDGE, W-CDMA and cdma2000.

For more information, visit our web site: <http://www.agilent.com/find/signalgenerator>

Signal Sources

Vector Signal Generators

Model	Frequency Range	Key Feature/Application	Page
E4438C ESG	250 kHz to 1, 2, 3, 4, 6 GHz	High performance RF vector signal generator with wide RF modulation bandwidth, improved internal baseband generator with more comprehensive capability for 3G (W-CDMA, 1xEV-DO, cdma2000, etc.) and adds GPS, WLAN formats. Works with Baseband Studio applications and accessories to provide fading, streaming of virtually unlimited length waveform files, and digital I/Q outputs.	131
E4430B/31B/32B/33B ESG	250 kHz to 1, 2, 3, 4 GHz	Internal baseband generator for arbitrary waveform and real-time signal generation of 2G, 3G (W-CDMA, 1xEV-DO, cdma2000, etc.), <i>Bluetooth</i> , and custom I/Q formats.	147
E4434B/35B/36B/37B ESG	250 kHz to 1, 2, 3, 4 GHz	Same as the E4430B/31B/32B/33B ESG, adds enhanced phase noise performance.	147
E8267C PSG	250 kHz to 20 GHz	Microwave custom I/Q modulation, complex pulse generation, two-tone, multi-tone, and Noise Power Ratio (NPR) tests. Works with Baseband Studio applications and accessories to provide streaming of virtually unlimited length waveform files and digital I/Q outputs.	140

Analog Signal Generators

Model	Frequency Range	Key Feature/Application	Page
E4400B/20B/21B/22B ESG	250 kHz to 1, 2, 3, 4 GHz	Superior level accuracy, wideband FM and phase modulation, electronic attenuator. Reliable and repeatable receiver and component test.	151
E4423B/24B/25B/26B ESG	250 kHz to 1, 2, 3, 4 GHz	Same as the E4400B/20B/21B/22B ESG, adds enhanced phase noise performance.	151
E8257C PSG	250 kHz to 20, 40 GHz	Low phase noise, high output power for component and receiver test (in channel and out of channel).	154
8648A/B/C/D	9 kHz to 1, 2, 3, 4 GHz	General purpose, low-cost receiver (including pager test) and component test. Semi-automated and automated manufacturing test with remote interface.	158
8644B/64A/65B	100 kHz to 2 GHz 252 kHz to 4, 6 GHz	Low phase noise at wide offsets for out of channel receiver tests.	160
8645A	252 kHz to 2 GHz	Fast frequency switching for frequency agile radios.	162
83650B	10 MHz to 50 GHz	50 GHz receiver test.	164

CW Signal Generators

Model	Frequency Range	Key Feature/Application	Page
E8247C PSG	250 kHz to 20, 40 GHz	Low phase noise, LO substitution, stimulus response test.	154
83650L	10 MHz to 50 GHz	50 GHz LO substitution and stimulus response test.	164

Millimeter-Wave Source Modules

Model	Frequency Range	Key Feature/Application	Page
83554A to 83558A	26.5 GHz to 110 GHz	Frequency extension to 110 GHz for the E8247C PSG, E8257C PSG, 83650B, 83650L.	166

- 6 GHz frequency range
- 160 MHz RF modulation bandwidth
- 320 Mbytes baseband memory
- 6 Gbyte non-volatile waveform storage



E4438C RF Vector Signal Generator

The Agilent E4438C ESG vector signal generator meets the needs of engineers who are designing and developing the next generation of wireless communication systems and is well suited for production test environments. An assortment of standards-based receiver and component test personalities for 3G and emerging communications formats are available to simplify the signal configuration process. The E4438C ESG vector signal generator's improved performance, extended frequency range, increased memory for waveform playback and storage, and application-specific personalities make it the clear choice for development and manufacturing from the component to the system level.

6 GHz Frequency Range

E4438C ESG provides different frequency options to suit your need:

- 1, 2, 3, 4 or 6 GHz

160 MHz RF Modulation Bandwidth

- Ideal for multi-carrier signals
- Up to 160 MHz RF modulation bandwidth using external I/Q inputs
- 80 MHz RF modulation bandwidth using internal baseband generator

320 Mbytes Baseband Memory

- 64 Msamples (320 Mbytes) for waveform playback
- 64x the memory of the previous generation
- Build longer, more complex waveforms

6 Gbytes Non-Volatile Memory

- 1.2 Gsamples (6 Gbytes) for storing waveforms and instrument states
- Eliminate waveform build times in manufacturing and development

Modulation Formats & Applications tailored for Both Component Testing as well as Receiver Testing

- | | |
|--------------------|---------------------------------|
| • TD-SCDMA (TSM) | • GPS |
| • W-CDMA | • 802.11a/b/g WLAN |
| • EDGE/GSM | • <i>Bluetooth</i> [™] |
| • 1xEV-DO/1xEV-DV | • AWGN |
| • cdma2000/cdmaOne | • Enhanced multitone |
| • NADC/PDC | • Custom |
| • PHS | • Pulse |
| • DECT | • Φ M/AM/FM |
| • TETRA | • Noise power ratio |

Powerful Standard Features

- Excellent spectral purity
- Electronic attenuator
- Simple softkey menu structure allows access to sophisticated features
- Built-in help
- Differential and single-ended I/Q outputs
- Suite of I/Q adjustments: gain, DC offsets, quadrature skew
- Save and recall instrument settings
- IntuiLink software allows easy data exchange from Microsoft[®] applications
- 10BaseT LAN and GPIB interfaces

Superior Dual Mode Baseband Generator

- Dual mode capability supports both waveform playback and real-time signal generation
- 80 MHz RF modulation bandwidth
- 64 Msamples (320 Mbytes) of waveform playback memory
- Generate waveforms at up to 100 Msamples/s
- Hardware resampling technology eliminates need for multiple reconstruction filters
- 16-bit DAC for improved dynamic range
- Flexible baseband reference clock 250 kHz to 100 MHz
- Industry standard filters or user-definable FIR filters
- Set E_b/N_o or C/N ratio for W-CDMA and cdma2000
- Generate AWGN with up to 80 MHz bandwidth

Baseband Studio

Baseband Studio is a suite of baseband signal applications and accessories that currently work with the E4438C ESG vector signal generator to emulate real-world signal conditions. The N5102A Baseband Studio digital signal interface module delivers ESG baseband signals as digital I/Q or IF data. A PC equipped with the N5101A Baseband Studio PCI card enables two new software applications. N5110 Baseband Studio for streaming lets you playback unique baseband waveform data of virtually unlimited length from a PC hard drive through the ESG for RF signal generation. N5115A Baseband Studio for fading provides digitally integrated fading of ESG baseband signals and calibrated noise in a single easy-to-setup solution.

For more info: www.agilent.com/find/basebandstudio

Signal Studio

Signal Studio is a collection of independent software applications that enable users to create waveform files for specific communications formats. The intuitive, easy-to-use graphical interface allows various signal parameters to be set for flexible waveform generation. Supported formats include:

- | | |
|--------------------|----------------------|
| • 802.11a/b/g WLAN | • Noise power ratio |
| • 1xEV-DO/1xEV-DV | • TD-SCDMA (TSM) |
| • <i>Bluetooth</i> | • Enhanced multitone |

Specifications For Frequency and Power Characteristics

Frequency

Frequency Range

Option¹

- 501 250 kHz to 1 GHz
- 502 250 kHz to 2 GHz
- 503 250 kHz to 3 GHz
- 504 250 kHz to 4 GHz
- 506 250 kHz to 6 GHz (requires Option UNJ)

Frequency Minimum

100 kHz²

Frequency Resolution

0.01 Hz

Frequency Switching Speed⁵

	Standard		With Option UNJ		With Option 506	
	Freq. ³	Freq./Amp. ⁴	Freq. ³	Freq./Amp. ⁴	Freq. ³	Freq./Amp. ⁴
Digital modulation on	<35 ms	<49 ms	<35 ms	<52 ms	<41 ms	<57 ms
Digital modulation off	<9 ms	<9 ms	<9 ms	<9 ms	<16 ms	<17 ms

[For hops <5 MHz within a band]

Digital modulation

on	<9 ms	<9 ms	<9 ms	<9 ms	<33 ms	<53 ms
off	<9 ms	<9 ms	<9 ms	<9 ms	<12 ms	<14 ms

Phase Offset

Phase is adjustable remotely (LAN, GPIB, RS-232) or via front panel in nominal 0.1° increments

Sweep Modes

Operating Modes

Frequency step, amplitude step and arbitrary list

Dwell Time

1 ms to 60 s

Number of Points

2 to 401

Internal Reference Oscillator

Stability⁶

	Standard	With Option UNJ or 1E5
Aging rate	<±1 ppm/yr	<±0.1 ppm/yr or <±0.0005 ppm/day after 45 days
Temp [0 to 55° C]	<±1 ppm	<±0.05 ppm
Line voltage	<±0.1 ppm	<±0.002 ppm
Line voltage range	(+5% to -10%)	(+5% to -10%)

RF Reference Output

- Frequency: 10 MHz
- Amplitude: 4 dBm ±2 dB

RF Reference Input Requirements

	Standard	With Option UNJ or 1E5
Frequency	1, 2, 5, 10 MHz ±10 ppm	1, 2, 5, 10 MHz ±1 ppm
Amplitude	-3.5 dBm to 20 dBm	
Input impedance	50 Ω	

Output Power

Power

	Standard	With Option UNB	With Option 506
250 kHz to 250 MHz	+11 to -136 dBm	+15 to -136 dBm	+12 to -136 dBm
>250 MHz to 1 GHz	+13 to -136 dBm	+17 to -136 dBm	+14 to -136 dBm
>1 to 3 GHz	+10 to -136 dBm	+16 to -136 dBm	+13 to -136 dBm
>3 to 4 GHz	+7 to -136 dBm	+13 to -136 dBm	+10 to -136 dBm
>4 to 6 GHz	N/A	N/A	+10 to -136 dBm

Level Resolution

0.02 dB

Level Range with Attenuator Hold Active

	Standard	With Option UNB	With Option 506
250 kHz to 1 GHz	23 dB	27 dB	24 dB
>1 to 3 GHz	20 dB	26 dB	23 dB
>3 to 4 GHz	17 dB	23 dB	20 dB
>4 to 6 GHz	N/A	N/A	20 dB

Level Accuracy [dB]

Standard^{6,7}

	Power Level			
	+7 to -50 dBm	-50 to -120 dBm	-120 to -127 dBm	<-127 dBm
250 kHz to 2.2 GHz	±0.5	±0.5	±0.6	(±1.5)
2.2 to 3 GHz	±0.5	±0.6	±0.7	(±2.5)
3 to 4 GHz	±0.6	±0.7	±0.8	(±2.5)

With Option UNB^{7,8}

	Power Level			
	+10 to -50 dBm	-50 to -120 dBm	-120 to -127 dBm	<-127 dBm
250 kHz to 2.2 GHz	±0.5	±0.5	±0.6	(±1.5)
2.2 to 3 GHz	±0.6	±0.7	±0.9	(±2.5)
3 to 4 GHz	±0.8	±0.9	±1.5	(±2.5)

With Option 506^{7,9}

	Power Level			
	+7 to -50 dBm	-50 to -110 dBm	-110 to -127 dBm	<-127 dBm
250 kHz to 2.2 GHz	±0.6	±0.6	±0.7	(±1.5)
2.2 to 3 GHz	±0.6	±0.7	±1.0	(±2.5)
3 to 4 GHz	±0.8	±0.9	±1.5	(±2.5)
4 to 6 GHz	±0.8	±0.9	(±2.5)	

Level Accuracy with Digital Modulation Turned On (relative to CW)

Conditions:

(with PRBS modulated data; if using I/Q inputs, $\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms}}$, nominal)¹⁰

Level Accuracy with ALC on

π/4 DQPSK or QPSK formats

Conditions: With raised cosine or root-raised cosine filter and α ≥ 0.35; with 10 kHz ≤ symbol rate ≤ 1 MHz; at RF freq ≥ 25 MHz; power ≤ max specified -3 dB

Constant amplitude formats (FSK, GMSK, etc)

Standard With Option 506

±0.15 dB ±0.20 dB

Level Accuracy with ALC off^{10,11} (±0.20 dB) (relative to ALC on)

Conditions: After power search is executed, with burst off.

Level Switching Speed¹⁰

	Standard	With Option UNB	With Option 506
Normal operation [ALC on]	<(15 ms)	<(21 ms)	<(21 ms)
When using power search manual	<(83 ms)	<(95 ms)	<(95 ms)
When using power search auto	<(103 ms)	<(119 ms)	<(119 ms)

Spectral Purity

SSB Phase Noise (at 20 kHz offset)¹²

	Standard	With Option UNJ
at 500 MHz	<(-124 dBc/Hz)	<-136 dBc/Hz, (<-139 dBc/Hz)
at 1 GHz	<(-118 dBc/Hz)	<-130 dBc/Hz, (<-133 dBc/Hz)
at 2 GHz	<(-112 dBc/Hz)	<-124 dBc/Hz, (<-127 dBc/Hz)
at 3 GHz	<(-106 dBc/Hz)	<-120 dBc/Hz, (<-123 dBc/Hz)
at 4 GHz	<(-106 dBc/Hz)	<-118 dBc/Hz, (<-121 dBc/Hz)
at 6 GHz	N/A	<-114 dBc/Hz, (<-117 dBc/Hz)

Residual FM¹² (CW mode, 0.3 to 3 kHz BW, CCITT, rms)

- Option UNJ <N x 1 Hz (<N x 0.5 Hz)¹³
- Standard
 - Phase noise mode 1 <N x 2 Hz
 - Phase noise mode 2 <N x 4 Hz

¹ The E4438C is available as a vector platform only. For analog models refer to the E4420B thru E4426B.

² Performance below 250 kHz not guaranteed.

³ To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.

⁴ Frequency switching time with the amplitude settled within ±0.1 dB.

⁵ Parentheses denote typical performance.

⁶ Quoted specifications for 23° C ± 5° C. Accuracy degrades by less than 0.03 dB/° C over full temperature range. Accuracy degrades by 0.3 dB above +7 dBm, and by 0.8 dB above +10 dBm.

⁷ Parentheses denote typical performance.

⁸ Quoted specifications for 23° C ± 5° C. Accuracy degrades by less than 0.01 dB/° C over full temperature range. Accuracy degrades by 0.2 dB above +10 dBm, and by 0.8 dB above +13 dBm.

⁹ Quoted specifications for 23° C ± 5° C. Accuracy degrades by less than 0.02 dB/° C over full temperature range. Accuracy degrades by 0.2 dB above +7 dBm.

¹⁰ Parentheses denote typical performance.

¹¹ When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.

¹² Parentheses denote typical performance.

¹³ Refer to frequency bands on next page for N values.

Specifications For Analog Modulation

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to \leq 250 MHz	1
2	>250 MHz to \leq 500 MHz	0.5
3	>500 MHz to \leq 1 GHz	1
4	>1 to \leq 2 GHz	2
5	>2 to \leq 4 GHz	4
6	>4 to \leq 6 GHz	8

Frequency Modulation^{1,4}

Maximum Deviation

Standard² With Option UNJ
 N x 8 MHz N x 1 MHz

Resolution

0.1% of deviation or 1 Hz, whichever is greater

Modulation Frequency Rate³ (deviation = 100 kHz)

Coupling	1 dB bandwidth	3 dB bandwidth
FM path 1 [DC]	DC to 100 kHz	(DC to 10 MHz)
FM path 2 [DC]	DC to 100 kHz	(DC to 0.9 MHz)
FM path 1 [AC]	20 Hz to 100 kHz	(5 Hz to 10 MHz)
FM path 2 [AC]	20 Hz to 100 kHz	(5 Hz to 0.9 MHz)

Deviation Accuracy² (1 kHz rate, deviation < N x 100 kHz)
 < \pm 3.5% of FM deviation + 20 Hz

Phase Modulation^{6,10}

Resolution

0.1% of set deviation

Modulation frequency response^{7,12}

Standard

Mode	Maximum Deviation	Allowable rates (3 dB BW)	
		Φ M path 1	Φ M path 2
Normal BW	N x 80 rad	DC to 100 kHz	DC to 100 kHz
High BW ¹¹	N x 8 rad	(DC to 1 MHz)	(DC to 0.9 MHz)
	N x 1.6 rad	(DC to 10 MHz)	(DC to 0.9 MHz)

With Option UNJ

Mode	Maximum Deviation	Allowable rates (3 dB BW)	
		Φ M path 1	Φ M path 2
Normal BW	N x 10 radians	DC to 100 kHz	DC to 100 kHz
High BW	N x 1 radians	(DC to 1 MHz)	(DC to 0.9 MHz)

Deviation Accuracy (1 kHz rate, Normal BW mode)

< \pm 5% of deviation + 0.01 radians

Distortion⁷ (1 kHz rate, deviation <80 radians on standard model,
 <10N radians on Option UNJ models, Normal BW mode) <1%

Amplitude Modulation^{6,8} (fc >500 kHz)

Range

0 to 100%

Resolution

0.1%

Rates (3 dB bandwidth)

- DC coupled: 0 to 10 kHz
- AC coupled: 10 Hz to 10 kHz

Accuracy^{9,12} 1 kHz rate \pm (6% of setting + 1%)

Distortion^{9,12} (1 kHz rate, THD)

Standard/Option UNJ Option 506

30% AM <1.5% <1.5%
 90% AM (<4%) (<5%)

Wideband AM

Rates (1 dB bandwidth)¹²

ALC on (400 Hz to 40 MHz)

ALC off (DC to 40 MHz)

Pulse Modulation

On/Off Ratio¹²

<2.8 GHz >80 dB

\geq 2.8 GHz (>64 dB)

Rise/Fall Times¹²

(150 ns)

Minimum Width¹²

ALC on (2 μ s)

ALC off (0.4 μ s)

Pulse Repetition Frequency¹²

ALC on (10 Hz to 250 kHz)

ALC off (DC to 1.0 MHz)

Level Accuracy^{12,13} (relative to CW at \leq 4 dBm standard, \leq 7.5 dBm Option UNB, \leq 4.5 dBm Option 506) (< \pm 1 dB)

Internal Pulse Generator

- Square wave rate: 0.1 Hz to 20 kHz
- Pulse
 - Period: 8 μ s to 30 seconds
 - Width: 4 μ s to 30 seconds
 - Resolution: 2 μ s

Internal Analog Modulation Source

(Provides FM, AM, pulse, and phase modulation signals and LF audio out)

Waveforms

sine, square, ramp, triangle, pulse, noise

Rate Range

Sine 0.1 Hz to 100 kHz
 Square, ramp, triangle 0.1 Hz to 20 kHz

Resolution

0.1 Hz

Frequency Accuracy

same as RF reference source

Swept Sine Mode (frequency, phase continuous)

Operating modes Triggered or continuous sweeps

Frequency range 0.1 Hz to 100 kHz

Sweep time 1 ms to 65 sec

Resolution 1 ms

Dual Sinewave Mode

Frequency range 0.1 Hz to 100 kHz

Amplitude ratio 0 to 100%

Amplitude ratio Resolution 0.1%

External Modulation Inputs

Modulation Types

Ext 1 FM, Φ M, AM, pulse, and burst envelope

Ext 2 FM, Φ M, AM, and pulse

High/Low Indicator (100 Hz to 10 MHz BW, AC coupled inputs only).

Activated when input level error exceeds 3% (nominal).

External Burst Envelope

Input Voltage

RF On: 0 V

RF Off: -1.0 V

Linear Control Range: 0 to -1 V

On/Off Ratio¹²

Condition: V_{in} below -1.05 V

<2.3 GHz >75 dB

\geq 2.3 GHz (>64 dB)

Rise/Fall Time¹²

Condition: With rectangular input (<2 μ s)

Minimum Burst Repetition Frequency¹²

ALC on (10 Hz)

ALC off DC

Input Port

External 1

Input Impedance

50 Ω , nominal

Composite Modulation

AM, FM, and Φ M each consist of two modulation paths which are summed internally for composite modulation. The modulation sources may be any two of the following: Internal, External 1, External 2.

Simultaneous Modulation

Multiple modulation types may be simultaneously enabled with some exceptions. Two modulation types cannot be generated simultaneously by the same modulation source.

¹ All analog performance above 4 GHz is typical.

² Refer to frequency bands on this page to compute specifications.

³ At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of calibration.

⁴ For non-Option UNJ units, specifications apply in phase noise mode 2 (default).

⁵ Parentheses denote typical performance.

⁶ All analog performance above 4 GHz is typical.

⁷ Refer to frequency bands on this page for N.

⁸ AM is typical above 3 GHz or if wideband AM or I/Q modulation is simultaneously enabled.

⁹ Peak envelope power of AM must be 3 dB less than maximum output power below 250 MHz.

¹⁰ For non-Option UNJ units, specifications apply in phase noise mode 2 (default).

¹¹ Bandwidth is automatically selected based on deviation.

¹² Parentheses denote typical performance.

¹³ With ALC off, specifications apply after the execution of power search. With ALC on, specifications apply for pulse repetition rates \leq 10 kHz and pulse widths \geq 5 μ s.

E4438C ESG

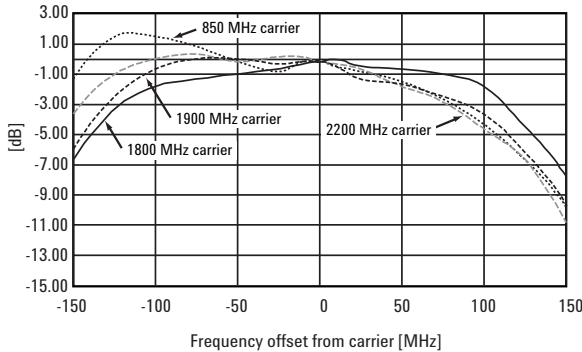
Specifications For I/Q Characteristics

I/Q Modulation Bandwidth

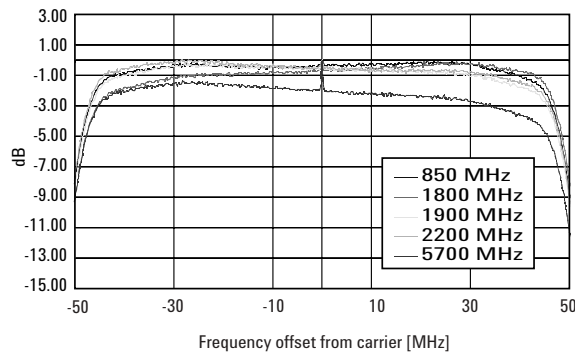
I/Q Inputs

Input impedance 50 Ω or 600 Ω
Full scale input¹ $\sqrt{I^2 + Q^2} = 0.5 V_{rms}$

I/Q Bandwidth Using External I/Q Source (ALC off)²



I/Q Bandwidth Using Internal I/Q Source



¹The optimum I/Q input level is $\sqrt{I^2 + Q^2} = 0.5 V_{rms}$. I/Q drive level affects EVM, origin offset, spectral regrowth, and noise floor. Typical level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms} .

²Parentheses denote typical performance.

I/Q Adjustments

Source	Parameter	Range
I/Q baseband inputs	Impedance	50 or 600 Ω
	I offset (600 Ω only)	±5 V
	Q offset (600 Ω only)	±5 V
I/Q baseband outputs	I/Q offset adjustment	±3 V
	I/Q offset resolution	1 mV
	I/Q gain balance	±4 dB
	I/Q attenuation	0 to 40 dB
	I/Q low pass filter	40 MHz, thru
RF output	I/Q offset adjustment	±50%
	I/Q gain balance	±4 dB
	I/Q attenuation	0 to 40 dB
	I/Q quad skew (≤3.3 GHz)	±10°
	I/Q quad skew (>3.3 GHz)	±5°
	I/Q low pass filter	2.1 MHz, 40 MHz, thru

Baseband Generator (arbitrary waveform mode) (Option 601 or 602)

Channels

2 (I and Q)

Resolution

16 bits (1/65,536)

Arbitrary Waveform Memory

- Maximum playback capacity
 - 8 Msamples/channel (Option 601)
 - 64 Msamples/channel (Option 602)
- Maximum storage capacity
 - Gsamples (Option 005)
 - 1Msample (Standard)

Waveform Segments

- Segment length: 60 samples to 8 Msamples or 32 Msamples
- Maximum number of segments
 - 1,024 (8 Msamples volatile memory)
 - 8,192 (64 Msamples volatile memory)
- Minimum memory allocation: 256 samples or 1 kbyte blocks

Waveform Sequences

- Maximum total number of segment files stored in the non-volatile file system: 16,384
- Sequencing: Continuously repeating
- Maximum number of sequences 16,384 (shared with number of segments)
- Maximum segments/sequence: 32,768 (including nested segments)
- Maximum segment repetitions: 65,536

Clock

Sample rate: 1 Hz to 100 MHz

Resolution: 0.001 Hz

Accuracy: same as timebase +2⁻⁴² (in non-integer applications)

Baseband Filters

40 MHz: used for spur reduction

2.1 MHz: used for ACPR reduction

Through: used for maximum bandwidth

Reconstruction Filter: (fixed)

50 MHz: (used for all symbol rates)

Triggers

Types: Continuous, single, gated, segment advance

Source: Trigger key, external, remote (LAN, GPIB, RS-232)

External polarity: Negative, positive

External delay time: 10 ns to 40 sec plus latency

External delay resolution: 10 ns

Markers

(Markers are defined in a segment during the waveform generation process, or from the ESG front panel. A marker can also be tied to the RF blanking feature of the ESG.)

Marker polarity: Negative, positive

Number of markers: 4

Multicarrier

Number of carriers: Up to 100 (limited by a max bandwidth of 80 MHz depending on symbol rate and modulation type)

Frequency offset (per carrier): -40 MHz to +40 MHz

Power offset (per carrier): 0 dB to -40 dB

Modulation

PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK

QAM: 4, 16, 32, 64, 256

FSK: Selectable: 2, 4, 8, 16

MSK

Data

Random ONLY

Multitone

Number of tones: 2 to 64, with selectable on/off state per tone

Frequency spacing: 100 Hz to 80 MHz

Phase (per tone): Fixed or random

Baseband Generator (real-time mode) (Option 601 or 602)

Basic Modulation Types (custom format)

• PSK: BPSK, QPSK, OQPSK, π/4DQPSK, 8PSK, 16PSK, D8PSK

• MSK: User-defined phase offset from 0 to 100°

• QAM: 4, 16, 32, 64, 256

• FSK

– Selectable: 2, 4, 8, 16 level symmetric, C4FM

– User defined: Custom map of up to 16 deviation levels:

Symbol rate Maximum Deviation

<5 MHz 4 times symbol rate

>5 MHz, <50 MHz 20 MHz

Resolution: 0.1 Hz

I/Q

Custom map of 256 unique values

FIR Filter

Nyquist, root Nyquist, Gaussian, rectangular, APCO 25, Custom FIR α : 0 to 1, B_0 , T : 0.1 to 1

Symbol Rate

Adjustable up to 50 Mb/s/sec

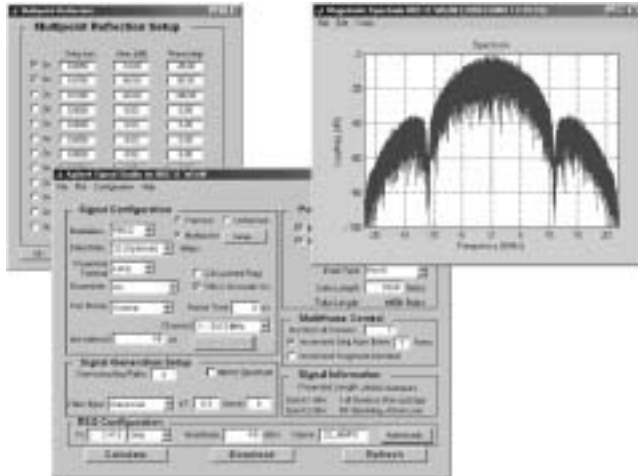
Data Types

- Internally generated data
 - Pseudo-random patterns
 - PN9, PN11, PN15, PN20, PN23
 - Repeating sequence
 - Any 4-bit sequence
 - Other fixed patterns
- Direct-pattern RAM (PRAM)
 - Max size
 - Option 601 8 Mb/s
 - Option 602 64 Mb/s (each bit uses an entire sample space)
 - Use
 - Non-standard framing
- User File
 - Max size
 - Option 601 800 kbytes
 - Option 602 6.4 Mbytes
 - Use
 - Continuous modulation or internally generated TDMA standard
- Externally Generated Data
 - Type
 - Serial data
 - Inputs
 - Data, bit clock, symbol sync
 - Accepts data rates $\pm 5\%$ of specified data rate

Internal Burst Shape Control

Rise/fall time range: Up to 30 bits

Rise/fall delay range: 0 to 63.5 bits

**Signal Studio for 802.11 WLAN (Option 417)**

Signal Studio for 802.11 WLAN simplifies your role in creating 802.11 a/b/g test signals for use with the E4438C ESG vector signal generator. Rather than spending valuable time creating your own 802.11 waveforms, use the software to create fully-coded, standards-based 802.11 frames and modulated data streams. Waveforms can easily be configured in an intuitive graphical interface and downloaded to the ESG to perform various receiver and component tests at RF and baseband.

Signal Studio for 802.11 WLAN, Option 417, replaces options 405, 410 and 415.

Signal Studio for 802.11 WLAN Features¹**WLAN Formats Supported**

802.11a, 802.11b, and 802.11g

Framing

Framed: bursted framed data includes preamble and header fields

Non-framed: non-bursted continuous data

Modulation Formats

DBPSK, DQPSK, BPSK, QPSK, 8-PSK, 16-QAM, 64-QAM

Data Rates

1, 2, 5.5, 6, 9, 11, 12, 18, 22, 24, 33, 36, 48, 54, custom

Data Source

1s, 0s, 01s, 10s, PN9, PN15, user file

Payload Data Length

Maximum: 2346 bytes (with MAC header and MAC FCS)

Minimum: 0 byte

Encoding Rates

1/2, 2/3, 3/4

Idle Interval

0 to 100,000 μ s

Oversample Ratio

2 to 9

Baseband Filtering

None, Gaussian, root cosine, ideal low pass, and user defined

Windowing for OFDM Modes

Raised cosine windowing for each OFDM symbol

Power Ramping for DSSS Modes

None, linear, cosine

Ramp time: 0 to 100,000 μ s

Scrambler

On, off, preamble only

Subcarrier Setup for OFDM Modes

Subcarriers are individually selectable

Service Field

0 to FFFF Hex (16 bits: First 7 LSB are masked to 0)

Scrambler Seed Initialization Value

0 to 7F Hex

Multipoint Reflection

Paths: 12

Delay: 0 to 10 μ s (Resolution: 0.1 ns)

Attenuation: 0 to -60 dB

Phase: $\pm 180^\circ$

Multiframe

Maximum no. of frames: Up to 2000, depends on

data rate, OSR, idle interval, and payload length

Segment field: 0 to 15

Sequence field: 0 to 4095

¹Features subject to change.

E4438C ESG

Signal Studio for 1xEV-DV and cdma2000 (option 414)

Signal Studio for 1xEV-DV and cdma2000 is a flexible software application for configuring 3GPP2 standards-based signals. The software works seamlessly with the E4438C ESG vector signal generator to generate RF test signals with the highest standards of performance. These test signals are available at RF, and also at baseband using the single-ended and differential I/Q outputs.

Agilent's first-to-market solution enables you to meet your market windows with confidence in your design. You save valuable time using Signal Studio to configure test signals rather than hand-coding your own. You can be confident your designs and devices are tested with standards-based signals, no matter which one of the over 100 possible configurations you choose. Be assured that the high level of signal coding enables thorough evaluation of receiver demodulation capabilities at various design stages, from baseband to RF.

Features

BTS/Mobile Setup

- Spread Rate: SR1
- Chip Rate: 1 kcps to 1.3 Mcps
- Voice Channel Power: -40 dBm to 0 dBm
- PDCH & PDCCH Channel Power: -60 dBm to 0 dBm
- PN Offset: 0 to 511
- Even Second Delay: 0.5 to 128 chips
- Trigger (reverse link): Trigger advance: 1 to 2457599, rising or falling edge
- Long Code State: 0 to 3FF FFFF FFFF Hex
- Phase Polarity: Normal or invert
- ESG Baseband Generator Reference Clock: Internal or external
- Input/Output:
 - (AUX): Data out, Data clock out, Symbol sync out, Alt power in, Event 3 out, Event 4 out
 - (BNC): Event 1 out, Event 2 out, Pattern trigger in, Single-ended Analog I/Q out, Differential Analog I/Q out
- Filters: IS-95, IS-95 with equalizer, IS-95 modified (MOD), IS-95 MOD with equalizer, Rectangular, Nyquist, Root Nyquist, Gaussian, UN3/4 GSM Gaussian, APCO 25 C4FM

Forward Link

Forward Link Channels: Pilot (F-PICH), synchronization (F-SYNC), quick paging (F-QPCH), paging (F-PCH), fundamental (F-FCH), supplemental 1 and 2 (F-SCH1, F-SCH2), orthogonally coded noise simulator (OCNS), packet data 1 & 2 (F-PDCH1, F-PDCH2), packet data control 1 and 2 (F-PDCCH1, F-PDCCH2)

Reverse Link

- Reverse Link Channels: Pilot (R-PICH), access (R-ACH), enhanced access (R-EACH), dedicated control (R-DDCH), common control (R-CCCH), supplemental 1 and 2 (R-SCH1, R-SCH2)
- Eb/No (Requires Option 403)
 - Minimum: -30 dB + normalized channel power + 10 log₁₀ (chip rate/bit rate)
 - Maximum: +30 dB + normalized channel power + 10 log₁₀ (chip rate/bit rate)

3 GPP W-CDMA Firmware Personality (option 400)

The 3GPP W-CDMA firmware option for the Agilent E4438C ESG Vector Signal Generator provides a broad collection of W-CDMA test signals. Combining the 3GPP W-CDMA waveform playback and real-time personalities into a single firmware option provides a viable test solution for evolving 3G mobile radio networks – from the component to the system level. This simplifies the ordering process and provides a flexible test solution for both development and manufacturing engineers.

Key Features

W-CDMA real-time signal generation

- Transmit Diversity
- Fully Coded Compressed mode
- Multiple PRACH
- Set AWGN using C/N, E_b/N₀, or E_c/N₀
- Closed loop power control
- 16 OCNS channels in the downlink
- Adjust channel powers in real-time
- Preconfigured 3GPP W-CDMA tests

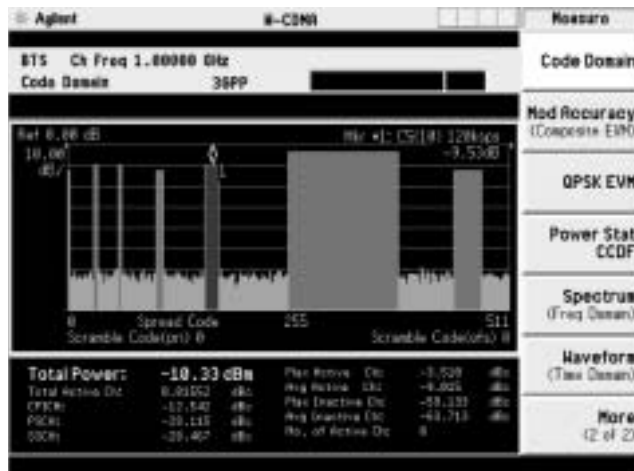
W-CDMA waveform playback

- HSDPA support
- Fast waveform build times
- Generate up to 16 carriers
- Multi-carrier timing and phase offsets
- Multi-carrier clipping

English URL www.agilent.com/find/products

Feature	W-CDMA Arbitrary Waveform Playback	W-CDMA Real-Time Signal Generation
Access Method Supported	Frequency Division Duplex [FDD] W-CDMA	
Compliant to Sept 2002 3GPP W-CDMA Specifications		
Primary Application	Component testing Example, testing ACPR and EVM where spectrally correct signals are needed	Receiver testing & ASIC and baseband verification Example testing BER and frames with full channel coding are needed
Coding Level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Fully coded Supports transport & physical layer coding, i.e. CRC, convolutional/turbo coding, interleaving, rate matching, etc.
Waveform Length	10 ms continuously repeated	Infinite
Filters	Standards based and custom	Standards based and custom
Baseband Clipping	Yes	No
Differential Outputs Available	Yes	Yes
Number of DPCH Channels	512	2
Number of OCNS	512	16
Data Types	PN9, random, 8 bit pattern	PN9, PN15, User File, 4 bit pattern
Standards Based Setups	Test models 1 through 4	Reference measurement channels Conformance tests
Multi-Carrier	16 Carriers	1
Compressed Mode	No	Yes
Set C/N, E _c /N ₀ or E _b /N ₀	No	Yes
Waveform Build Times	Seconds	Milliseconds
Downlink Channels	C-PICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, DPCH, OCNS, HS-SCCH, HS-PDSCH	C-PICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, OCNS
Uplink Channels	DPCH, DPDCH	DPCH, DPDCH, PRACH

Please refer to the opt 400 Product Overview for detailed specification.



Korean URL www.agilent.co.kr/find/products

cdma2000 and IS-95A personalities (Option 401)

Feature	IS-95A Arbitrary Waveform Playback	cdma2000 Arbitrary Waveform Playback	cdma2000 Real-Time Signal Generation
Primary Application	Component testing	Component testing	Receiver testing and ASIC baseband verification
Signal Coding Level	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Partially coded Supports physical layer coding, i.e. spreading and scrambling only	Fully coded Supports CRC, convolutional/turbo coding, interleaving, power control and complex scrambling
Waveform Length	26.67 ms	26.67 ms	Infinite
Number of Carriers	Up to 12	Up to 12	1
Number of Channels per Carrier	Up to 256	Up to 256	Up to 8 forward link Up to 5 reverse link
Set E_b/N_0 and C/N	No	No	Yes

Please refer to the option 401 Product Overview for detailed specification.

Signal Studio for 1xEV-DO (Option 404)

Forward Link	
Pilot Channel	PN offset index: 0 to 511 Selectable mode: continuous or bursted
MAC Channel	
Reverse activity	Data: 0 or 1 Gain relative to pilot: -30 dB to +30 dB
Reverse power control	Data: 0 or 1 Gain relative to pilot: -30 dB to +30 dB
Traffic Channel	Data bitstream: 0s, 1s, 01s, 10s, PN9, PN15 Modulation type: QPSK, 8-PSK, 16-QAM
Idle Slot Gain	Noise level relative to pilot: 0 dB to -80 dB
Filter Types	Rectangular, IS-95 standard, IS-95 modified (improved ACP), phase equalization
Oversampling Ratio	Valid range: 2 to 30
Forward Link FTM (factory test mode)	
Pilot Channel	PN offset index: 0 to 511
MAC Channel	I/Q data: all zeros
Traffic Channel	Number of packets: 1 to 32 Preamble MAC index: 5 to 63 Packet payload: 0s, 1s, 01s, 10s, PN9, PN15 Data rate: 38.4, 76.8, 153.6, 307.2, 614.4, 921.6, 1228.8, 1843.2, 2457.6 kbps Encoding rate: 1/5 or 1/3 (automatically set) Modulation type: QPSK, 8-PSK, 16-QAM
Control Channel	Data rate: 38.4 and 76.8 kbps
Filter Types	Rectangular, IS-95 standard, IS-95 modified (improved ACP), phase equalization
Oversampling Ratio	Valid range: 2 to 30
Reverse Link	
Pilot Channel	
Reverse Rate Indicator Channel	Data: 0 to 7 Octal
Data Rate Control Channel	Data: 0 to F Hexadecimal Walsh Cover Index: 0 to 7 Gain relative to pilot: -30 dB to +30 dB
Data Channel	Data Bitstream: 0s, 1s, 01s, 10s, PN9, PN15 Data rate: 9.6, 19.2, 38.4, 76.8, 153.6 kbps Encoding rate: 1/4 rate @ 9.6, 19.2, 38.4, 76.8 kbps 1/2 rate @ 153.6 kbps Modulation type: BPSK
I/Q Mask (42-bit)	Valid Range: 0000000000 to 3FFFFFFF
Filter Types	Rectangular, IS-95 standard, IS-95 modified (improved ACP)
Oversampling Ratio	Valid range: 2 to 30

Signal Studio for TD-SCDMA (TSM) (Option 411)

General Configuration	
Specification Version	CWTS TSM 05.02 V3.0.0 (2002-08) CWTS TSM 05.03 V3.0.0 (2002-08) CWTS TSM 05.04 V3.0.0 (2002-08)
Scramble Code	0 to 127
Midamble Base	0 to 127
Max Users	2, 4, 6, 8, 10, 12, 14, or 16
Baseband Filtering	Root Nyquist and Nyquist with adjustable filter alpha, Gaussian, or rectangle
Filter Optimization	ACP or EVM
IQ Phase	Normal or inverted
Number of Uplink Slots (switch point)	1 to 6
Chip Clock	Internal or external
Chip Rate	320 kcps to 1.408 Mcps
Graphic Displays	Frame timeslot structure
Pilot Signal Configuration	
DwPTS (downlink pilot timeslot physical channel)	
Downlink SYNC code	0 to 31
Power	0 to -40 dB
Phase pattern	S1, S2, or none
UpPTS (uplink pilot timeslot physical channel)	
Uplink SYNCH code	0 to 255
UpPTS power	0 to -40 dB
Time offset	-5 to 5 chips
Resources Unit (RU) Configuration (Uplink and Downlink)	
Physical Channel Type	DPCH
Number of Channels	Up to 16 channels per timeslot
Slot Number	0 to 6
Spread Factor	1, 2, 4, 8, or 16
Channelization Code	0 to 15
User Number	1 to 16
Data Type	Fixed 4-bit pattern, PN9, PN15
Time Offset	-5 to 5 chips
Power Level	0 to -60 dB

Option 411 (cont.)

Transport Layer Coding (Uplink and Downlink)	
Number of Fully-Coded Transport Channels	8 channels that can be independently allocated to any timeslot
Spread Factor	8 or 16
Channelization Code	0 to 15
Transport Channel Types	Uncoded, TCH-T/EFS, TCH-T/F9.6M, TCH-T/F9.6, TCH-T/HS, TCH-T/F14.4M, TCH-T/F14.4, FACCH-T/F, FACCH-T/H, BCCH-T, PCH-T, AGCH-T, NCH-T, CBCH-T, RACH-T, FACH-T, HOACH-T, FNICH-T
Data Source for Transport Channel ¹	Fixed 4-bit pattern, PN9, PN15, user file
Error Insertion	BLER, BER, or none for either data field
User Number	1 to 16
Time Offset	-5 to 5 chips (uplink)
Power Level	0 to -60 dB

GPS Personality (Option 409)

Ranging Code	Choice of code: C/A, P, C/A+P Preset: C/A
Satellite ID	Valid range: 1 to 37 Preset: 1
Carrier Frequency	User-settable for 250 kHz up to 6 GHz depending on purchase of option 501, 502, 503, 504 or 506 for the ESG
Doppler Shift	Valid range: -125 kHz to +125 kHz Preset: 0.0
Data Modes for C/A Code Only	Choice of mode: telemetry, raw, encoded
TLM	Choice of data: not user-selectable
Raw	Choice of data: PN9, PN15, fix-4, user file Preset: PN9
Encoded	Choice of data: PN9, PN15, fix-4, user file
GPS Reference Frequency (f ₀)	Valid range: 1 kcps to 12.5 Mcps Preset: 10.23 Mcps
Chip Rate	C/A chip rate is automatically set equal to one-tenth of f ₀ -value; P chip rate set equal to f ₀ -value Preset: C/A chip rate 1.023 Mcps, P chip rate 10.23 Mcps
GPS Reference Clock	Choice of internal (equal to f ₀) or external (user supplied) clock source Preset: internal
Relative P Code Power	Valid range: 0 to -40 dB
Filter Types	Rectangular, IS-95 standard, IS-95 modified (improved ACP), IS-2000, root Nyquist, Nyquist, Gaussian, user FIR Preset: rectangular
I/Q Code Phase	Choice of normal (P code phase lags C/A code phase) or inverted Preset: normal

Signal Studio for Noise Power Ratio (Option 421)

Noise Bandwidth	80 MHz (maximum)
Notch Width	0.001% to 20% relative to noise bandwidth
Notch Center	±50% relative to noise bandwidth center frequency
Notch Suppression ^{1,2}	
ESG/PSG integrated NPR	-66 dBc (typical for 2001 tones) -61 dBc (typical for 8001 tones)
ESG/PSG notch IMD tones ³	-60 dBc (typical for 2001 tones) -55 dBc (typical for 8001 tones)
Temperature Stability ²	
ESG/PSG	1 dB/°C (typical for integrated NPR) 1 dB/°C (typical for notch IMD tones)
Amplitude Accuracy	±0.5 dB over noise BW (typical)

¹ Depends on number of tones and available calibration time.

² ≤ 8001 tones (with random phase relationships), 80 MHz noise bandwidth, 1% to 10% notch width, notch offsets ≤ 8 MHz. Carrier feedthrough is ignored.

³ For best performance, use notch offsets to avoid placing notch within 100 kHz from carrier.

Signal Studio for Bluetooth (Option 406)

Data Streams	0s, 1s, 01s, 10s, 8-bit pattern, PN9, PN15
Packet Types	
ACL	DH1, DH3, DH5, DM1, DM3, DM5, AUX1
SCO	HV1, HV2, HV3, DM1
Control	NULL, POLL, ID
Bluetooth Device Address	Valid range: 0000 0000 0000 to FFFF FFFF FFFF Hex
Active Member Address	Valid range: 0 to 7
Payload Data Patterns	0s, 1s, 01s, 10s, 8-bit pattern, PN9, PN15, user file
Burst Power Ramp	Power ramp valid range: 1 to 10 μs Ramp settling valid range: 1 to 20 μs (cannot be more than 10 μs greater than the power ramp setting) Dirty transmitter test menu • Power ramp valid range: 1 to 100 μs • Ramp settling valid range: 1 to 120 μs (cannot be more than 20 μs greater than the power ramp setting) Resolution: 1 μs
Impairments	
Frequency Offset	Valid range: -100 kHz to 100 kHz Dirty transmitter test valid range: -150 to 150 kHz Resolution: 1 kHz
Frequency Drift	
Linear	Valid range: -100 kHz to 100 kHz Resolution: 1 kHz
Sinusoidal	Valid range: -100 kHz to 100 kHz Resolution: 1 kHz Rate: 300 Hz, 500 Hz, 1.6 kHz
Modulation Index	Valid range: 0.250 to 0.400 Dirty transmitter test valid range: 0.200 to 0.400 Resolution: 0.001
Symbol Timing Error	Valid range: -50 ppm to 50 ppm Dirty transmitter test valid range: -150 ppm to 150 ppm Resolution: 1 ppm
AWGN	C/N valid range: 10 dB to 40 dB Resolution: 1 dB Seed valid range: 1 to 65535
Clock and Gate Delay	Valid range: 0 to 100 μs Resolution: (1 μs/oversampling ratio)
Oversampling Ratio	Valid range: 2 to 20

Signal Studio for Enhanced Multitone¹ (Option 408)

Number of Tones	2 to 64
Tone Spacing	1 kHz to 50 MHz, limited by 80 MHz I/Q bandwidth
Tone Power (relative)	0 to -50 dB
Phase Distribution	Fixed, random or parabolic
Suppression Level	-50 to -90 dBc, depending on number of tones and available calibration time. Expected suppression = 80 dBc - 10 log (N/8), where N is the number of tones
Calibration Interval	8 hours
Calibration Time	10 minutes (8 tones, -80 dBc suppression)
Temperature Stability	1 dB/°C (typical for IMD products) 5 dB/°C (worst case for LO feedthrough and unbalanced images)

AWGN (real-time mode) (Option 403)

Crest Factor (output power set at least 16 dB below maximum power)	>16 db
Randomness	89 bit pseudo-random generation, repetition period 3 x 10 ⁹ years
Carrier to Noise Ratio	Magnitude error ≤ 0.2 dB at baseband I/Q outputs.

¹ All values typical.

TDMA Personalities (Option 402)¹

The following formats are included with option 402: NADC, PDC, PHS, TETRA, DECT, GSM, GPRS, EDGE, EGPRS

Bit Error Rate (BER) Analyzer (Option UN7)

Clock Rate	100 Hz to 60 MHz
Supported Data Patterns	PN9, 11, 15, 20, 23
Resolution	10 digits
Bit Sequence Length	100 bits to 4.294 Gbits after synchronization

General Characteristics**Operating Characteristics**

Power Requirements	90 to 254 V; 50, or 60 Hz; 300 W maximum, power factor corrected. Not for 400 MHz use. ⁴
Operating Temperature Range ³	0 to 55°C
Shock and Vibration	Meets MIL-STD-28800E Type III, Class 3.
Leakage	Conducted and radiated interference meets MIL-STD-461C CE02 Part 2 and CISPR 11. Leakage is typically <1 μ V (nominally 0.1 μ V with a 2-turn loop) at \leq 1000 MHz, measured with a resonant dipole antenna, one inch from any surface with output level <0 dBm (all inputs/outputs properly terminated).
Storage Registers	Memory is shared by instrument states, user data files, sweep list files and waveform sequences. Depending on the number and size of these files, up to 100 storage registers and 1000 register sequences (10 per register) are available.
Weight	<16 kg (35 lb.) net, <23 kg (50 lb.) shipping
Dimensions	133 mm H x 426 mm W x 432 mm D (5.25 in H x 16.8 in W x 17 in D)
Remote Programming Interface	GPIO (IEEE-488.2-1987) with listen and talk, RS-232, LAN (10BaseT).
Control languages ²	SCPI version 1996.0, also compatible with 8656B and 8657A/B/C/D/J1 mnemonics.
Functions controlled	All front panel functions except power switch and knob.

Key Literature

E4438C ESG Vector Signal Generator, Datasheet, literature number 5988-4093EN
 Agilent E4438C ESG Vector Signal Generator, Brochure, literature number 5988-3935EN
 E4438C ESG Vector Signal Generator, Configuration Guide, literature number 5988-4085EN

For more information, visit our web site: www.agilent.com/find/esg

Ordering Information**Frequency Options**

E4438C-501 1 GHz frequency range
 E4438C-502 2 GHz frequency range
 E4438C-503 3 GHz frequency range
 E4438C-504 4 GHz frequency range
 E4438C-506 6 GHz frequency range (requires option UNJ, includes mechanical attenuator)

Hardware Options

E4438C-UNB High output power with mechanical attenuator (included with 506)
 E4438C-UNJ Enhanced phase noise performance (includes 1E5)
 E4438C-1E5 High-stability time base
 E4438C-1EM Moves all front panel connectors to rear
 E4438C-601 Internal baseband generator with 8 Msamples with digital bus capability
 E4438C-602 Internal baseband generator with 64 Msamples with digital bus capability
 E4438C-005 6 Gbyte internal hard drive, requires option 601 or 602
 E4438C-003 Enables digital output connectivity with N5102A
 E4438C-UN7 Internal bit-error-rate analyzer
 E4438C-300 GSM/EDGE base station loopback BERT

Firmware Options

E4438C-400 3GPP W-CDMA FDD personalities
 E4438C-401 cdma2000 and IS-95A personalities
 E4438C-402 TDMA personalities (includes GSM, EDGE, NADC, PDC, PHS, TETRA, DECT)
 E4438C-403 Calibrated noise personality
 E4438C-409 GPS personality

Signal Studio Software Options⁵

E4438C-404 1xEV-DO
 E4438C-414 1xEV-DV
 E4438C-406 Bluetooth
 E4438C-408 Enhanced Multitone
 E4438C-411 TD-SCDMA (TSM)
 E4438C-417 802.11 WLAN
 E4438C-421 Noise power ratio (NPR)

N5101A Baseband Studio PCI card**N5110A Baseband Studio for waveform streaming**

N5110A-120 Hard drive waveform streaming up to 20 MSa/s
 N5110A-121 Extend hard drive streaming bandwidth from 20 up to 40 MSa/s
 N5110A-125 Signal generator hard drive streaming connectivity

N5115A Baseband Studio for fading

N5115A-160 One fading channel with up to 17 MHz RFBW
 N5115A-161 Extend one fading channel from 17 up to 30 MHz RFBW
 N5115A-168 Add AWGN to one fading channel
 N5115A-170 ESG signal generator connectivity for one fading channel

N5102A Baseband Studio digital signal interface module

¹Parentheses denote typical performance.

²ESG series does not implement 8657A/B "Standby" or "On" (R0 or R1, respectively) mnemonics.

³Save and recall of user files and instrument states from non-volatile storage is guaranteed only over the range 0 to 40°C.

⁴For 400 MHz systems, order transformer 70001-60066.

⁵Requires either Option 001 or 002 (baseband generator) to function.

E8267C

- First microwave signal generator with integrated vector modulation up to 20 GHz
- Frequency coverage up to 110 GHz for analog and CW applications
- Highest output power in the industry
- Excellent phase noise performance
- Ramp sweep and scalar analyzer interface now available



The Agilent PSG signal generators offer the features you need to be successful in today's complex technical environment. Whether working on aerospace and defense applications such as radar systems and satellite communications, terrestrial microwave radio for broadband wireless access, or performing component tests, the PSG is the solution for you.

5

E8267C Realistic Signal Simulation for Radar, Satellite Communication and Broadband Wireless

- Integrated microwave vector signal generator operating up to 20 GHz
- Internal baseband generator achieves 80 MHz RF modulation bandwidth
- External I/Q inputs achieves 160 MHz RF modulation bandwidth
- Optional extended bandwidth to 1 GHz
- Flexible waveform sequencing
- Flexible analog modulation formats: AM, FM, Φ M, and pulse
- Narrow pulse modulation (20 ns) down to 10 MHz
- Industry leading high output power
- Enhanced phase noise

The new PSG Vector Signal Generator can Help you Simulate Real-World Environments

Many systems that operate at microwave frequencies need wide modulation bandwidths ranging from tens to hundreds of megahertz, whether they are pulsed radar sets or broadband wireless communication systems. The E8267C has features that enable the generation of vector modulated signals and include:

- Internal I/Q modulation capability
- Optional wideband I/Q inputs supporting RF modulation bandwidth of 1 GHz
- Optional internal baseband generator, which operates in dual mode, combining the capabilities of a 64 Msample, deep memory arbitrary waveform generator with the sophisticated coding power of a real-time baseband generator
- Standard two-tone and multitone applications are built into the optional internal baseband generator of the PSG vector signal generator. Users can press a few simple soft keys to quickly generate multitone waveforms, and define relative tone spacing, relative tone power and phase relationships. These capabilities eliminate the issues associated with combining multiple continuous wave signal generators, and significantly reduce test costs
- Compatibility with industry-standard software packages – including Agilent's Advanced Design System (ADS) software and other industry standard software packages such as MATLAB and Excel® – which makes it easy to generate and download customized arbitrary waveform files

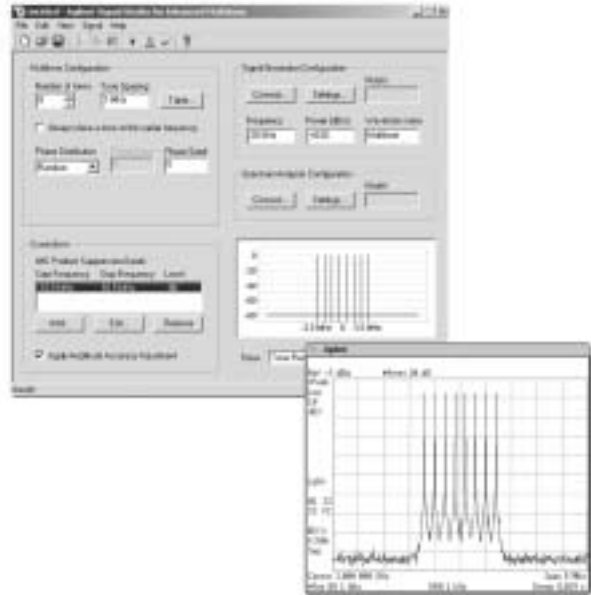
Baseband Studio

Baseband Studio is a suite of baseband signal applications and accessories that currently work with the E8267C PSG vector signal generator to emulate real-world signal conditions. The N5102A Baseband Studio digital signal interface module delivers PSG baseband signals as digital I/Q or IF data. A PC equipped with the N5101A Baseband Studio PCI card enables a new software application. N5110 Baseband Studio for streaming lets you playback unique baseband waveform data of virtually unlimited length from a PC hard drive through the ESG for RF signal generation.

For more info: www.agilent.com/find/basebandstudio

Signal Studio

Signal Studio is a collection of independent software applications that enable users to create waveform files for specific applications. The intuitive, easy-to-use graphical interface allows various signal parameters to be set for flexible waveform generation.



Signal Studio for Enhanced Multitone (Option 408)

Signal Studio for Enhanced Multitone is a powerful tool for creating multitone I/Q waveforms. It uses pre-distortion to provide multiple tones from a single signal generator, virtually free of IMD products. This software works with the Agilent E8267C PSG vector signal generator and the E4440A series PSA spectrum analyzers.

Features

- Intuitive user interface
- Up to 64 tones
- Adjustable relative tone power
- Wide correction bandwidth
- IMD suppression >70 dBC
- CCDF plot
- 10B/T LAN and GPIB connectivity
- Automate with your test executive
- Programming examples in Visual Basic and LabVIEW
- User's Guide and examples available in the software's built-in HELP system



Signal Studio for Pulse Building (Option 420)

Signal Studio for Pulse Building is a flexible software application for creating complex pulse patterns. The software provides many sophisticated features to configure single emitter test patterns for radar receiver test. Custom pulse shaping, intra-pulse modulation, and user-defined pulse patterns can all be easily achieved with the straightforward graphical user interface or with your own test executive using the COM-based application programming interface (API). When coupled with an ESA or ISA spectrum analyzer, the software performs corrections to improve pulse flatness and rejection of sampling images.

Features

- Create a library of custom pulse shapes by configuring or importing pulses
- Apply intra-pulse modulation to built-in and imported pulses
- Build a library of complex pulse pattern for radar receiver test
- Enhance signal quality using baseband pre-distortion
- Automate signal configuration and generation using the COM based application programming interface (API)
- Connect to the PSG using 10 Base T LAN and GPIB
- Utilize built-in help with pulse and pattern configuration examples

Signal Studio for Noise Power Ratio (Option 421)

Signal Studio for Noise Power Ratio (NPR) is a powerful tool that creates I/Q waveforms to generate a NPR test stimulus. Typically used to characterize in-band nonlinear distortion of wideband components and systems, a NPR test stimulus simulates worst-case loading conditions for the device under test (DUT). The software provides many flexible features to configure a wideband noise signal with a user-defined notch placed within the noise bandwidth. Use the Signal Studio graphical interface or the COM-based application programming interface (API) to control the software. This software uses a PSA spectrum analyzer to create the notch and improve the flatness of the wideband noise signal.

Please refer to the option 421 Technical Overview for details.

Specifications

Frequency

Range¹

Option 520: 250 kHz to 20 GHz

Resolution²

CW: 0.001 Hz

All Sweep modes: 0.01 Hz

Accuracy

Aging rate \pm temperature effects \pm line voltage effects

Switching Speed³

<15 ms (typical)

Phase Offset

Adjustable in nominal 0.1° increments

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to 250 MHz	1/8
2	>250 to 500 MHz	1/16
3	>500 MHz to 1 GHz	1/8
4	>1 to 2 GHz	1/4
5	>2 to 3.2 GHz	1/2
6	>3.2 to 10 GHz	1
7	>10 to 20 GHz	2

Internal Timebase Reference Oscillator

	Standard	Option UNR
Aging Rate	< $\pm 1 \times 10^{-7}$ /year or < $\pm 4.5 \times 10^{-9}$ /day after 45 days	< $\pm 3 \times 10^{-8}$ /year or < $\pm 2.5 \times 10^{-10}$ /day after 30 days

Temperature Effects (typical)

< $\pm 5 \times 10^{-8}$ 0 to 55° C

< $\pm 4.5 \times 10^{-9}$ 0 to 55° C

Line Voltage Effects (typical)

< $\pm 2 \times 10^{-9}$ for +5%–10% change

< $\pm 2 \times 10^{-10}$ for $\pm 10\%$ change

External Reference Frequency

1, 2, 2.5, 5, 10 MHz (within 1 ppm)

10 MHz only (within 1 ppm)

Digital Sweep

Operating Modes

Step sweep of frequency or amplitude or both (start to stop)

List sweep of frequency or amplitude or both (arbitrary list)

Sweep Range

Frequency sweep: Within instrument frequency range

Amplitude sweep: Within attenuator hold range

Dwell Time 1 ms to 60 s

Frequency settling time: 28 ms (typical)

Amplitude settling time: 10 ms (typical)

Number of Points

2 to 1601

Triggering

Auto, external, single, or GPIB

Ramp (analog) Sweep (Option 007)⁴

Operating Modes

- Synthesized frequency sweep (start/stop), (center/span), (swept CW)
- Power (amplitude) sweep (start/stop)
- Manual sweep

RPG control between start and stop frequencies

• Alternate sweep

Alternates successive sweeps between current and stored states

Sweep Span Range

Settable from minimum⁵ to full range

¹ Useable to 100 kHz.

² In ramp sweep mode (Option 007), resolution is limited with narrow spans and slow sweep speeds. Refer to ramp sweep specifications for more information.

³ To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz

⁴ During Ramp sweep operation, AM and Pulse Modulation are useable but not specified; FM, Phase Modulation, Wideband AM and I/Q modulation are not useable.

⁵ Minimum settable sweep span is proportional to carrier frequency and sweep time. Actual sweep span may be slightly different than desired setting for spans less than $[0.00004\% \text{ of carrier frequency or } 140 \text{ Hz}] \times [\text{sweep time in seconds}]$. Actual span will always be displayed correctly.

E8267C

Maximum Sweep Rate

Start Frequency	Maximum Sweep Rate	Max Span for 100 ms Sweep
250 kHz to <0.5 GHz	25 MHz/ms	2.5 GHz
0.5 to <1 GHz	50 MHz/ms	5 GHz
1 to <2 GHz	100 MHz/ms	10 GHz
2 to <3.2 GHz	200 MHz/ms	20 GHz
≥3.2 GHz	400 MHz/ms	20 GHz

Frequency Accuracy

±0.05% of span ±timebase (at 100 ms sweep time, for sweep spans less than maximum values given above)

Accuracy improves proportionally as sweep time increases¹

Sweep Time (forward sweep, not including bandswitch and retrace intervals)
Resolution: 1 ms

Manual mode: Settable 10 ms to 99 seconds

Auto mode: Set to minimum value determined by maximum sweep rate and 8757D setting

Triggering

Auto, external, single, or GPIB

Markers (10 independent continuously variable frequency markers)

Display: Z-axis intensity or RF amplitude pulse

Functions: M1 to center, M1/M2 to start/stop, marker delta

Two-Tone (master/slave) Measurements²

Two PSG's can synchronously track each other, with independent control of start/stop frequencies

Network Analyzer Compatibility

Fully compatible with Agilent 8757D scalar network analyzer³

Also useable with Agilent 8757A/C/E scalar network analyzers for making basic swept measurements⁴

Output

Power⁵ (dBm)

Frequency Range

250 kHz to 3.2 GHz⁶: -130 to +13

250 kHz to 3.2 GHz (with Option 1E6)⁶: -130 to +10

>3.2 to 20 GHz⁷: -130 to +18

Step Attenuator

0 to 115 dB in 5 dB steps

Attenuator Hold Range Minimum (Same as max power sweep range)

From -15 dBm to maximum specified output power with step attenuator in 0 dB position. Can be offset using step attenuator.

Amplitude Switching Speed⁸

CW or analog modulation: <5 ms (typical)

When using power search: <25 ms (typical)

Level Accuracy⁹ (dB)

Frequency	>+10 dBm	+10 to -10 dBm	-10 to -70 dBm	-70 to -90 dBm	-90 to -110 dBm
250 kHz to 2 GHz	±0.6	±0.6	±0.7	±0.8	±1.4
>2 to 20 GHz	±0.8	±0.8	±0.9	±1.0	±1.7

CW Level Accuracy with I/Q modulation (relative to CW)¹⁰

(With PRBS modulated data)

With ALC On:

QAM or QPSK formats¹¹: ±0.2 dB

Constant-amplitude formats (FSK, GMSK, etc): ±0.2 dB

With ALC Off¹²: ±0.2 dB (typical)

Resolution

0.01 dB

Temperature Stability

0.01 dB/°C (typical)

User Flatness Correction

Number of points: 2 to 1601 points/table

Number of tables: Up to 10,000, memory limited

Path loss: Arbitrary, within attenuator range

Entry modes: Remote power meter¹³, remote bus, manual (user edit/view)

Output Impedance

50 Ω (nominal)

SWR (internally leveled) (typical)

250 kHz to 2 GHz <1.4:1

>2 GHz to 20 GHz <1.6:1

Leveling Modes

Internal leveling, external detector leveling, millimeter source module, ALC Off

External Detector Leveling

Range: -0.2 mV to -0.5 V (nominal) (-36 dBm to +4 dBm using Agilent 33330D/E detector)

Bandwidth: 10 kHz (typical) (Note: not intended for pulsed operation)

Maximum Reverse Power

1/2 Watt (nominal)

Spectral Purity

3/Harmonics¹⁴ (dBc at +10 dBm or maximum specified output power, whichever is lower)

<1 MHz -27 dBc (typical)

1 MHz to 2 GHz -27 dBc

>2 GHz to 20 GHz -55 dBc

SSB Phase Noise (CW)

Offset from Carrier (dBc/Hz)

Frequency	20 kHz	20 kHz (typical)
250 kHz to 250 MHz	-130	-134
>250 to 500 MHz	-136	-140
>500 MHz to 1 GHz	-130	-134
>1 to 2 GHz	-124	-128
>2 to 3.2 GHz	-120	-124
>3.2 to 10 GHz	-110	-113
>10 to 20 GHz	-104	-108

Option UNR: Enhanced SSB Phase Noise (CW)

Offset from carrier (dBc/Hz)

Frequency	100 Hz spec (typical)	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz	-94 (-115)	-110 (-123)	-128 (-132)	-130 (-133)
>250 to 500 MHz	-100 (-110)	-124 (-130)	-132 (-136)	-136 (-141)
>500 MHz to 1 GHz	-94 (-104)	-118 (-126)	-130 (-135)	-130 (-135)
>1 to 2 GHz	-88 (-98)	-112 (-120)	-124 (-129)	-124 (-129)
>2 to 3.2 GHz	-84 (-94)	-108 (-116)	-120 (-125)	-120 (-125)
>3.2 to 10 GHz	-74 (-84)	-98 (-106)	-110 (-115)	-110 (-115)
>10 to 20 GHz	-68 (-78)	-92 (-100)	-104 (-107)	-104 (-109)

¹ Typical accuracy for sweep times >100 ms can be calculated from the equation: [(0.005% of span) + (sweep time in seconds)] ± timebase. Accuracy is not specified for sweep times <100 ms.

² For Master/Slave operation use Agilent Technologies part #8120-8806 Master/Slave interface cable.

³ When measuring low-pass devices in AC mode, dynamic range may be reduced up to 10 dB below 3.2 GHz.

⁴ GPIB system interface is not supported with 8757A/C/E, only with 8757D. As a result, some features of 8757A/C/E, such as frequency display, pass-through mode, and alternate sweep, do not function with PSG signal generators.

⁵ Maximum power specification is warranted from 15 to 35°C, and is typical from 0 to 15°C. Maximum power over the 35 to 55°C range typically degrades less than 2 dB.

⁶ With I/Q modulation on, maximum power specification is typical. With external inputs enabled, $\sqrt{I^2 + Q^2} > 0.2 V_{rms}$.

⁷ With I/Q modulation on, maximum power specification is typically +15 dBm. With external inputs enabled, $\sqrt{I^2 + Q^2} > 0.2 V_{rms}$.

⁸ To within 0.1 dB of final amplitude within one attenuator range.

⁹ Specifications apply in CW and list/step sweep modes over the 15 to 35°C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels >-5 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with Type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz. Level accuracy is not specified below -110 dBm.

¹⁰ If external inputs are used, specification applies with input level $\sqrt{I^2 + Q^2} = 0.3 V_{rms}$ and I/Q modulator attenuation = 10 dB.

¹¹ Measured with symbol rate >10 kHz and power ≤ 0 dBm.

¹² Relative to ALC on, after power search is executed. When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.

¹³ Compatible with Agilent Technologies EPM Series (E4418B and E4419B) power meters.

¹⁴ Specifications for harmonics beyond maximum instrument frequencies are typical.

Residual FM

CW mode: $<N \times 8$ Hz (typical)
 Option UNR: $<N \times 4$ Hz (typical)
 Ramp sweep mode: $<N \times 1$ kHz (typical) (rms, 50 Hz to 15 kHz bandwidth)

Broadband Noise

(CW mode at +10 dBm output, for offsets >10 MHz)
 >2.4 to 20 GHz <-148 dBc/Hz (typical)

Frequency Modulation**Maximum Deviation**

$N \times 8$ MHz

Resolution

0.1% of deviation or 1 Hz, whichever is greater

Deviation Accuracy

$<\pm 3.5\%$ of FM deviation + 20 Hz (1 kHz rate, deviations $<N \times 800$ kHz)

Modulation Frequency Response

Path	Rates (at 100 kHz deviation) 1 dB Bandwidth	3 dB Bandwidth (typical)
FM 1	dc/20 Hz to 100 kHz	dc/5 Hz to 10 MHz
FM 2	dc/20 Hz to 100 kHz	dc/5 Hz to 1 MHz

dc FM¹ Carrier Offset

$\pm 0.1\%$ of set deviation + ($N \times 8$ Hz)

Distortion

$<1\%$ (1 kHz rate, deviations $<N \times 800$ kHz)

Sensitivity

$\pm 1 V_{\text{peak}}$ for indicated deviation

Phase Modulation**Maximum Deviation**

$N \times 80$ radians ($N \times 8$ radians in high-bandwidth mode)

Resolution

0.1% of set deviation

Deviation Accuracy

$<\pm 5\%$ of deviation + 0.01 radians (1 kHz rate, normal BW mode)

Modulation Frequency Response

Mode	Maximum Deviation	Rates (3 dB BW)
Normal BW	$N \times 80$ rad	dc – 100 kHz
High BW	$N \times 8$ rad	dc – 1 MHz (typical)

Distortion

$<1\%$ (1 kHz rate, THD, dev $<N \times 80$ rad, normal BW mode)

Sensitivity

$\pm 1 V_{\text{peak}}$ for indicated deviation

Amplitude Modulation ($f_c > 2$ MHz)² (typical)

Depth	Linear Mode	Exponential (log) Mode (Downward modulation only)
Maximum	$>90\%$	>20 dB
Settable ³	0 to 100 %	0 to 40 dB
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	$<\pm(6\%$ of setting + 1 %)	$<\pm(2\%$ of setting + 0.2 dB)

Ext Sensitivity

Line Mode: $\pm 1 V_{\text{peak}}$ for indicated depth

Exponential (log) Mode: -1 V for indicated depth

Rates (3 dB bandwidth, 30% depth)

dc/10 Hz to 100 kHz (typical) (useable to 1 MHz)

Distortion (1 kHz rate, linear mode, THD)

30% AM $<1.5\%$

90% AM $<4\%$

Wide Band AM**Rate (typical 1 dB bandwidth)**

ALC on: 1 kHz to 80 MHz

ALC off: DC to 80 MHz

External I input

Sensitivity: 0.5 V = 100%

Input impedance: 50 Ω (nominal)

External Modulation Inputs (Ext1 & Ext2)**Modulation Types**

AM, FM, and Φ M

Input Impedance

50 or 600 Ω (nominal) switched

High/Low Indicator (100 Hz to 10 MHz BW, ac coupled inputs only)

Activated when input level error exceeds 3% (nominal)

Simultaneous Modulation

All modulation types may be simultaneously enabled except: FM with Φ M, linear AM with exponential AM, and Wideband AM with I/Q. AM, FM, and Φ M can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2). Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type.

Internal Modulation Source

Dual function generators provides two independent signals (internal1 and internal2) for use with AM, FM, Φ M, or LF Out.

Waveforms

Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine⁴

Rate Range

Sine: 0.5 Hz to 1 MHz

Square, ramp, triangle: 0.5 Hz to 100 kHz

Resolution: 0.5 Hz

Accuracy: Same as timebase

LF Out

Output: Internal1 or internal2. Also provides monitoring of internal1 or internal2 when used for AM, FM, or Φ M.

Amplitude: 0 to $3 V_{\text{peak}}$, into 50 Ω (nominal)

Output impedance: 50 Ω (nominal)

Swept Sine Mode: (frequency, phase continuous)

Operating modes: Triggered or continuous sweeps

Frequency range: 1 Hz to 1 MHz

Sweep rate: 0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 us to 2 s

Resolution: 0.5 Hz (0.5 sweep/s)

¹At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of user calibration.

²For $f_c < 2$ MHz AM is usable but not specified. AM specifications apply with ALC on, and envelope peaks $<$ maximum specified power.

³For AM depth settings $>90\%$ or >20 dB, deep AM mode or 1 kHz ALC BW is recommended.

⁴Internal2 is not available when using swept sine or dual sine modes.

E8267C

Pulse Modulation¹

	Standard >3.2 GHz	Standard ≥500 MHz to ≤3.2 GHz	Option 1E6 ≥10 MHz to ≤3.2 GHz
On/Off Ratio	80 dB	80 dB (typical)	80 dB
Rise/Fall Times (Tr, Tf)	10 ns (6 ns typical)	100 ns (typical)	10 ns (8 ns typical)
Pulse Width			
Internally leveled	≥1 μs	≥2 μs (typical)	≥1 μs
Level hold (ALC Off with power search) ²	≥20 ns (typical)	≥0.5 μs (typical)	≥20 ns (typical)
Repetition Frequency			
Internally leveled	10 Hz to 500 kHz (typical)	10 Hz to 250 kHz (typical)	10 Hz to 500 kHz (typical)
Level hold (ALC Off with power search) ²	dc to 10 MHz (typical)	dc to 1 MHz (typical)	dc to 10 MHz (typical)
Level Accuracy (relative to CW)			
Internally leveled	±0.5 dB ±0.15 (typical)	±0.5 dB	±0.5 dB
Level hold (ALC Off with power search) ²	≤20 GHz ±0.8 dB (typical)	±0.5 dB (typical)	±1.0 dB (typical)
Width Compression	±5 ns (typical)	±50 ns (typical)	±5 ns (typical)
Video Feed-Through³	<2 mV (typical)	<200 mV (typical)	<125 mV (typical)
Video Delay (Ext input to Video)	40 ns (nominal)	40 ns (nominal)	40 ns (nominal)
RF Delay (Tm) (Video to RF output)	35 ns (nominal)	280 ns (nominal)	45 ns (nominal)
Pulse Overshoot (Vor)	<10% (typical)	<10% (typical)	<1 GHz 20% (typical) ≥1 GHz 10% (typical)
Input Level	+1 V _{peak} = RF On	+1 V _{peak} = RF On	+1 V _{peak} = RF On
Input Impedance	50 Ω (nominal)	50 Ω (nominal)	50 Ω (nominal)

Internal Pulse Generator

Modes

Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source.

Period (PRI) (Tp)

70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)

Pulse Width (Tw)

10 ns to 42 s

Delay (Td)

Free-run mode: 0 to ±42 s

Triggered with delay and doublet modes: 75 ns to 42 s with ±10 ns jitter

Resolution

10 ns (width, delay, and PRI)

Vector Modulation

External I/Q Inputs

Input impedance: switched 50 or 600 W (nominal)

Input range⁴: Minimum 0.1 V_{rms}, maximum 1 V_{peak}

Flatness: ±1 dB within ±40 MHz of carrier (with ALC off) (typical)

Vector Accuracy⁵

Formats: BPSK, QPSK, 16-256QAM (α=0.3, Root Nyquist filter, symbol rate 4 Msyms/s)

• EVM: <1.2% RMS, <0.8% RMS (typical)

• Origin offset

250 kHz to 3.2 GHz: -45 dBc (typical)

3.2 to 20 GHz: -50 dBc (typical)

I/Q Adjustments

• I & Q offsets

- External inputs (600 Ω) ±5 Volts
- External inputs (50 Ω) ±50 %

- Internal baseband generator ±50 %
- I/Q attenuation: 0 to 40 dB
- I/Q gain balance: ±4 dB
- I/Q quadrature skew: ±10° range (typical)
- Low pass filter: Selectable 40 MHz or through

I/Q Baseband Outputs

Differential: I, I bar, Q, Q bar

Single ended: I, Q

Frequency range: DC to 40 MHz

Output voltage into 50 W: 1.5 V_{r-p} (typical)

DC offset adjustments: ±3 V

DC offset resolution: 1 mV

Low pass filter: Selectable 40 MHz or through

I/Q Baseband Generator (arbitrary waveform mode)
(Option 602)

Channels

2 [I and Q]

Resolution

16 bits [1/65,536]

Baseband Waveform Memory

Length (playback): 64 Msamples/channel

Length (storage): 1.2 Gsamples on 6 GB hard drive (Option 005)

Waveform Segments

Segment length: 60 samples to 64 Msamples

Maximum number of segments: 8,192

Minimum memory allocation: 256 samples or 1 kbyte blocks

Waveform Sequences

Maximum total number of segments: 16,384

Sequencing: Continuously repeating

Maximum number of sequences: 16,384

Maximum segments/sequence: 1 to 32,768

Maximum segment repetitions: 1 to 65,536

Clock

Sample rate: 1 Hz to 100 MHz

Resolution: 0.001 Hz

Accuracy: Same as timebase +2⁻⁴² [in non-integer applications]

Reconstruction Filter: [fixed]

50 MHz [used for all symbol rates]

Baseband Spectral Purity [full scale sinewave]

Harmonic distortion: 100 kHz to 2 MHz: <-65 dBc (typical)

Phase noise: <-127 dBc/Hz (typical) (baseband output of 10 MHz

sinewave at 20 kHz offset)

IM performance: <-74 dB (typical) (two sinewaves at 950 kHz and 1050 kHz at baseband)

Triggers

Types: Continuous, single, gated, segment advance

Source: Trigger key, external, remote [LAN, GPIB, RS-232]

External polarity: Negative, positive

External delay time: 10 ns to 40 sec plus latency

External delay resolution: 10 ns

Markers

(Markers are defined in a segment during the waveform generation process, or from the PSG front panel. A marker can also be tied to the RF blanking feature of the PSG.)

Marker polarity: Negative, positive

Number of markers: 4

¹With ALC off, specs apply after the execution of power search. Specs apply with Atten Hold off (default mode), or ALC level between 0 and +10 dBm.

²Power search is a calibration routine that improves level accuracy in ALC-off mode. Un-pulsed RF power will be present typically up to 50 ms when executing power search.

³With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.

⁴For optimum signal quality, the I and Q inputs should be 0.7 V_{peak} with $\sqrt{(I^2 + Q^2)} + 150 \text{ mV}_{\text{rms}}$.

Different RMS levels are accommodated by adjusting the internal I/Q modulator attenuator, which may be either manually or automatically set. The minimum input level required to maintain RF level accuracy is $\sqrt{(I^2 + Q^2)} = 0.1 \text{ V}_{\text{rms}}$.

⁵Measured with Agilent 89441A Vector Signal Analyzer. Valid after executing I/Q calibration, and instrument is maintained within ±5°C of calibration temperature.

RF power <0 dBm. External I/Q input level $\sqrt{(I^2 + Q^2)} = 0.3 \text{ V}_{\text{rms}}$, I/Q modulator attenuator = 10 dB.

Multi-Carrier

Number of carriers: Up to 100 (limited by a max bandwidth of 80 MHz depending on symbol rate and modulation type)
 Frequency offset (per carrier): -40 MHz to +40 MHz
 Power offset (per carrier): 0 dB to -40 dB

Modulation

PSK: BPSK, QPSK, OQPSK, $\pi/4$ DQPSK, 8PSK, 16PSK, D8PSK

QAM: 4, 16, 32, 64, 256

FSK: Selectable: 2, 4, 8, 16

MSK

Data: Random ONLY

Two-Tone

Frequency spacing: 100 Hz to 80 MHz (symmetrical about carrier)
 IM distortion

250 kHz to 3.2 GHz: <-45 dBc for RF levels <0 dBm (typical)

>3.2 GHz to 20 GHz: <-55 dBc for RF levels <0 dBm (typical)

I/Q Baseband Generator (real-time mode) (Option 602)**Basic Modulation Types** (custom format)

PSK: BPSK, QPSK, OQPSK, $\pi/4$ DQPSK, 8PSK, 16PSK, D8PSK

MSK: User-defined phase offset from 0 to 100°

QAM: 4, 16, 32, 64, 256

FSK: Selectable: 2, 4, 8, 16 level symmetric

User defined: Custom map of up to 16 deviation levels

Symbol rate: Maximum deviation

<5 MHz: 4 times symbol rate

5 MHz to 50 MHz: 20 MHz

Resolution: 0.1 Hz

I/Q

Custom map of 256 unique values

FIR Filter

Selectable: Nyquist, root Nyquist, Gaussian, Rectangular, Custom FIR

α : 0 to 1, BbT: 0.1 to 1

Symbol Rate

For external serial data: Adjustable from 1000 symbols/sec to a maximum

symbol rate of 50 Mbits/sec ÷ #bits/symbol

For internally generated data: Adjustable from 1000 symbols/sec to 50 Msymbols/sec. and a maximum of 8 bits per symbol. Modulation quality may be degraded at high symbol rates.

Data Types

- Internally generated data
 - Pseudo-random patterns: PN9, PN11, PN15, PN20, PN23
 - Repeating sequence: Any 4-bit sequence, Other fixed patterns
- Direct-pattern RAM [PRAM]
 - Max size: 64 Mbits (each bit uses an entire sample space)
 - Use: Non-standard framing
- User file
 - Max size: 3.2 Mbytes
 - Use: Continuous modulation or internally generated TDMA standard
- Externally generated data
 - Type: Serial data
 - Inputs: Data, bit clock, symbol sync Accepts data rates $\pm 5\%$ of specified data rate

Wideband external I/Q inputs (Option 015)**RF Output Frequency Range**

3.2 to 20 GHz

Input

Input (baseband) frequency range: DC to >500 MHz (nominal)

I/Q Offset Adjustments

$\pm 50\%$

RF Path Filters⁵

Carrier Frequency Low-pass 3 dB cutoff frequency (nominal)

>3.2 to 5 GHz 5.5 GHz

>5 to 8 GHz 8.9 GHz

>8 to 12.8 GHz 13.9 GHz

>12.8 GHz 22.5 GHz

Signal Studio for Enhanced Multitone^{1,3} (Option 408)

E8267C

Number of Tones

2 to 64

Tone Spacing

1 kHz to 50 MHz, limited by 80 MHz I/Q bandwidth. Spacing is linear, however individual tones may be disabled.

Tone Power (relative)

0 to -50 dB

Phase Distribution

Fixed, random or parabolic

Suppression Bands

Set up to 10 different suppression levels over different band segments

Suppression level²

-50 to -90 dBc, depending on number of tones and available calibration time.

Estimated suppression = 80 dBc - 10 log (N/8), where N is the number of tones.

Calibration Interval

8 hours (recommended)

Calibration Time (typical)

10 minutes (8 tones, -80 dBc suppression)³

Temperature Stability

3 dB/°C (typical for IMD products)

5 dB/°C (worst case for LO feedthrough and images)

Amplitude Accuracy

± 0.2 dB (typical)⁴

Connections

10 baseT LAN or IEEE-488 GPIB

Instrument Settings

PSG Frequency, amplitude, markers

PSA Span, RBW, VBW, attenuator setting, detector type, number of averages, trigger source

Graphic Displays

Tone settings and suppression bands, CCDF

Application Programming Interface

COM object

Signal Studio for Pulse Building (Option 420)**Pulse Properties****Trapezoidal and Raised Cosine**

Rise time (0 to 100 percent)	Minimum: 25 ns (typical)
Fall time (100 to 0 percent)	Minimum: 25 ns (typical)
Pulse width (100 to 100 percent)	Minimum: 10 ns (typical)
Pulse width jitter	Type: Gaussian or uniform
	Deviation resolution: 10 ns

Custom I/Q and Custom Profile

I and Q scale factor $1/(\max(\sqrt{I^2 + Q^2}))$

Intra-Pulse Modulation

AM Step	Amplitude range: 0 to -55 dB (typical) Step size: user-defined
Barker	Barker code 2, 3, 4, 5, 7, 11, 13
BPSK	Bit pattern: alternating 01 Phase shift: 0 = 0° and 1 = 180° Step size: user-defined
Custom BPSK	Bit pattern: user-defined Phase shift: 0 = 0° and 1 = 180° Step size: depends on number of bits in bit pattern
FM chirp	Maximum deviation: ± 40 MHz Maximum rate: 80 MHz/ μ s
FM Step	Frequency offset: ± 40 MHz from carrier Step size: user-defined
QPSK	Phase pattern: 45°, 135°, 225°, 315° Step size: user-defined

¹Subject to change.

²Spectrum analyzer averaging set to four.

³For best performance, use an odd number of tones symmetrically placed around the center frequency in a stable temperature environment.

⁴With amplitude accuracy adjustment enabled.

⁵Save and recall of user filters and instrument states from Option 005 Hard Drive is guaranteed only over the range 0 to 40°C.

E8267C

Signal Studio for Noise Power Ratio (Option 421)

Noise Bandwidth	80 MHz (maximum)
Notch Width	0.001% to 20% relative to noise bandwidth
Notch Center	±50% relative to noise bandwidth center frequency
Notch Suppression^{1,2}	
ESG/PSG integrated NPR	–66 dBc (typical for 2001 tones) –61 dBc (typical for 8001 tones)
ESG/PSG notch IMD tones ³	–60 dBc (typical for 2001 tones) –55 dBc (typical for 8001 tones)
Temperature Stability²	
ESG/PSG	1 dB/°C (typical for integrated NPR) 1 dB/°C (typical for notch IMD tones)
Amplitude Accuracy	±0.5 dB over noise BW (typical)

¹ Depends on number of tones and available calibration time.² ≤ 8001 tones (with random phase relationships), 80 MHz noise bandwidth, 1% to 10% notch width, notch offsets ≤ 8 MHz. Carrier feedthrough is ignored.³ For best performance, use notch offsets to avoid placing notch within 100 kHz from carrier.

Pattern Properties

Pattern objects	Pulse, pattern, or off-time
Repetition interval	Minimum: object length (does not apply to off-time)
Repetition interval jitter	Type: Gaussian or uniform Deviation resolution: 10 ns
Number of repetitions	Maximum per pattern object: 65,535 (or up to 64 k * 16k if same pattern object is re-used)
Frequency offset	Range: 0 to ±40 MHz (with no modulation)
Phase offset	Range: ± π radians
Scale	Range: 0 to –55 dB (typical)
Pattern length	Unique pulses: up to 16,000 Unique playback memory: 64 Msamples

Markers/Triggers

Signal start, Pulse start, Pulse gate
Maximum delay: ±50 ns

Signal Quality

On/Off ratio	≥55 dB with pulse modulator disabled (typical) ≥80 dB with pulse modulator enabled (typical)
Image rejection²	≤ –40 dBc at ±40 MHz from carrier (typical)
RF modulation flatness²	±0.5 dB over 80 MHz RF modulation bandwidth (typical)
Carrier suppression²	≤ –60 dBc (time and temperature dependent) (typical with I/Q adjustments)

Remote Programming

Interfaces

GPIB (IEEE-488.2,1987) with listen and talk, RS-232, and 10BaseT LAN interface.

Control Languages

SCPI version 1997.0. Also will emulate most applicable Agilent 836xxB, Agilent 837xxB, and Agilent 8340/41B commands, providing general compatibility with ATE systems which include these signal generators.

IEEE-488 Functions

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2.

General

Power Requirements

90 to 267 Vac 50 to 60 Hz, (automatically selected), 650 W maximum.

Option UNS: External module allows operation at 400 Hz

Operating Temperature Range

0 to 55°C¹Storage Temperature Range³

–40 to 71°C

With Option 005: –4° to 65°C, gradient less than 20°C/hour

Shock and Vibration

Meets MIL-STD-28800E Type III, Class 3.

EMC

Conducted and radiated interference and immunity meets IEC/EN 61326-1 and MIL-STD-461C Part 2, RE02. Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 class A.

Storage Registers

Up to 800 storage registers and 10 register sequences are available.

Security

Display blanking.

Compatibility

Agilent Technologies 83550 Series millimeter heads (not for use with I/Q modulation), Agilent Technologies 8757D scalar network analyzers, Agilent Technologies EPM Series power Meters.

Self-Test

Internal diagnostic routine tests most modules (including microcircuits) in a preset condition. For each module, if its node voltages are within acceptable limits, then the module “passes” the test.

Weight

<25 kg (54 lb.) net, <33 kg (74 lb.) shipping.

Dimensions

178 mm H x 426 mm W x 498 mm D (7” H x 16.8” W x 19.6” D in.)

Key Literature

PSG Signal Generator, Brochure Literature number: 5988-7538EN

Agilent E8267C PSG Vector Signal Generator Data Sheet Literature

number 5988-6632EN

PSG Configuration Guide Literature number 5988-7541EN

www.agilent.com/find/psg

Ordering Information

Agilent Microwave Vector Signal Generators Options

Frequency Range (required option)

E8267C-520 250 kHz to 20 GHz

Enhanced Phase Noise

E8267C-UNR Enhanced phase noise performance

Narrow Pulse Modulation

E8267C-1E6 Provides narrow pulse modulation below 3.2 GHz

Analog (ramp) Sweep

E8267C-007 Provides analog (ramp) sweep and scalar network analyzer interface

Connectors

E8267C-1ED Type-N (f) connector

E8267C-1EM Moves all connector to rear panel

Power Supply

E8267C-UNS External module allows operation at 400 Hz

Internal Baseband Generator with Memory

E8267C-602 Internal baseband generator with 64 Msample memory

E8267C-005 6 GB internal hard drive

E8267C-003 Enables digital output connectivity with N5102A

Wideband External I/Q

E8267C-015 Wideband external I/Q inputs

Signal Studio Software

E8267C-408 Enhanced Multitone

E8267C-420 Pulse Building

E8267C-421 Noise Power Ratio (NPR)

N5101A Baseband Studio PCI card

N5110A Baseband Studio for waveform streaming

N5110A-120 Hard drive waveform streaming up to 20 MSa/s

N5110A-121 Extend hard drive streaming bandwidth from 20 up to 40 MSa/s

N5110A-125 Signal generator hard drive streaming connectivity

N5115A Baseband Studio for fading

N5115A-160 One fading channel with up to 17 MHz RFBW

N5115A-161 Extend one fading channel from 17 up to 30 MHz RFBW

N5115A-168 Add AWGN to one fading channel

N5115A-170 ESG signal generator connectivity for one fading channel

N5102A Baseband Studio digital signal interface module

¹ Save and recall of user filters and instrument states from Option 005 Hard Drive is guaranteed only over the range 0 to 40°C.² Typical performance after corrections are applied to the baseband signal by the Signal Studio for pulse building software.³ Storage below –20°C Instrument states may be lost.

- Firmware personality options for W-CDMA, cdma2000, and EDGE
- Superior spectral purity on ESG-DP Series
- RF modulation bandwidth up to 35 MHz (external I/Q inputs)
- Superior level accuracy
- Step sweep (frequency, power, and list)
- Wideband AM, FM, and phase modulation
- Real-time Baseband Generator (Option UN8)
- Built-in TDMA formats for DECT, GSM, NADC, PDC, PHS, and TETRA (with Option UN8)
- Internal Dual Arbitrary Waveform Generator (Option UND)
- Flexible creation of custom modulation (with Option UND)
- Internal Bit-Error-Rate Analyzer (Option UN7)
- 3 year warranty



ESG-DP Series E4437B

ESG-D and ESG-DP Series Digital and Analog Signal Generators

The Agilent ESG-D and ESG-DP series of RF signal generators provide a wide range of digital modulation capabilities, in addition to a comprehensive feature set and excellent analog performance – all at an affordable price. The ESG-DP series provides all the same features of the ESG-D series, plus outstanding phase-noise performance. The ESG-D and DP series provide excellent modulation accuracy and stability, as well as unprecedented level accuracy. These signal generators are ideally suited to meet the demanding requirements of today's digital receiver test, component test, and local oscillator applications.

For more information visit the ESG web site : www.agilent.com/find/esg

External I and Q Modulation

Use the analog I and Q inputs to generate complex modulation formats required for the development and testing of RF digital communications systems. A built-in quadrature modulator processes the I and Q input signals to provide superior modulation accuracy and stability over 18 MHz (1dB) baseband bandwidth.

Excellent Level Accuracy

Superior level accuracy of ± 0.5 dB (above -127 dBm, $f_c < 2$ GHz) and ± 0.9 dB ($f_c > 2$ GHz) provides unmatched specified performance and minimizes test uncertainty. Even with digital modulation turned on, level accuracy is better than ± 1.1 dB. This unprecedented performance ensures precise measurement of even the most sensitive analog or digital receivers.

Hardware Options

Option UN8, Real-Time I/Q Baseband Generator

Option UN8 generates fully coded signals, which makes it ideally suited for testing receiver and base-station capabilities when measuring actual data is critical. This option simulates mobile or base-station transmissions of common digital communication standards.

Internally generate real-time signals for common standards to test receivers. Option UN8 includes DECT, GSM, NADC, PDC, PHS, and TETRA communication standards. Change modulation types, data, symbol rate, filter type, and filter factor to generate customized signals for component and system margin testing. Create custom signals by mapping I/Q values and building a unique FIR filter. Easily

configure timeslots to simulate different types of traffic, control, or synchronization channels (or bursts). Generate mobile or base station transmissions with the internal burst capabilities. Also reduce the need for external equipment with comprehensive data generation capabilities. Option UN8 also includes limited *Bluetooth* capabilities.

Option UND, Internal Dual Arbitrary Waveform Generator

Option UND generates partially coded statistically correct signals, which make it ideally suited for component testing.

Playback virtually any mathematically generated waveform. Option UND provides an extremely flexible baseband generator for complex waveforms. I/Q files may be generated from application programs such as MATLAB. Download long or multiple waveforms (up to 1 Msample) to play or store in non-volatile RAM. The 14 bits of DAC resolution enhance dynamic range and noise performance. Optimized for I/Q generation, the dual arbitrary option simplifies setup. Pre-defined formats include NADC, PDC, PHS, GSM, DECT, TETRA, APC025, CDPD, PWT, and EDGE. Also test *Bluetooth* components and systems with standards-based signals.

Option UN7, Internal Bit-Error-Rate Analyzer

Perform bit-error-rate analysis for sensitivity and selectivity measurements. Option UN7 provides analysis capabilities to test any PN9 or PN15 bit sequence and indicates pass or fail conditions for user-specified test limits. Choose data rates up to 10 Mbps. The BER analyzer will automatically indicate when either data and/or clock signals are not valid. User defined resynchronization limit is available to reset counters and restart the measurement when data is lost.

Firmware Options

Personalities are software programs that may be ordered already installed on a new ESG or may be downloaded from our web site: www.agilent.com/find/esg. The firmware may be activated by purchasing a license key. Once the license key is purchased, future firmware upgrades for that option are free.

Personality options cdmaOne (Option UN5), 3GPP W-CDMA (Option 100), and cdma2000 (Option 101) require the Arbitrary Waveform Generator (Option UND) hardware.

Personality options 3GPP W-CDMA (Option 200), cdma2000 (Option 201), and EDGE (Option 202) require the Real-time I/Q Baseband Generator (Option UN8) hardware.

Option UN5, Multichannel, Multicarrier cdmaOne Personality

Generate partially coded, multicarrier CDMA signals with multiple channels in each carrier for base-station and mobile tests, at system or component level. Tailor a test to specific requirements like the complementary cumulative distribution function (CCDF) by selecting predefined multicarrier CDMA configurations, or by explicitly defining the characteristics of each channel on each carrier. Testing with Walsh-coded channels accurately simulates the actual signal power a component experiences. View the power statistics of the IS-95 waveforms produced by the ESG-D & DP series compared to additive Gaussian white noise (AWGN).

Option 100, Multichannel, Multicarrier 3GPP W-CDMA Personality

Generate partially coded, multicarrier 3GPP W-CDMA signals with multiple channels. Users can generate both uplink and downlink signals which are suitable for component, subsystem, mobile, and base-station tests. Option 100 supports the 3.84 Mcps chip rate, provides individual channel rates based on a 7.5 ksps base for the downlink, and a 15 ksps for an uplink. Downlink physical channels include PCCPCH, PSCH, SSCH, DPCH, CPICH, PICH, and OCNS.

Option 101, Multichannel, Multicarrier cdma2000 Personality

Generate partially coded, multichannel forward- and reverse-link signals, either the 1X or 3X chip rate. Choose multicarrier or direct spreading type in forward link. HPSK spreading/modulation type is used in the reverse link for IS95C radio configuration. Select from predefined channel configurations or use the table editor to fully configure a cdma2000 channel configuration according to user requirements. Forward-link channel types include pilot, paging, synchronization, fundamental code and supplemental channels. Reverse-link channel types include pilot, dedicated control channel, fundamental code and supplemental code channels. Each channel can be set to a separate code domain power level. Clip the peak-to-average power of signals before or after FIR filtering.

E4430B
E4431B
E4432B
E4433B
E4434B
E4435B
E4436B
E4437B

E4430B
E4431B
E4432B
E4433B
E4434B
E4435B
E4436B
E4437B

Option 200, Real-Time 3GPP W-CDMA Personality

Generate fully coded real-time W-CDMA uplink and downlink signals. By utilizing the real-time I/Q baseband generator of Option UN8 (Rev C or higher) and Option UN9, this firmware option provides fully coded reference measurement channels to perform BERT and baseband testing on mobile receiver and base-station designs. This complements the existing Option 100, which provides a partially coded multichannel multicarrier W-CDMA signal used for component test only. Option 200 gives the user the capability to generate custom physical, control, sync, and transport channels while supporting adjustments of the channel parameters. This flexibility combined with the ability to insert data bits at the transport or physical layer is ideal for different stages of testing.

Option 201, Real-Time cdma2000 Personality

Generate fully coded IS-2000 (SR1) signals for mobile receiver tests. Conduct frame or bit error tests and functional tests of the mobile unit's protocol handling. Option 201 is backward compatible with IS-95 systems using Radio Configurations 1 or 2. Fully coded channels include pilot, sync, paging, quick paging, fundamental, and supplemental traffic channels plus OCNS and QOF. Channels are easily configurable using the built-in table editor, with control over power level, FIR filter type, PN offset, Even Second delay, and others, depending upon channel type.

Option 202, Real-Time EDGE Personality

Generate continuous or framed signals. Produce fully coded signals using internally or externally generated data. Option 202 uses $3\pi/8$ -rotating 8PSK, and a "linearized" Gaussian Tx filter. Edit frame data fields and use custom filtering to customize your signal. Synchronize two ESGs to combine EDGE (8PSK) and GSM (GMSK) timeslots. Upload externally defined burst shape waveforms.

Other Options Available

Other options are available to improve output power (Option UNB), to extend memory (Option UN9), and to vary timeslot power levels (Option UNA). There is a wide range of special options available that are not listed. If interested in any special options, please contact your Agilent sales representative.

Specifications

Analog, Remote Programming, and General Specifications

For analog, remote programming, and general specifications, please refer to the ESG-A & AP specifications located on page 151. ESG-A and ESG-D, and ESG-AP and DP have the same analog specifications except for:

- high performance pulse modulation, option 1E6, is not available on the ESG-D & DP
- frequency switching speed for Modulation on: ESG-D: <90 ms
ESG-DP: <100 ms

More specification differences, in addition to those listed above for the ESG-D and DP, are listed below.

Frequency

Frequency Range	ESG-D Series	ESG-DP Series (enhanced phase noise)
250 kHz – 1000 MHz	E4430B	E4434B
250 kHz – 2000 MHz	E4431B	E4435B
250 kHz – 3000 MHz	E4432B	E4436B
250 kHz – 4000 MHz	E4433B	E4437B

Level Accuracy with Digital Modulation

(After power search is executed; relative to CW level accuracy with ALC on; with burst off; if external I/Q is enabled: $\sqrt{I^2 + Q^2} = 0.5$ V rms)

Level Accuracy with ALC Off: ± 0.3 dB, typical

(With ALC on; relative to CW; with PRBS-modulated data; if using I/Q inputs, $\sqrt{I^2 + Q^2} = 0.5$ V rms nominal)

$\pi/4$ DQPSK or QPSK Formats

ESG-D	ESG-DP
± 0.15 dB	± 0.20 dB

(Relative to CW; with raised cosine or root-raised cosine filter and $\alpha \geq 0.35$; with 10 kHz \leq symbol rate ≤ 1 MHz; at RF freq. ≥ 25 MHz; power \leq max. specified -3 dBm or -6 dBm with Option UNB.)

Constant Amplitude Formats (FSK, GMSK, etc.)

ESG-D	ESG-DP
No degradation in power level accuracy	± 0.10 dB

I/Q Modulation

I & Q Inputs

- Input Impedance: 50Ω
 - Full Scale Input: $\sqrt{I^2 + Q^2} = 0.5$ V rms
- ### Adjustments/Impairments (nominal)
- DC Offset: (I and Q independently adjustable) $\pm 100\%$
 - I/Q Gain Ratio: ± 4 dB
 - I/Q Quadrature: $\pm 10^\circ$ (for $f_c \leq 3.3$ GHz)

DC Vector Accuracy

(Relative to full scale, power $\leq +7$ dBm ($\leq +10$ dBm for Option UNB))

Frequency (GHz)	<0.6	0.6 to 2	2 to 3.7	≤ 4
Static EVM (rms)	<0.75%	<0.5%	<0.75%	<1%
Magnitude Error (rms)	<0.5%	<0.35%	<0.5%	<0.75%
Phase Error (rms)	<0.35°	<0.25°	<0.35°	<0.5°
Origin Offset (dBc)	<-46	<-46	<-40	<-40

External Burst Envelope Control

Input Voltage

RF On 0 V
RF Off -1 V

On/Off Ratio:

≤ 3 GHz: >75 dB
>3 GHz: >60 dB

Rise/Fall Time: <2 μ s with rectangular input, typical

Minimum Burst Rate

ALC On: 10 Hz, typical
ALC Off: dc

Input Impedance: 50Ω , nominal

Coherent Carrier Out

Range: 250 MHz to maximum carrier frequency

Level: 0 dBm ± 5 dB, typical

Impedance: 50Ω

Option Specifications

Option UN8, Real-Time I/Q Baseband Generator

The following formats are included with option UN8: NADC, PDC, PHS, TETRA, DECT, and GSM.

Modulation Formats

- PSK: BPSK, QPSK, OQPSK, $\pi/4$ DQPSK, 8PSK, 16PSK, D8PSK
- MSK: User-defined phase offset
- QAM: 4, 16, 32, 64, 256
- FSK: Selectable: 2, 4, 8, 16 level symmetric
- Custom I/Q: Map of 16 unique values for I and Q

Filters: Nyquist, root Nyquist, Gaussian, Custom FIR, rectangular

Filter Rate: α : 0 to 1; B_bT : 0.1 to 1

Symbol Rate: Adjustable up to 12.5 Msymbols/sec

TDMA Data Structure

Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept user file, PRBS (PN9 or PN15) or external data with the appropriate clock.

Internally Generated Data

Pseudo-Random Patterns: Continuous PN9, PN11, PN15, PN20 or PN23
Repeating Sequence: Any 4-bit sequence

Downloadable Data

- Direct-pattern RAM (PRAM)
Max size: 1 Mbytes (std.); 8 Mbytes (Option UN9)
- User File max. size: 128 kbytes

Externally Generated Data

- Inputs: Data, bit/symbol clocks (accepts rates $\pm 5\%$ of specified data rate)
- Reference Frequency
Internal or external: 1, 2, 5, 10 MHz reference.
Data clock can be locked to an external 13 MHz (GSM) reference

Frame Trigger Delay Control

- Range: 0 to 65,535 bits
- Resolution: 1 bit

Internal Burst Shape Control (varies with standards and bit rates)

- Rise/Fall Time Range: Up to 30 bits
- Rise/Fall Delay Range: 0 to 63.5 bits

I/Q Outputs

- EVM (NADC, PDC, PHS, TETRA): 1% rms
- Global Phase Error (GSM): 0.75° rms
- Deviation Accuracy (DECT): 1 kHz rms

Option UND, Dual Internal Arbitrary Waveform Generator

The following predefined formats are included with option UND:
NADC, PDC, PHS, GSM, DECT, TETRA, APC025, CDPD, PWT, EDGE

Channels: 2

Resolution: 14 bits (1/16384)

Waveform Memory

- Playback: 1 Msample/channel
- Storage (non-volatile RAM): 1 Msample/channel

Waveform Segments

- Length: 16 samples to 1 Msample
- Number of Segments: 1 to 128

Waveform Sequences

- Sequencing: Continuously repeating
- Number of Sequences: 1 to 128

Sample Rate: 1 Hz to 40 MHz

Output Reconstruction Filters

- Type: Elliptic
- Fcutoff (nominal, 3 dB): 250 kHz, 2.5 MHz, 8 MHz and through

Baseband Spectral Purity

(typical, full scale sinewave, >20 x oversampling)

Harmonic Distortion

- ≤100 kHz: ≤-80 dBc
- 100 kHz to 2 MHz: <-65 dBc

Non-Harmonic Spurious: <-80 dBc

Phase Noise: <-120 dBc/Hz

(baseband output of 1 MHz sinewave at 20 kHz offset)

IM Performance: <-69 dB

(two sinewaves at 950 kHz and 1050 kHz at baseband, full scale)

Option UN7, Bit-Error-Rate Analyzer

Clock Rate: 100 Hz to 10 MHz

Supported Data Patterns: PN9, PN15

Resolution: 10 digits (6 digits for BER (exponential display))

Minimum Synchronization Length

- 2 Mbps Mode: 9 bits (PN9), 15 bits (PN15)
- 10 Mbps Mode: 43 bits (PN9), 48 bits (PN15)

Bit Sequence Length: 100 bits to 4.294 Gbits after synchronization

Features

	2 Mbps Mode	10 Mbps Mode
Bit count	X	X
Error-bit-count	X	
Bit-Error-Rate	X	
Pass/fail indication	X	X
Valid data and clock detection	X	X
Automatic re-synchronization	X	
Special pattern ignore	X	

Option UN5, Multichannel, Multicarrier cdmaOne Personality

Chip (symbol) Rate: 1.2288 MHz (default) Adjustable to 1 Hz to 10 MHz with 4x oversampling

Modulation

- QPSK (forward): With Walsh and short code spreading
- Offset QPSK (reverse): With short code spreading of random data

Predefined Channel Configurations (power levels per IS-97-A)

- Pilot Channel: Incl. IS-95 modified filter, with equalizer
- 9 Channel: Incl. pilot, paging, sync, 6 traffic and IS-95 modified filter, with equalizer
- 32 Channel: Incl. pilot, paging, sync, 29 traffic and IS-95 modified filter, with equalizer
- 64 Channel: Incl. pilot, 7 paging, sync, 55 traffic and IS-95 modified filter, with equalizer
- Reverse Channel: Incl. IS-95 filter

Rho

- 0.9996 (≤4 dBm, IS-95 filter, ≤2 GHz, typical)

Option 100, Multichannel 3GPP W-CDMA Personality (Supports R99 December 2001 3GPP W-CDMA Standard)

Provides partially coded data for component test applications.

Chip Rates: 3.84 Mcchips/sec ±10 %

Downlink

- Modulation: QPSK
- Predefined channel configurations (partially coded)
 - 1 DPCH
 - 3 DPCH
 - PCCPCH + SCH
 - PCCPCH + SCH + 1 DPCH
 - PCCPCH + SCH + 3 DPCH
- Test Model 1: with 16, 32, or 64 DPCH
- Test Model 2
- Test Model 3: with 16 or 32 DPCH
- Test Model 4

Channel Types

- (downlink) PICH, OCNS, PCCPCH, PSCH, SSCH, CPICH, DPCH
- (uplink) DPCCCH, DPDCCH

Multicarrier

- Number of carriers: Up to 4 (user defined, individually configurable)
- Frequency offset (per carrier): Up to ±7.5 MHz
- Offset resolution: <1 Hz

Uplink

- Modulation: OCQPSK (HPSK)

Predefined Channel Configurations (partially coded)

1 DPCCCH	15 ksps, spread code 0
DPCCCH + 1 DPDCCH	960 ksps, spread code 1
DPCCCH + 2 DPDCCH	960 ksps, spread code 1
DPCCCH + 3 DPDCCH	960 ksps, spread code 2
DPCCCH + 4 DPDCCH	960 ksps, spread code 2
DPCCCH + 5 DPDCCH	960 ksps, spread code 3

Option 200, Real-Time W-CDMA Personality (Supports R99 December 2000 3GPP W-CDMA Standard)**Downlink Specifications****Channel Types Generated**

Primary Synchronization (PSCH), Secondary Synchronization (SSCH), Primary Common Control (P-CCPCH), Common Pilot (CPICH), Dedicated Physical (DPCH), Page Indication (PICH), Acquisition Indication (AICH), Physical Downlink Shared (PDSCH), OCNS DPCCCH, PDCH

Downlink Channel Configurations

- PSCH
 - Power: -40 to 0 dB
- SSCH
 - Power: -40 to 0 dB
 - Secondary Scramble Code Group: 0 to 63
- P-CCPCH
 - Power: -40 to 0 dB
 - OVSF: 0 to 255
 - Data: PN9, FIX4, User File, PN15
 - Transport Channel: BCH Coding
 - System Frame Number (SFN): Incrementing
- CPICH
 - Power: -40 to 0 dB
- DPCH
 - Reference Measurement Setup: 12.2, 64, 144, 384 kbps
 - **Physical Layer Control:**
 - Configurable parameters: Power, OVSF, Slot Format, TPC, TFCI
 - Symbol Rate: 7.5 – 960 ksps
 - TDPCCH Offset: 0 to 149
 - Secondary Scramble Code Offset: 0 to 15
 - Data: PN9, PN15, 4-bit repeating pattern, User File, Transport Channel
 - **Transport Layer (DCH) Control:**
 - (Up to 6 DCH's for each DPCH)
 - Block Size, Transport Time Interval (TTI), Rate Matching, CRC Size, Transport Channel Number
 - Data: PN9, FIX4, User File
 - Coding: None, Convolutional 1/2, Convolutional 1/3, Turbo
- PICH
 - Power: -40 to 0 dB
 - OVSF: 0 to 511

Uplink Specifications

See ESG Technical Specifications, p/n 5965-3096E and Configuration Guide, p/n 5965-4973E for details

E4430B
E4431B
E4432B
E4433B
E4434B
E4435B
E4436B
E4437B

5

E4430B
E4431B
E4432B
E4433B
E4434B
E4435B
E4436B
E4437B**Option 101, Multichannel cdma2000 Personality****Spreading Rate:** SR1,SR3**Multicarrier:** Up to 12 (user defined, individually configured)**Frequency Offset** (per carrier): -7.5 MHz to +7.5 MHz**Power Offset:** 0 dB to -40 dB**Forward Link**

• Spreading Type: Direct spread (DS), multicarrier

User-defined cdma2000 (Channel types)

(partially coded) Pilot, paging (SR1 only), sync, fundamental, and supplemental

Radio Configuration:

• SR1: 1 to 5

• SR3: 6 to 9

Data Rate: 1.2 kbps to 1036.8 kbps, depends on the selected radio configuration**Walsh Code:** Pilot and sync have fixed codes, Walsh 0 and 32.**Channel Power:** 0 to -40 dB**PN Offsets:** 0 to 511**Data Pattern:** 00-FF(HEX) or random**Reverse Link**

• Spreading Type: Direct spread only

User-defined cdma2000 (Channel types)

(partially coded) Pilot, dedicated control channel, fundamental, and supplemental

Radio Configuration: 1 to 6**Data Rate:** 1.2 kbps to 1036.8 kbps, depends on radio config.**Channel Power:** 0 to -40 dB**Data Pattern:** 00-FF(HEX) or random

5

Option 201, Real-Time cdma2000 Personality**Channel Types Generated** Up to four channels of any of the following:

Pilot, Paging, Quick Paging, Sync, F-Fundamental, F-Supplemental, OCNS

Global Controls Across All Channels

• Channel Power: 0 to -40 dB

• Filters: IS95, IS95 w/eq, IS95 mod, IS95 mod w/eq, Root Nyquist, Nyquist, Gaussian, user-defined FIR, Rectangle, APCO 25 C4FM

Spread Rate: 1**PN Offset:** 0 to 511**Chip Rate:** 50 Hz to 1.3 MHz**Even Second Delay:** 0.5 to 128 chips**I/Q Voltage Scale:** 0 to -40 dB**Code Domain Power:** Equal powers or scale to 0 dB**Pilot Channel**

• Walsh: 0 (non-adjustable)

Sync Channel

• Walsh: 0 to 63

• Data: Free editing of the following: SID, NID, F-synch type, Sys_Time, PRAT, LTM_Off, Msg_Type, P_REV, MIN_P_REV, LP_SEC, DAYLT, CDMA Freq, ext CDMA freq, and Reserved

Paging Channel

• Walsh: 0 to 63

• Data: Default paging message or Userfile

• Long Code Mask: 0-3FFFFFFF (HEX)

• Rate: 4.8 or 9.6 kbps

Quick Paging Channel

• Power: 0 to -40 dB

• Walsh: 0 to 127

• Data rate: 2.4 kbps to 4.8 kbps

• Config. change: 0 to 3

• Paging indicator: -1 to 383

Fundamental Channel

• Radio Config.: 1 to 5

• Walsh: 0 to 63

• Data Rate: 1.2 to 14.4 kbps, depending on radio configuration data PN9, PN15, userfile, external serial data, or predefined bit patterns

• Long Code Mask: 0-3FFFFFFF (HEX)

• Power Control: N up/down, "N" may be set from 1 to 80

• Power Puncture: On/Off

• Frame Offset: 0 to 15

• Frame Length: 20 ms (non-adjustable)

• QOF: 0 to 3

Supplemental Channel (Same channel configuration as Fundamental, except)

• Radio Config.: 3 to 5

• Walsh: 0 to 63, depending on RC and Data Rate

• Data Rate: 19.2 to 307.2 kbps, depending on radio configuration

• Turbo Coding: May be selected for data rates from 28.8 to 153.6 kbps

OCNS Channel**Walsh:** 0 to 63**Option 202, Real-Time EDGE Personality****Modulation**3 π /8-rotating 8PSK (per EDGE specifications)

User-selectable (see Modulation under Option UN8)

Filter

"Linearized" Gaussian (per EDGE specifications)

User-selectable (see Filter under Option UN8)

Symbol Rate

User-adjustable (see Symbol rate under Option UN8)

270.833 kHz (default)

Burst Shape

Defaults to EDGE standard power vs. time mask with user definable burst shape. Alternatively, upload externally defined burst shape waveforms

Data Structure

Time slots may be configured as normal or custom.

The data field of a time slot can accept a user file, PRBS (PN9 or PN15),

a fixed sequence or external data. All other fields in a timeslot are

editable. Conforms to 8.3.0 Release 99

Key Literature

ESG Family RF Signal Generators (brochure), p/n 5968-4313E

ESG Family RF Signal Generators Data Sheet, p/n 5965-3096E

ESG Family RF Signal Generators Configuration Guide, p/n 5965-4973E

For additional information, visit our web site: www.agilent.com/find/esg**Ordering Information****ESG-D Series**

E4430B 1 GHz Signal Generator

E4431B 2 GHz Signal Generator

E4432B 3 GHz Signal Generator

E4433B 4 GHz Signal Generator

ESG-DP Series

E4434B 1 GHz Signal Generator

E4435B 2 GHz Signal Generator

E4436B 3 GHz Signal Generator

E4437B 4 GHz Signal Generator

ESG-D Series Options

Opt 1E5 Add high-stability timebase

ESG-D and ESG DP Series Options

Opt UNA Alternate time slot level control (for Option UN8)

Opt UNB High power with mechanical attenuator

Hardware Options

Opt UND Internal dual arbitrary waveform generator

Opt UN7 Internal Bit-Error-Rate Analyzer

Opt UN8 Real-time I/Q baseband generator

Opt UN9 Add 7 M RAM to Opt UN8

Firmware Options

Opt UN5 Multicarrier, multichannel cdmaOne

Personality for Option UND

Opt 100 Multicarrier, multichannel W-CDMA

Personality for Option UND

Opt 101 Multicarrier, multichannel W-CDMA

Personality for Option UND

Opt 200 Real-time W-CDMA Personality for Option UN8/UN9

Opt 201 Real-time cdma2000 Personality for Option UN8/UN9

Opt 202 Real-time EDGE Personality for Option UN8/UN9

- Flexible architecture, upgrade paths for options
- Superior spectral purity on ESG-AP series
- 4 GHz electronic attenuator for reliability and repeatability
- Superior level accuracy
- Wideband FM and phase modulation
- Step sweep (frequency, power and list)
- Built-in function generator
- 3 year warranty



ESG-A series E4421B

ESG-A and ESG-AP Series Analog Signal Generators

The Agilent ESG-A & AP series of analog RF signal generators offer excellent in-channel performance with superior quality and reliability, at an affordable price. The ESG-AP series provides all of the features of ESG-A, plus enhanced phase-noise performance. The ESG-A & AP series provide superb frequency and level control, and wide modulation capabilities. They are ideally suited to meet the demanding requirements of today's receiver test, component test and local oscillator applications.

For more information, visit the ESG web site: www.agilent.com/find/esg

Low Cost of Ownership

Low initial cost, three-year warranty and a two-year calibration cycle, are all features that help minimize the cost of ownership. The ESG-A and AP RF signal generators are designed for long-term dependability, maximizing production throughput and uptime.

Excellent Level Accuracy

Superior level accuracy of ± 0.5 dB (above -127 dBm, $f_c < 2$ GHz) and ± 0.9 dB ($f_c > 2$ GHz) provides unmatched performance and minimizes test uncertainty. This unprecedented performance ensures precise measurement of even the most sensitive analog receivers.

High-Stability Timebase

The high stability timebase, Option 1E5, for the ESG-A series and standard on the ESG-AP series, provides increased frequency stability and accuracy, which results in reduced drift and phase noise. The high-stability timebase improves measurement repeatability and reliability.

High-Performance Pulse Modulation, Option 1E6

The high performance pulse modulation, Option 1E6, for the ESG-A and AP series provides improved pulse rise and fall times, plus exceptional on/off ratios. Option 1E6 improves radar and pulse carrier measurements.

Specifications

Frequency

Range	ESG-A series	ESG-AP series (Enhanced Phase Noise)
250 kHz – 1000 MHz	E4400B	E4423B
250 kHz – 2000 MHz	E4420B	E4424B
250 kHz – 3000 MHz	E4421B	E4425B
250 kHz – 4000 MHz	E4422B	E4426B

Resolution: 0.01 Hz

Frequency Accuracy: $f_c \times$ timebase accuracy

Switching Speed (typical)

	ESG-A	ESG-AP
Modulation On	<50 ms	<65 ms
Modulation Off	<40 ms	<55 ms

Sweep Modes: Step: frequency and power, and arbitrary list

- Dwell Time: 1 ms to 60 sec
- Number of points: 2 to 401

Internal Reference Oscillator

Timebase Stability

	ESG-A	Opt 1E5 ESG-A (Standard on ESG-AP)
Aging Rate	$< \pm 1$ ppm/yr.	$< \pm 0.1$ ppm/yr. or $< \pm 0.0005$ ppm/day after 45 days
Temperature (0°C to 55°C)	$< \pm 1$ ppm, typical	$< \pm 0.05$ ppm, typical
Line Voltage	$< \pm 0.1$ ppm (+5%, -10%), typical	$< \pm 0.002$ ppm, typical (+5%, -10%)

Time-base Accuracy: $= \pm$ aging rate \pm temperature effects \pm line voltage effects.

Timebase Reference Output:

- Frequency: 10 MHz
- Amplitude: > 0.35 V rms into 50 Ω load

External Reference Input:

Frequency: 1, 2, 5, 10 MHz, \pm typ. 10 ppm (typical 1 ppm, ESG-AP and Option 1E5 for ESG-A)

Amplitude: > 0.15 V rms

Input Impedance: 50 Ω

Output

Power

Range	Standard	Option UNB
250 kHz to 1000 MHz	+13 to -136 dBm	+17 to -136 dBm
>1000 MHz to 3000 MHz	+10 to -136 dBm	+16 to -136 dBm
>3000 MHz to 4000 MHz	+7 to -136 dBm	+13 to -136 dBm

Resolution: 0.02 dB

Level Accuracy (at 23°C \pm 5°C)

Output Power/ Frequency Range	+7 to -120 dBm (+10 to -120 dBm, Opt UNB)	-120 to -127 dBm	<-127 dBm
250 kHz to 2 GHz	± 0.5 dB	± 0.5 dB	± 1.5 dB
>2000 MHz to 3 GHz	± 0.9 dB	± 0.9 dB	± 2.5 dB
>3000 MHz to 4 GHz	± 0.9 dB	± 0.9 dB (± 1.5 dB, Opt UNB)	± 2.5 dB

Amplitude Switching Speed: < 30 ms, typical

- With Power Search Mode: < 300 ms, typical

Reverse Power Protection:

- 250 kHz to 2000 MHz: 50 watts
- > 2000 MHz to 4000 MHz: 25 watts
- Max. DC Voltage: 50 V

SWR (typical)

Frequency Range	Standard	Option UNB
250 kHz to 2000 MHz	$< 1.4:1$	$< 1.25:1$
>2000 to 4000 MHz	$< 1.9:1$	$< 1.35:1$

Output Impedance: 50 Ω

E4400B
E4420B
E4421B
E4422B
E4423B
E4424B
E4425B
E4426B

5

E4400B
E4420B
E4421B
E4422B
E4423B
E4424B
E4425B
E4426B

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to ≤249.999 MHz	1
2	>249.999 to ≤500 MHz	0.5
3	>500 MHz to ≤1 GHz	1
4	>1 to ≤2 GHz	2
5	>2 to ≤4 GHz	4

Note: Refer to the N listed in Frequency Bands Table to compute specifications

Spectral Purity

SSB Phase Noise (typical, at 20 kHz offset)

	ESG-A	ESG-AP (Enhanced Phase Noise)
at 500 MHz	<-120 dBc/Hz	<-138 dBc/Hz
at 1000 MHz	<-116 dBc/Hz	<-134 dBc/Hz
at 2000 MHz	<-110 dBc/Hz	<-127 dBc/Hz
at 3000 MHz	<-104 dBc/Hz	<-124 dBc/Hz
at 4000 MHz	<-104 dBc/Hz	<-122 dBc/Hz

Residual FM (CW mode, 0.3 – 3 kHz, post detection BW, as specified by CCITT, rms)

ESG-A series:

- Phase Noise Mode 1: <N x 2 Hz
- Phase Noise Mode 2: <N x 4 Hz

ESG-AP series:

<N x 1 Hz (<N x 0.5 Hz, typical)

Note: Mode 1 optimizes phase noise at offsets <10 kHz and Mode 2 optimizes phase noise at offsets >10 kHz.

5

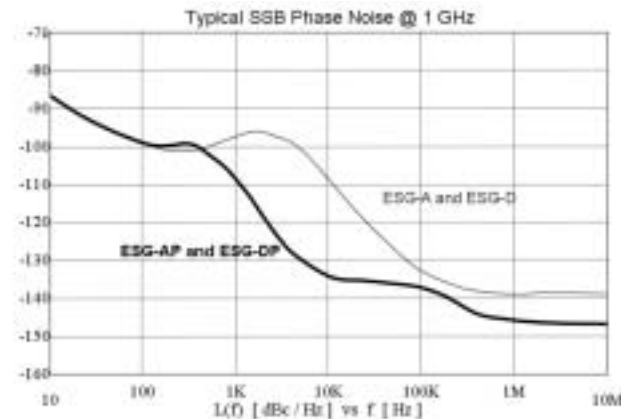


Figure 1: Typical SSB noise at 1 GHz (for additional phase noise plots, please refer to ESG family RF Signal Generators Technical Specifications literature, p/n 5965-3096E.)

Frequency Modulation

Maximum Deviation:

- ESG-A: N x 10 MHz
- ESG-AP: N x 1 MHz

Resolution: 0.1% of deviation or 1 Hz, whichever is greater

Deviation Accuracy (1 kHz rate, dev. <N x 100 kHz): <±(3.5% of FM deviation + 20 Hz)

Modulation Frequency Response (deviation = 100 kHz)

Path	Rates	
	1 dB Bandwidth	3 dB Bandwidth, typical
FM1	20 Hz to 100 kHz	5 Hz to 10 MHz
FM2	20 Hz to 100 kHz	5 Hz to 1 MHz

Distortion For a deviation of N x 100 kHz, and 1 kHz rate, THD <1%.

Phase Modulation

Maximum Deviation

	ESG-A	ESG-AP
Normal BW	N x 90 radians	N x 10 radians
High BW	N x 2π radians	N x 1 radians

Resolution: 0.1% of set deviation

Deviation Accuracy (1 kHz rate): <±(5% of deviation + 0.01 radians)

Modulation Frequency Response

ESG-A

Φ Mode	Max. Deviation	Rates (3 dB BW) ΦM1	ΦM2
Normal BW	N x 2π rad	dc –100 kHz	dc –100 kHz
High BW	N x 2π rad	dc –1.5 MHz (typ.) dc –4 MHz (typ.)	dc –0.9 MHz (typ.) dc –1 MHz (typ.)

ESG-AP

Φ Mode	Max. Deviation	Rates (3 dB BW) ΦM1	ΦM2
Normal BW	N x 10 rad	dc –100 kHz	dc –100 kHz
High BW	N x 1 rad	dc –1 MHz (typ.)	dc –1 MHz (typ.)

Distortion: For a deviation of <N x 90 rad (<N x 10 rad for ESG-AP), and 1 kHz rate in normal BW mode, THD <1%.

Amplitude Modulation fc >500 kHz (AM is typical above 3 GHz)

Range (envelope peak = max. specified power): 0 to 100%

Resolution: 0.1%

Rates (3 dB bandwidth): 10 Hz to 10 kHz

Distortion (1 kHz rate, THD): 30% AM: <1.5%, 90% AM: <4% (typical)

Accuracy (1 kHz rate): <±(6% of modulation index setting + 1%)

(Example of accuracy: with 40% depth of modulation at 1 kHz rate, the accuracy will be ±2.4% + 1%)

Pulse Modulation

On/Off Ratio: ≤3 GHz: >80 dB; >3 GHz: >60 dB

Rise/Fall Times: 150 ns, typical

Minimum Width (typical): ALC On: 2 μs; ALC Off: 0.4 μs

Pulse Repetition Frequency (typical):

ALC On: 10 Hz – 250 kHz

ALC Off: dc – 1.0 MHz

Level Accuracy (relative to CW): ±0.5 dB, typical

(With ALC on, repetition rates ≤10 kHz and pulse widths ≥5 μs)

Internal Pulse Generator:

Squarewave Rates: 0.1 Hz – 50 kHz

Pulse:

• Period: 16 μs to 30 sec

• Width: 8 μs to 30 sec

• Resolution: 4 μs

High Performance Pulse Modulation, Option 1E6

• On/Off Ratio: ≤2 GHz: >80 dB; >2 GHz: >70 dB

• Rise/Fall times: <10 ns

Internal Modulation Source

Provides AM, FM, and ΦM Signals and LF Out

Waveforms: sine, square, ramp, triangle, pulse, and noise

Rate Range:

• Sine: 0.1 Hz – 50 kHz

• Square, Ramp, Triangle: 0.1 Hz – 10 kHz

Resolution: 0.1 Hz

• Pulse only: 4 μs

Frequency Accuracy: 0.005%, typical

Swept Sine Mode (Frequency, Phase Continuous)

• Operating Modes: Triggered or Continuous Sweeps

• Frequency Range: 0.1 Hz to 50 kHz

• Sweep Time: 1 ms to 65 sec

• Resolution: 1 ms

Dual Sinewave Mode

• Frequency Range: 0.1 Hz to 50 kHz

• Amplitude Ratio: 0 to 100%

• Amplitude Resolution: 0.1%

Low Frequency Out (Internal Modulation Source)**Amplitude:** 0 to 3 V peak into 50 Ω **Output Impedance:** <1 Ω **External Modulation Inputs****Modulation Types:**

- Ext1: Φ M, FM, AM, and Burst Envelope
- Ext2: Φ M, FM, AM, and Pulse

High/Low Indicator (100 Hz to 10 MHz BW, AC coupled inputs only):
Activated when input level error exceeds 3% (nominal)**Simultaneous Modulation**

All modulation types may be simultaneously enabled, except:
 FM with Φ M; AM with Burst Envelope; Wideband AM with I/Q. AM,
 Φ M and FM can sum simultaneous inputs from any two sources:
 EXT 1 and EXT 2, INT and EXT 1, INT and EXT 2. Any given source
 (INT, EXT 1 or EXT 2) may only be routed to one activated modulation type.

Remote Programming**Interface:** GPIB (IEEE-488.2-1987) with Listen and Talk. RS-232.**Control Languages:** SCPI version 1992.0, also compatible with 8656B
and 8657A/B/D/J mnemonics**Functions Controlled:** All front-panel functions except power switch
and knobs**General****Power Requirements:** 90 to 254 V; 50, 60, or 400 Hz; 200 W maximum**Operating Temperature Range:** 0°C to 55°C**Leakage:** Conducted and radiated interference meets MIL-STD-461C
CE02 Part 2 and CISPR 11**Storage Registers:** Up to 800 storage registers, up to 10 sequences available**Weight:** <12.7 kg (28 lb) net, <21 kg (46 lb) shipping**Dimensions:** 133 mm H x 426 mm W x 432 mm D
(5.25 in H x 16.8 in W x 17 in D)**Key Literature**

ESG Family RF Signal Generators (brochure), p/n 5968-4313E

ESG Family RF Signal Generators Technical Specifications, p/n 5965-3096E

ESG Family RF Signal Generators Configuration Guide, p/n 5965-4973E

For additional information, visit the ESG web site:

www.agilent.com/find/esg**Ordering Information****ESG-A Series****E4400B** 1 GHz Signal Generator**E4420B** 2 GHz Signal Generator**E4421B** 3 GHz Signal Generator**E4422B** 4 GHz Signal Generator**ESG-AP Series****E4423B** 1 GHz Signal Generator**E4424B** 2 GHz Signal Generator**E4425B** 3 GHz Signal Generator**E4426B** 4 GHz Signal Generator**ESG-A Series Hardware Options****Opt 1E5** Add high-stability timebase**ESG-A and ESG AP Series Hardware Options****Opt 1E6** High performance pulse modulation**Opt UNB** High power with mechanical attenuatorDocumentation, support, and mechanical options available
with any ESG model

E4400B

E4420B

E4421B

E4422B

E4423B

E4424B

E4425B

E4426B

Signal Generators

154

Analog & CW Signal Generators (cont.)

E8247C
E8257C

- Highest output power in the industry
- Excellent phase noise performance
- Ramp sweep and scalar analyzer interface now available
- Frequency coverage up to 110 GHz for analog and CW applications



E8247C/E8257C Analog and CW Microwave Signal Generators

5

E8247C CW Generator for LO Substitution and Component Test Application

- Industry leading high output power
- Enhanced phase noise
- Superior level accuracy
- Code compatibility with other Agilent microwave signal generators¹
- Ramp sweep capability with fast sweep rate
- Automatic operation with the 8757D scalar network analyzer

E8257C Advanced Communication Testing of Receiver Quality, Transmitter Sensitivity and Selectivity

Contains all features of the E8247C, plus

- Flexible analog modulation formats: AM, FM, Φ M and pulse
- Internal modulation with sine, square, triangular, ramp, and noise waveforms
- Narrow pulse modulation (20 ns) down to 10 MHz

¹80 to 100% code compatibility with Agilent 8340/8341, E824x/E825xA, 836xxB/L, and 837xx microwave signal generators.

Specifications

Frequency

Range¹

Option 520: 250 kHz to 20 GHz

Option 540: 250 kHz to 40 GHz

Resolution

CW: 0.001 Hz²

All Sweep modes: 0.01 Hz

Accuracy

Aging rate \pm temperature effects \pm line voltage effectsSwitching Speed³

<15 ms (typical)

Phase Offset

Adjustable in nominal 0.1° increments

Frequency Bands

Band	Frequency Range	N #
1	250 kHz to 250 MHz	1/8
2	>250 to 500 MHz	1/16
3	>500 MHz to 1 GHz	1/8
4	>1 to 2 GHz	1/4
5	>2 to 3.2 GHz	1/2
6	>3.2 to 10 GHz	1
7	>10 to 20 GHz	2
8	>20 to 40 GHz	4

Internal Timebase Reference Oscillator

	Standard	Option UNR
Aging Rate	< $\pm 1 \times 10^{-7}$ /year or < $\pm 4.5 \times 10^{-9}$ /day after 45 days	< $\pm 3 \times 10^{-8}$ /year or < $\pm 2.5 \times 10^{-10}$ /day after 30 days

Temperature Effects (typical)

< $\pm 5 \times 10^{-8}$ 0 to 55°C< $\pm 4.5 \times 10^{-9}$ 0 to 55°C

Line Voltage Effects (typical)

< $\pm 2 \times 10^{-8}$ for +5%–10% change< $\pm 2 \times 10^{-10}$ for $\pm 10\%$ change

External Reference Frequency

1, 2, 2.5, 5, 10 MHz (within 1 ppm)

10 MHz only (within 1 ppm)

Digital Sweep

Operating Modes

Step sweep of frequency or amplitude or both (start to stop)

List sweep of frequency or amplitude or both (arbitrary list)

Sweep Range

Frequency sweep: Within instrument frequency range

Amplitude sweep: Within attenuator hold range

Dwell Time 1 ms to 60 s

Frequency settling time: 28 ms (typical)

Amplitude settling time: 10 ms (typical)

Number of Points

2 to 1601

Triggering

Auto, external, single, or GPIB

Ramp (analog) Sweep (Option 007)⁴

Operating Modes

Synthesized frequency sweep (start/stop), (center/span), (swept CW)

Power (amplitude) sweep (start/stop)

Manual sweep

RPG control between start and stop frequencies

Alternate sweep

Alternates successive sweeps between current and stored states

Sweep Span Range

Settable from minimum⁵ to full range¹ Useable to 100 kHz.² In ramp sweep mode (Option 007), resolution is limited with narrow spans and slow sweep speeds. Refer to ramp sweep specifications for more information.³ To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.⁴ During Ramp sweep operation, AM and Pulse Modulation are useable but not specified; FM, Phase Modulation, Wideband AM and I/Q modulation are not useable.⁵ Minimum settable sweep span is proportional to carrier frequency and sweep time. Actual sweep span may be slightly different than desired setting for spans less than $[0.00004\% \text{ of carrier frequency or } 140 \text{ Hz}] \times [\text{sweep time in seconds}]$. Actual span will always be displayed correctly.

Maximum Sweep Rate

Start Frequency	Maximum Sweep Rate	Max Span for 100 ms Sweep
250 kHz to <0.5 GHz	25 MHz/ms	2.5 GHz
0.5 to <1 GHz	50 MHz/ms	5 GHz
1 to <2 GHz	100 MHz/ms	10 GHz
2 to <3.2 GHz	200 MHz/ms	20 GHz
≥3.2 GHz	400 MHz/ms	36.8 GHz

Frequency Accuracy

±0.05% of span ± timebase (at 100 ms sweep time, for sweep spans less than maximum values given above)

Accuracy improves proportionally as sweep time increases¹

Sweep Time (forward sweep, not including bandswitch and retrace intervals)

Resolution: 1 ms

Manual mode: Settable 10 ms to 99 seconds

Auto mode: Set to minimum value determined by maximum sweep rate and 8757D setting

Triggering

Auto, external, single, or GPIB

Markers 10 independent continuously variable frequency markers

Display: Z-axis intensity or RF amplitude pulse

Functions: M1 to center, M1/M2 to start/stop, marker delta

Two-tone (master/slave) measurements²

Two PSG's can synchronously track each other, with independent control of start/stop frequencies

Network Analyzer Compatibility

Fully compatible with Agilent 8757D scalar network analyzer³

Also useable with Agilent 8757A/C/E scalar network analyzers for making basic swept measurements⁴

Output

Power⁵ (dBm)

Frequency Range	Standard	Option 1EA
20 GHz Models		
250 kHz to 3.2 GHz	-20 to +13	-20 to +16
250 kHz to 3.2 GHz (with Option 1E6)	-20 to +13	-20 to +13
>3.2 to 20 GHz	-20 to +13	-20 to +20
40 GHz Models		
250 kHz to 3.2 GHz	-20 to +9	-20 to +15
250 kHz to 3.2 GHz (with Option 1E6)	-20 to +9	-20 to +12
>3.2 to 20 GHz	-20 to +9	-20 to +18
>20 to 40 GHz	-20 to +9	-20 to +14
20 GHz Models with Step Attenuator (Option 1E1)		
250 kHz to 3.2 GHz	-135 to +11	-135 to +15
250 kHz to 3.2 GHz (with Option 1E6)	-135 to +11	-135 to +12
>3.2 to 20 GHz	-135 to +11	-135 to +18
40 GHz Models with Step Attenuator (Option 1E1)		
250 kHz to 3.2 GHz	-135 to +7	-135 to +14
250 kHz to 3.2 GHz (with Option 1E6)	-135 to +7	-135 to +11
>3.2 to 20 GHz	-135 to +7	-135 to +16
>20 to 40 GHz	-135 to +7	-135 to +12

Step Attenuator

0 dB and 5 to 115 dB in 10 dB steps

Attenuator Hold Range Minimum (Same as max power sweep range)

From -20 dBm to maximum specified output power with step attenuator in 0 dB position. Can be offset using Option 1E1 attenuator

Amplitude switching speed⁶

CW or analog modulation: <5 ms (typical)

When using power search: <25 ms (typical)

Level Accuracy⁷ (dB)

Frequency	> +10 dBm	+10 to -10 dBm	-10 to -20 dBm
250 kHz to 2 GHz	±0.6	±0.6	±1.4
2 GHz to 20 GHz	±0.8	±0.8	±1.2
>20 to 40 GHz	±1.0	±0.9	±1.3

Level Accuracy with Step Attenuator⁸ (dB)

Frequency	> +10 dBm	+10 to -10 dBm	-10 to -70 dBm	-70 to -90 dBm	-90 to -110 dBm
250 kHz to 2 GHz	±0.6	±0.6	±0.7	±0.8	±1.4
>2 to 20 GHz	±0.8	±0.8	±0.9	±1.0	±1.7
>20 to 40 GHz	±1.0	±0.9	±1.0	±2.0	

Resolution

0.01 dB

Temperature Stability

0.01 dB/°C (typical)

User Flatness Correction

Number of points: 2 to 1601 points/table

Number of tables: Up to 10,000, memory limited

Path loss: Arbitrary, within attenuator range

Entry modes (user edit/view): Remote power meter⁹, remote bus, manual

Output Impedance

50 Ω (nominal)

SWR (internally leveled) (typical)

250 kHz to 2 GHz <1.4:1

>2 GHz to 20 GHz <1.6:1

>20 GHz to 40 GHz <1.8:1

Leveling Modes

Internal leveling, external detector leveling, millimeter source module, ALC Off

External Detector Leveling

Range: -0.2 mV to -0.5 V (nominal) (-36 dBm to +4 dBm using Agilent

33330D/E detector)

Bandwidth: 10 kHz (typical) (Note: not intended for pulsed operation)

Maximum Reverse Power

1/2 Watt (nominal)

Spectral Purity

Harmonics¹⁰ (dBc at +10 dBm or maximum specified output power, whichever is lower)

<1 MHz -28 dBc (typical)

1 MHz to 2 GHz -28 dBc

>2 GHz to 20 GHz -55 dBc

>20 GHz to 40 GHz -50 dBc (typical)

SSB Phase Noise (CW) Offset from Carrier (dBc/Hz)

Frequency	20 kHz	20 kHz (typical)
250 kHz to 250 MHz	-130	-134
>250 to 500 MHz	-136	-140
>500 MHz to 1 GHz	-130	-134
>1 to 2 GHz	-124	-128
>2 to 3.2 GHz	-120	-124
>3.2 to 10 GHz	-110	-113
>10 to 20 GHz	-104	-108
>20 to 40 GHz	-98	-102

¹ Typical accuracy for sweep times >100 ms can be calculated from the equation:

$[(0.005\% \text{ of span}) + (\text{sweep time in seconds}) \pm \text{timebase}] \pm \text{timebase}$. Accuracy is not specified for sweep times <100 ms.

² For Master/Slave operation use Agilent Technologies part #8120-8806 Master/Slave interface cable.

³ When measuring low-pass devices in AC mode, dynamic range may be reduced up to 10 dB below 3.2 GHz

⁴ GPIB system interface is not supported with 8757A/C/E, only with 8757D. As a result, some features of 8757A/C/E, such as frequency display, pass-through mode, and alternate sweep, do not function with PSG signal generators.

⁵ Maximum power specification is warranted from 15 to 35°C, and is typical from 0 to 15°C. Maximum power over the 35 to 55°C range typically degrades less than 2 dB.

⁶ To within 0.1 dB of final amplitude within one attenuator range.

⁷ Specifications apply in CW and List/Step sweep modes over the 15 to 35°C temperature range. Degradation outside this range, for power levels >-10 dBm, is typically <0.3 dB.

In Ramp sweep mode (with Option 007), specifications are typical. For instruments with Type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz.

⁸ Specifications apply in CW and List/Step sweep modes over the 15 to 35°C temperature range, with attenuator hold off (normal operating mode). Degradation outside this range, for ALC power levels >-10 dBm, is typically <0.3 dB. In Ramp sweep mode (with Option 007), specifications are typical. For instruments with type-N connectors (Option 1ED), specifications are degraded typically 0.2 dB above 18 GHz. Level accuracy is not specified below -110 dBm.

⁹ Compatible with Agilent Technologies EPM Series (E4418B and E4419B) power meters.

¹⁰ Specifications for harmonics beyond maximum instrument frequencies are typical.

E8247C

E8257C

5

E8247C
E8257C

Option UNR: Enhanced SSB Phase Noise (CW) Offset from carrier (dBc/Hz)

Frequency	100 Hz spec (typical)	1 kHz spec (typical)	10 kHz spec (typical)	100 kHz spec (typical)
250 kHz to 250 MHz	-94 (-115)	-110 (-123)	-128 (-132)	-130 (-133)
>250 to 500 MHz	-100 (-110)	-124 (-130)	-132 (-136)	-136 (-141)
>500 MHz to 1 GHz	-94 (-104)	-118 (-126)	-130 (-135)	-130 (-135)
>1 to 2 GHz	-88 (-98)	-112 (-120)	-124 (-129)	-124 (-129)
>2 to 3.2 GHz	-84 (-94)	-108 (-116)	-120 (-125)	-120 (-125)
>3.2 to 10 GHz	-74 (-84)	-98 (-106)	-110 (-115)	-110 (-115)
>10 to 20 GHz	-68 (-78)	-92 (-100)	-104 (-107)	-104 (-109)
>20 to 40 GHz	-62 (-72)	-86 (-94)	-98 (-101)	-98 (-103)

Residual FM

CW mode: <N x 6 Hz (typical)
Option UNR: <N x 4 Hz (typical)
Ramp sweep mode: <N x 1 kHz (typical) (rms, 50 Hz to 15 kHz bandwidth)
Broadband Noise (CW mode at +10 dBm output, for offsets >10 MHz)
>2.4 to 20 GHz <-148 dBc/Hz (typical)
>20 to 40 GHz <-141 dBc/Hz (typical)

Frequency Modulation

Maximum Deviation

N x 8 MHz

Resolution

0.1% of deviation or 1 Hz, whichever is greater

Deviation Accuracy

<±3.5% of FM deviation + 20 Hz (1 kHz rate, deviations <N x 800 kHz)

Modulation Frequency Response

Path	Rates (at 100 kHz deviation)	
	1 dB Bandwidth	3 dB Bandwidth (typical)
FM 1	dc/20 Hz to 100 kHz	dc/5 Hz to 10 MHz
FM 2	dc/20 Hz to 100 kHz	dc/5 Hz to 1 MHz

dc FM¹ Carrier Offset

±0.1% of set deviation + (N x 8 Hz)

Distortion

<1% (1 kHz rate, deviations <N x 800 kHz)

Sensitivity

±1 V_{peak} for indicated deviation

Phase Modulation

Maximum Deviation

N x 80 radians (N x 8 radians in high-bandwidth mode)

Resolution

0.1% of set deviation

Deviation Accuracy

<±5% of deviation + 0.01 radians (1 kHz rate, normal BW mode)

Modulation Frequency Response

Mode	Maximum Deviation	Rates (3 dB BW)
Normal BW	N x 80 rad	dc to 100 kHz
High BW	N x 8 rad	dc to 1 MHz (typical)

Distortion

<1% (1 kHz rate, THD, dev <N x 80 rad, normal BW mode)

Sensitivity

±1 V_{peak} for indicated deviation

Amplitude Modulation (f_c > 2 MHz)² (typical)

Depth	Linear Mode	Exponential (log) Mode (Downward modulation only)
Maximum	>90%	>20 dB
Settable ³	0 to 100 %	0 to 40 dB
Resolution	0.1%	0.01 dB
Accuracy (1 kHz rate)	<±(6% of setting + 1%)	<±(2% of setting + 0.2 dB)

Ext Sensitivity

Line Mode: ±1 V_{peak} for indicated depth
Exponential (log) Mode: -1 V for indicated depth

Rates (3 dB bandwidth, 30% depth)
dc/10 Hz to 100 kHz (typical) (useable to 1 MHz)

Distortion (1 kHz rate, linear mode, THD)

30% AM <1.5%
90% AM <4 %

External Modulation Inputs (Ext1 & Ext2)

Modulation Types

AM, FM, and ΦM

Input Impedance

50 or 600 Ω (nominal) switched

High/Low Indicator (100 Hz to 10 MHz BW, ac coupled inputs only)

Activated when input level error exceeds 3% (nominal)

Simultaneous Modulation

All modulation types may be simultaneously enabled except: FM with ΦM, and linear AM with exponential AM. AM, ΦM, and FM can sum simultaneous inputs from any two sources (Ext1, Ext2, internal1, or internal2) Any given source (Ext1, Ext2, internal1, or internal2) may be routed to only one activated modulation type.

Internal Modulation Source

Dual function generators provides two independent signals (internal1 and internal2) for use with AM, FM, ΦM, or LF Out.

Waveforms

Sine, square, positive ramp, negative ramp, triangle, Gaussian noise, uniform noise, swept sine, dual sine²¹

Rate Range

Sine: 0.5 Hz to 1 MHz
Square, ramp, triangle: 0.5 Hz to 100 kHz
Resolution: 0.5 Hz
Accuracy: Same as timebase

LF Out

Output : Internal1 or internal2. Also provides monitoring of internal1 or internal2 when used for AM, FM, or ΦM.

Amplitude: 0 to 3 V_{peak} (nominal) into 50 Ω

Output impedance: 50 W (nominal)

Swept Sine Mode: (frequency, phase continuous)

Operating modes: Triggered or continuous sweeps

Frequency range: 1 Hz to 1 MHz

Sweep rate: 0.5 Hz to 100 kHz sweeps/s, equivalent to sweep times 10 us to 2 s

Resolution: 0.5 Hz (0.5 sweep/s)

¹At the calibrated deviation and carrier frequency, within 5°C of ambient temperature at time of user calibration.

²For f_c < 2 MHz AM is usable but not specified. AM specifications apply with ALC on, and envelope peaks <maximum specified power. For instruments without Option 1E1 attenuator, specs apply for carrier amplitude >-2 dBm.

³For AM depth settings >90% or >20 dB, deep AM mode or 1 kHz ALC BW is recommended.

5

Pulse Modulation¹

	Standard >3.2 GHz	Standard ≥500 MHz to ≤3.2 GHz	Option 1E6 ≥10 MHz to ≤3.2 GHz
On/off Ratio	80 dB (typical)	80 dB	80 dB
Rise/Fall Times (Tr, Tf)	10 ns (6 ns typical)	100 ns (typical)	10 ns (8 ns typical)
Pulse Width Internally leveled	≥1 μs	≥2 μs (typical)	≥1 μs
Level hold (ALC Off with power search) ²	≥20 ns (typical)	≥0.5 μs (typical)	≥20 ns (typical)
Repetition Frequency Internally leveled	10 Hz to 500 kHz (typical)	10 Hz to 250 kHz (typical)	10 Hz to 500 kHz (typical)
Level hold (ALC Off with power search) ²	dc to 10 MHz (typical)	dc to 1 MHz (typical)	dc to 10 MHz (typical)
Level Accuracy (relative to CW) Internally leveled	±0.5 dB ±0.15 (typical)	±0.5 dB	±0.5 dB
Level hold (ALC Off with power search) ²	≤20 GHz ±0.8 dB (typical) ≤40 GHz ±1.2 dB (typical)	±0.5 dB (typical)	±1.0 dB (typical)
Width Compression	±5 ns (typical)	±50 ns (typical)	±5 ns (typical)
Video Feed-Through³	<2 mV (typical)	<200 mV (typical)	<125 mV (typical)
Video Delay (Ext input to Video)	40 ns (nominal)	40 ns (nominal)	40 ns (nominal)
RF Delay (Tm) (Video to RF output)	35 ns (nominal)	280 ns (nominal)	45 ns (nominal)
Pulse Overshoot (Vor)	<10% (typical)	<10% (typical)	<1 GHz 20% (typical) ≥1 GHz 10% (typical)
Input Level	+1 V _{peak} = RF On	+1 V _{peak} = RF On	+1 V _{peak} = RF On
Input Impedance	50 Ω (nominal)	50 Ω (nominal)	50 Ω (nominal)

Internal Pulse Generator

Modes

Free-run, triggered, triggered with delay, doublet, and gated. Triggered with delay, doublet, and gated require external trigger source.

Period (PRI) (Tp)

70 ns to 42 s (Repetition frequency: 0.024 Hz to 14.28 MHz)

Pulse Width (Tw)

10 ns to 42 s

Delay (Td)

Free-run mode: 0 to ±42 s

Triggered with delay and doublet modes: 75 ns to 42s with ±10 ns jitter

Resolution

10 ns (width, delay, and PRI)

Remote Programming

Interfaces

GPIB (IEEE-488.2,1987) with listen and talk, RS-232, and 10BaseT LAN interface.

Control Languages

SCPI version 1997.0. Also will emulate most applicable Agilent 836xxB, Agilent 837xxB, and Agilent 8340/41B commands, providing general compatibility with ATE systems which include these signal generators.

IEEE-488 Functions

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2.

General

Power Requirements

90 to 132 Vac 50 to 60 Hz, or 195 to 267 Vac 50 to 60 or 400 Hz. (automatically selected), 300 W maximum.

Operating Temperature Range

0 to 55 °C

Storage Temperature Range⁴

–40 to 71 °C

Shock and Vibration Meets

MIL-STD-28800E Type III, Class 3.

EMC

Conducted and radiated interference and immunity meets IEC/EN 61326-1 and MIL-STD-461C Part 2, RE02. Meets radiated emission requirements of CISPR Pub 11/1997 Group 1 class A.

Storage Registers

Up to 800 storage registers and 10 register sequences are available.

Security

Display blanking.

Compatibility

Agilent Technologies 83550 Series millimeter heads, Agilent Technologies 8757D Scalar Network Analyzers, Agilent Technologies EPM Series Power Meters.

Weight

<22 kg (48 lb.) net, <30 kg (68 lb.) shipping.

Dimensions

178 mm H x 426 mm W x 498 mm D (7" H x 16.8" W x 19.6" D in.)

Key Literature

PSG Signal Generator, Brochure Literature number 5988-7538EN
Agilent E8247/57C PSG CW and Analog Signal Generators Data Sheet
Literature number 5988-7454EN
PSG Configuration Guide Literature number 5988-7541EN

www.agilent.com/find/psg

Ordering Information

E8247C PSG CW Signal Generator

E8257C PSG Analog Signal Generator

Frequency Range (required option)

Option 520 250 kHz to 20 GHz

Option 540 250 kHz to 40 GHz

Step Attenuator

Option 1E1 Adds output step attenuator

High Output Power

Option 1EA High RF output power

Enhanced Phase Noise

Option UNR Enhanced phase noise performance

Narrow Pulse Modulation

Option 1E6 Provides narrow pulse modulation below 3.2 GHz

Analog (Ramp) Sweep

Option 007 Provides analog (ramp) sweep and scalar network analyzer interface

Connectors

Option 1ED Type-N (f) connector

Option 1EM Moves all connector to rear panel

¹With ALC off, specs apply after the execution of power search. For instruments without a step attenuator, specs apply between 0 and +10 dBm. For instruments with the step attenuator, specs apply with Atten Hold Off, or ALC level between 0 and +10 dBm.

²Power search is a calibration routine that improves level accuracy in ALC-off mode.

³Un-pulsed RF power will be present typically up to 50 ms when executing power search.

⁴With attenuator in 0 dB position. Video feed-through decreases with attenuator setting.

⁵Storage below –20°C Instrument states may be lost.

E8247C

E8257C

5

8648A
8648B
8648C
8648D

- ±1 dB level accuracy through 2.5 GHz
- 4 Hz residual FM at 500 MHz
- Electronic attenuator (1 GHz models)
- +10/+13 to -136 dBm output power
- Simple, dependable operation
- Pager signaling (8648A Option 1EP)



8648A/B/C/D

8648A/B/C/D Synthesized Signal Generators

5 Superior Value in Economy Signal Generators

The 8648A/B/C/D family of synthesized signal generators delivers solid performance and reliability at an affordable price. These signal generators provide the features and performance needed for semi-automated receiver testing and for use in a variety of general-purpose applications over a 9 kHz to 4000 MHz frequency range.

High Reliability and Simplicity

Designed to Agilent's stringent quality specifications, these signal generators provide consistent performance. The all-electronic attenuator in the 8648A easily handles millions of amplitude cycles with highly repeatable output levels.

An easy-to-use front panel interface shortens the operator's learning curve and increases productivity. A front panel organized in functional blocks speeds identification of the task and simplifies operation.

Ideal for Manufacturing and Semi-Automated Test

The 8648 series are ideal for manufacturing high-volume products such as cordless telephones, pagers and two-way radios. The Agilent 8648 series provides good frequency range coverage, residual FM, level accuracy and phase noise, in addition to optional high power, pulse modulation and waveform modulation. The Agilent 8648 series provides ±1 dB absolute amplitude accuracy up to 2.5 GHz. All of the models offer ultra stable dc FM, with ±500 Hz carrier frequency accuracy below frequencies of 1001 MHz, and low RF leakage.

Applications such as receiver tuning and alignment benefit from the simple user interface. These signal generators are so easy to learn and use that experienced operators are no longer required. With 300 full storage registers and ten user-definable sequences, the signal generator easily adapts to any test procedure. Once setups are stored in registers, operators can quickly sequence through them, either from the front panel or through a remote keypad (83300A). In addition, the 83301A memory interface provides the means to transfer register information from one 8648 to another.

For automated test applications, the 8648 offers full GPIB programmability and uses SCPI programming codes. In addition, the 8648 series reduces software development costs by providing full GPIB code compatibility with the 8656B and 8657A/B signal generators.

New Cost-Effective Pager Testing

The 8648A with Option 1EP provides an economical, one-box solution for pager test. Option 1EP adds the pager encoding capability for POC-SAG, FLEX, and FLEX-TD formats to the 8648A. Ideal for pager test applications, the 8648A with Option 1EP offers superior frequency accuracy, deviation accuracy, and dc FM performance.

Specifications

Frequency

- 8648A: 100 kHz to 1000 MHz
- 8648B: 9 kHz to 2000 MHz
- 8648C: 9 kHz to 3200 MHz
- 8648D: 9 kHz to 4000 MHz

Resolution

8648A/B/C/D: 0.001 Hz

Display: 10 Hz

Switching Speed (typical)

8648A/B/C/D: <1001 MHz: <75 ms; ≥1001 MHz: <100 ms

Accuracy (after one hour warm-up and within one year calibration): Typically $\pm 3 \times 10^{-6}$ x carrier frequency in Hz, $\pm 0.15 \times 10^{-6}$ x carrier frequency in Hz for Option 1E5 (typically $\pm 0.072 \times 10^{-6}$ x fc)

Internal Reference Oscillator

Accuracy and Stability (calibration adjustment dependent; after one hour warm-up and within one year of calibration), ± aging rate ± temperature effects ± line voltage effects

	Standard Timebase	Option 1E5
Aging	<±2 ppm/yr	<±0.1 ppm/yr; <±0.0005 ppm/day
Temperature	<±1 ppm	<±0.01 ppm (typ.)
Line Voltage (±5%)	<±0.5 ppm	N/A

Output: 10 MHz, typically >0.5 V_{rms} into 50 Ω

External Reference Oscillator Input: Accepts 2, 5, 10 MHz ± 5 ppm and a level range of 0.5 V to 2 V_{rms} into 50 Ω

Spectral Purity

Harmonics (output ≤4 dBm): <-30 dBc

Subharmonics (output ≤+4 dBm) <1001 MHz: -60 dBc;

≥1001 MHz: -50 dBc; >3200 MHz: -40 dBc

Nonharmonics (≥5 kHz offset, ≤+4 dBm output level)

• 8648A/B/C/D

<249 MHz: <-55 dBc; <2001 MHz: <-54 dBc

<1001 MHz: <-60 dBc; ≤4000 MHz: <-48 dBc

Residual FM (CCITT, rms)

• 8648A/B/C/D

<249 MHz: <7 Hz, typically <4 Hz

<501 MHz: <4 Hz, typically <2 Hz

<1001 MHz: <7 Hz, typically <4 Hz

<2001 MHz: <14 Hz, typically <8 Hz

≤4000 MHz: <28 Hz, typically <12 Hz

SSB Phase Noise (at 20 kHz offset, typical)

• 8648A/B/C/D

@ fc 500 MHz: <-120 dBc/Hz; @ fc 3000 MHz: <-106 dBc/Hz

@ fc 1000 MHz: <-116 dBc/Hz; @ fc 4000 MHz: <-104 dBc/Hz

@ fc 2000 MHz: <-110 dBc/Hz

Output Range

• 8648A: +10 to -136 dBm

• 8648B/C/D: ≤2500 MHz: +13 to -136 dBm; >2500 MHz: +10 to -136 dBm

Max. Power with Option 1EA (High Power) on 8648B/C/D only						
Freq. (MHz)	<0.1	≤1000	≤1500	≤2100	≤2500	≤4000
Power (dBm)	+17	+20	+19	+17	+15	+13

Display Resolution: 0.1 dB

Accuracy (specified power <13 dBm to -127 dBm)

• 8648A/B/C/D (applies at 25° ±5°C):

≤2500 MHz: ±1.0 dB

≤3200 MHz: ±1.5 dB (≥-100 dBm; ±3.0 dB <-100 dBm)

≤4000 MHz: ±2.0 dB (≥-100 dBm; ±3.0 dB <-100 dBm)

Reverse Power Protection (watts into 50 Ω)

• 8648A/B: 50 watts

• 8648C/D: 50 watts ≤2000 MHz; 25 watts >2000 MHz

SWR: (output ≤ -6 dBm, typical)

- 8648A/B/C/D:
 ≤ 249 kHz: $< 2.5:1$
 ≤ 2500 MHz: $< 1.5:1$
 ≤ 3200 MHz: $< 2.0:1$

Output Impedance: Nominally 50Ω

Frequency Modulation

Peak Deviation (rates > 25 Hz ac FM)	8648A/B/C/D
< 249 MHz	0 to 200 kHz
< 501 MHz	0 to 100 kHz
< 1001 MHz	0 to 200 kHz
< 2001 MHz	0 to 400 kHz
≤ 4000 MHz	0 to 800 kHz

Resolution

- For $\leq 10\%$ peak deviation
 < 2001 MHz: 10 Hz
 ≥ 2001 MHz: 20 Hz
- For $> 10\%$ to maximum peak deviation
 < 2001 MHz: 100 Hz
 ≥ 2001 MHz: 200 Hz

Deviation Accuracy (internal 1 kHz rate)

- 8648A/B/C/D
 < 1001 MHz: $\pm 3\%$ of deviation ± 30 Hz
 < 2001 MHz: $\pm 3\%$ of deviation ± 60 Hz
 ≤ 4000 MHz: $\pm 3\%$ of deviation ± 120 Hz
- 8648A Option 1EP only:
50 Hz at 276 to 284 MHz, 406 to 512 MHz, and 929 to 932 MHz

Rates

- 8648A/B/C/D
Internal: 400 Hz to 1 kHz (10 Hz to 20 kHz for Option 1E2)
External dc: dc to 150 kHz (typical, 3 dB BW)
External ac: 1 Hz to 150 kHz (typical, 3 dB BW)

Distortion (1 kHz rate, THD + N, 0.3 to 3 kHz BW)

- < 1001 MHz: $< 1\%$ at deviations > 4 kHz
- < 2001 MHz: $< 1\%$ at deviations > 8 kHz
- ≤ 4000 MHz: $< 1\%$ at deviations > 16 kHz
- 8648A/B/C/D 88 to 108 MHz: $< 0.5\%$ at deviations ≥ 75 kHz

Carrier Frequency Accuracy (relative to CW in dc FM, at $25^\circ \pm 5^\circ \text{C}$)

- < 1001 MHz: ± 100 (typ. 40^*) Hz, deviations < 10 kHz
- < 2001 MHz: ± 200 (typ. 80^*) Hz, deviations < 20 kHz
- ≤ 4000 MHz: ± 400 (typ. 160^*) Hz, deviations < 40 kHz

FM + FM: Internal 1 kHz to 400 Hz source plus external. In internal plus external FM mode, the internal source produces the set level of deviation. The external input should be set to $\leq \pm 0.5$ V peak or 0.5 Vdc (one-half the set deviation).

Phase Modulation

Peak Deviation

- < 249 MHz: 0 to 10 radians
- < 501 MHz: 0 to 5 radians
- < 1001 MHz: 0 to 10 radians
- < 2001 MHz: 0 to 20 radians
- ≤ 4000 MHz: 0 to 40 radians

Resolution

- < 2001 MHz: 0.01 radian
- ≥ 2001 MHz: 0.02 radian

Deviation Accuracy (internal 1 kHz rate, typical)

- 8648A/B/C/D
 < 1001 MHz: $\pm 3\%$ of deviation ± 0.05 radians
 < 2001 MHz: $\pm 3\%$ of deviation ± 0.1 radians
 ≤ 4000 MHz: $\pm 3\%$ of deviation ± 0.2 radians

Rates

- Internal: 400 Hz or 1 kHz (10 Hz to 20 kHz for Option 1E2, 8648A/B/C/D only)
- External: 20 Hz to 10 kHz (typical, 3 dB BW)

Distortion (1 kHz rate)

- 8648A/B/C/D
 < 1001 MHz: $< 1\%$ at deviations ≥ 3 radians
 < 2001 MHz: $< 1\%$ at deviations ≥ 6 radians
 ≤ 4000 MHz: $< 1\%$ at deviations ≥ 2 radians

*Within one hour after dc FM calibration

Amplitude Modulation

(AM is not specified below 1.5 MHz and is typical above 1001 MHz.)

Range: 0 to 100%; output $\leq +4$ dBm

Resolution: 0.1%

Accuracy (1 kHz rate): $\pm 5\%$ of setting $\pm 1.5\%$ (for 8648B/C/D, specification is applicable at $25^\circ \pm 5^\circ \text{C}$ and $< 70\%$ depth)

Rates

Internal: 400 Hz or 1 kHz (10 Hz to 20 kHz for Option 1E2, 8648A/B/C/D only)

External dc: dc to 25 kHz (typical, 3 dB BW)

External ac: 1 Hz to 25 kHz (typical, 3 dB BW)

Distortion (1 kHz rate, THD + N, 0.3 to 3 kHz BW)

- 8648A: @ 30% AM: $< 2\%$; @ 90% AM: $< 3\%$
- 8648B/C/D: @ 30% AM: $< 2\%$; @ 70% AM: $< 3\%$

Pager Test Option 1EP (8648A only)

Signaling Formats: POCSAG, FLEX, and FLEX-TD (RCR-43)

Pulse Option 1E6 (8648B/C/D only)

On/Off Ratio: > 80 dB < 2000 MHz; > 70 dB ≥ 2000 MHz

Rise/Fall Times: < 10 ns

Modulation Generator Option 1E2 (8648A/B/C/D only)

Adds variable frequency modulation generator

Frequency Range

- Sine: 10 Hz to 20 kHz
- Square, Triangle, Sawtooth: 100 Hz to 2 kHz

Frequency Accuracy: $\pm 0.01\%$ typical

Frequency Resolution: 1 Hz (3 digits displayed)

Modulation Source

- Internal: 400 Hz or 1 kHz, front panel BNC connector provided at nominally 1 V (p-p) into 600Ω
- External: 1 V peak into 600Ω (nominal) required for full scale modulation. (High/Low indicator provided for external signals ≤ 10 kHz.)

Remote Programming

Interface: GPIB (IEEE-488.2-1987) with Listen and Talk

Control Languages: SCPI version 1992.0. The 8648A/B/C/D are code compatible with the 8656B and 8657A/B.

Functions Controlled: All front panel functions except power switch and knobs

IEEE-488: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2

General

Power Requirements: 90 to 264 V, 48 to 440 Hz; 170 VA max

Operating Temperature: 0°C to 50°C

Leakage: Conducted and radiated interference meets MIL-STD-461B RE02 and FTZ 1046. Typically $< 1 \mu\text{V}$

Key Literature

8648A/B/C/D Data Sheet, p/n 5965-3432E

Signal Generator Selection Guide, p/n 5965-3094E

8648A/B/C Brochure, p/n 5962-6191E

8648A Option 1EP Pager Encoder Datasheet, p/n 5964-4116E

Ordering Information

8648A Synthesized Signal Generator

8648B Synthesized Signal Generator

8648C Synthesized Signal Generator

8648D Synthesized Signal Generator

8648D-1EA High Power (8648B/C/D only)

8648D-1EP Pager Encoder (8648A only)

8648D-1E6 Pulse (8648B/C/D only)

8648D-1E2 Modulation Generator

8648D-1E5 High-Stability Timebase

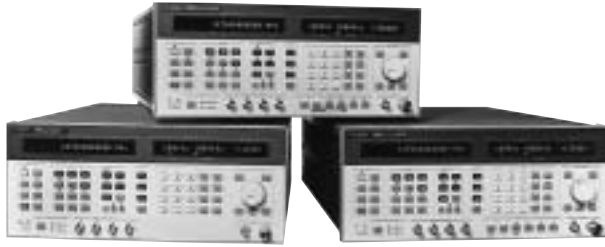
83301A Memory Interface

Signal Generators

160 Analog & CW Signal Generators (cont.)

8644B
8664A
8665B

- Frequency ranges of 1 GHz, 2 GHz, 3 GHz, or 6 GHz
- Low noise and spurious performance
- AM, FM, and pulse modulation
- Lowest specified leakage (optional)
- Internal modulation source for complex waveforms
- On-site repair and calibration



8644B, 8664A, 8665B

These signal generators offer RF designers and manufacturers a selection of frequency range and high performance. They are well suited for traditional out-of-channel receiver test applications.

5

8644B 1 GHz/2 GHz High-Performance Signal Generator

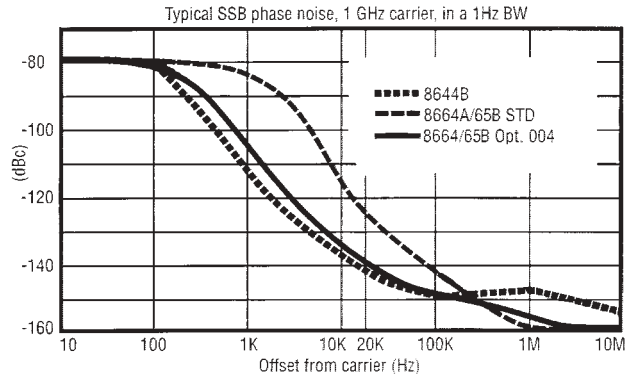
The 8644B offers high performance in the 1 to 2 GHz frequency range. It has low SSB phase noise even at wide offsets from the carrier (-150 dBc/Hz, >100 kHz offset). This makes it ideal for the traditional out-of-channel or selectivity tests such as, spurious response and adjacent channel selectivity.

8664A 3 GHz and 8665B 6 GHz High-Performance Signal Generators

The 8664A and 8665B are suited for out-of-channel receiver measurements through the use of Option 004 (low-noise enhancement) and for such applications as radar testing through the use of Option 008 (pulse modulation) and spurious testing of receivers.

Wideband FM and Optional Pulse Modulation

FM rates of up to 2 MHz and deviations to 20 MHz peak are suitable for many applications such as higher-rate digital communications. An optional pulse modulator with on/off ratio of >80 dB and rise/fall times of <5 ns is available. Pulse width and delay can be internally adjusted between 50 ns and 999 ms, eliminating the need for an external pulse generator.



Typical SSB Phase Noise, at 1 GHz Carrier, in a 1 Hz BW

Specifications

	8644B	8664A; 8665B
Frequency Range	0.252 to 1030 MHz 0.252 to 2060 MHz (Option 002)	0.1 to 3000 MHz (8664A) 0.1 to 6000 MHz (8665B)
Resolution	0.01 Hz	0.01 Hz
Accuracy	Timebase stability $\times f_c$	Timebase stability $\times f_c$
Switching speed (typical)	<350 ms	<100 ms (Option 004)

Internal Reference Oscillator

Output: 10 MHz, >0.15 V_{rms} into 50 Ω ; (Option 001) >1 V_{rms} into 50 Ω

Timebase Stability

	Standard Timebase	High Stability (Opt. 001)
Aging Rate	1.5×10^{-8} /day	3×10^{-10} /day
Temperature Effects	7×10^{-10}	6×10^{-10}
Line Voltage Effects	2×10^{-10}	1×10^{-10}

Specifications (cont.)

8644B
8664A
8665B

	8644B	8664A; 8665B
Spectral Purity		
SSB phase noise @ 1 GHz (20 kHz offset)	-136 dBc/Hz	-117 dBc/Hz; -134 dBc/Hz (Option 004)
Nonharmonics: (>10 kHz offset)	<-105 dBc, 0.252 to 1030 MHz <-100 dBc, 1030 to 2060 MHz	<-100 dBc, 187.5 to 2060 MHz <-90 dBc, 2060 to 6000 ¹ MHz, 0.1 to 187.5 MHz
Harmonics <-30 dBc, output ≤+8 dBm (with Option)	<-25 dBc, output ≤+10 dBm	<-30 dBc, output ≤+10 dBm
Subharmonics	None, 0.252 to 515 MHz <-52 dBc, 515 to 1030 MHz <-40 dBc, 1030 to 2060 MHz	<-75 dBc, 0.1 to 1500 MHz <-40 dBc, 1500 to 3000 MHz <-50 dBc, 3000 to 6000 ¹ MHz
Residual FM @ 1 GHz: 0.3 to 3 kHz post det. BW	<1 Hz rms	<7.5 Hz rms; <1.2 Hz rms (Option 004)
Output Level		
Range	+16 to -137 dBm, +13 dBm (Option 002, 005)	+13 to -139.9 dBm, +9 dBm (Option 008)
Resolution	0.1 dB	0.1 dB
Absolute accuracy	±1 dB, output ≥-127 dBm	±1 dB, output ≥-119.9 dBm, 1 to 1000 MHz ±1.5 dB, output ≥-119.9 dBm, 1000 to 3000 MHz ±2 dB, output ≥-119.9 dBm, >3000 ¹ MHz, <1 MHz 25 W ² ; 0.1 to 2060 MHz; 1 W, >2060 ¹ MHz
Reverse power protection	50 W	
Amplitude Modulation		
Depth: (@ ≤+7 dBm)	0 to 100%	0 to 100%
Resolution	0.1%	0.1%
Bandwidth (3 dB) ≤+7 dBm	dc to 100 kHz, 128 MHz <f _c <1030 MHz	dc to >10 kHz, >10 MHz
Accuracy: 1 kHz rate	±(7% of setting + 1%) up to 80% depth	±(6% of setting + 1%) up to 90% depth
Distortion: 30% depth, 1 kHz rate	<2%; <4% (Option 002)	<4%
Frequency Modulation		
Maximum peak deviation (Deviation halves per lower octave)	20 MHz/200 kHz ³ ; >1030 MHz; 10 MHz/100 kHz ³ ; >515 MHz	20 MHz, 3000 to 6000 ¹ MHz; 10 MHz, 1500 to 3000 MHz
Resolution	2.5% of setting	2.5% of setting
Bandwidth (3 dB)	dc to 100 kHz	dc to 800 kHz
Carrier accuracy in FM	±0.5% of setting	±0.6% of setting
Indicator accuracy	<5%, <30 kHz rates; <10%, <100 kHz rates	±9%, <20 kHz rates
Distortion	<5%, 20 Hz to 100 kHz rates	<1%, 20 Hz to 20 kHz rates
Pulse Modulation		Option 008
On/off ratio	>35 dB; >80 dB, >1030 MHz	>80 dB
Rise/fall time, 10 to 90%	<100 ns	<8 ns
Repetition rate	dc to 1 MHz	dc to 10 MHz
Internal width/delay	N/A	Variable, 50 ns to 1 s
Internal Modulation Source		
Waveforms and rates	Sine; white Gaussian noise (0.1 Hz to 400 kHz); Triangle, sawtooth, square (0.1 Hz to 50 kHz)	
Frequency accuracy	Same as timebase	
Output level (into 600 Ω)	1 V pk, 2 V pk 8644B	
Output resolution	2 mV pk	
Frequency Sweep		
Digital sweep	Digitally stepped sweep over entire frequency range. Linear/log selection. 0.5 to 1000 s sweeps.	
Markers/Z-axis output	3 markers available/Z-axis output nominally +5 V/X-axis output nominally 0 to 10 V	
Phase continuous sweep	40 MHz of span available at maximum carrier frequency. 20 ms to 10 s sweep times	
Remote Programming		
Interface	GPIO (IEEE 488.2-1987)	
Control language	Hewlett-Packard Systems Language (HP-SL). All functions controlled except power	
IEEE-488 functions	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2	
General		
Power requirements	±10% of 100 V, 120 V, 220 V, or 240 V; 48 to 440 Hz; 500 VA (except 8644B: 400 VA)	
Operation temperature	0°C to 55°C	
Leakage	Conducted and radiated interference meets MIL-STD-461B RE02 and FTZ 1046	
Calibration interval	Recommended 3 years (MTBC)	
Weight	8644B: 30 kg (67 lb), 8664A/65B: 35 kg (78 lb)	
Size	177 mm H x 426 mm W x 624 mm D (7 in x 16.8 in x 24.6 in). Option 010 adds 35 mm (1.4 in) to D	

¹3000 MHz for 8664A, 6000 MHz for 8665B²N/A to 8665B³Low-noise mode

Ordering Information

	8644B	8664A	8665B
Options			
001 High-Stability Timebase	✓	✓	✓
002 2 GHz Doubled Output	✓	N/A	N/A
004 Low-Noise Option	standard	✓	✓
005 Electronic Attenuator (N/A with Option 002)	✓	N/A	N/A
008 Pulse Modulation	standard	✓	✓
009 Specified VOR/ILS ²	✓	N/A	N/A
011 2 GHz Internal Frequency Counter	✓	N/A	N/A
Service Kit	(08645-61116)	(08665-61116)	(08665-61116)
003 Rear-Panel Input/Output	✓	✓	✓
010 Reduced-Leakage Configuration	✓	✓	✓
907 Front-Handle Kit (5062-3990)	✓	✓	✓
908 Rack Flange Kit (5062-3978)	✓	✓	✓
909 Combined Front/Rack Flange Kit (5061-9684)	✓	✓	✓

¹See Specifications²Not compatible with Options 002 or 005

8645A

- 252 kHz to 1030 MHz frequency range with optional coverage to 2060 MHz
- 15 μ s frequency switching
- Standalone control of frequency agility
- Specified performance while fast hopping
- FM rates to 10 MHz, deviations to 20 MHz
- Low spurious and phase noise



8645A

8645A Agile Signal Generator

The Agilent 8645A agile signal generator combines high performance with frequency agility for new fast-switching test requirements. These capabilities are important for performance testing of such devices as frequency agile radios and surveillance receivers. Besides extending traditional receiver testing to agile applications, the 8645A can be used to create complex signal simulations involving several modulation types and frequency agility. These complex RF signals can quantitatively exercise a receiver's vulnerability to a jamming transmission. The 8645A can also be a fast-switching stimulus needed to decrease production test times. The high performance and frequency agility of the 8645A provide capability for both static and agile test requirements with just one calibrated signal generator.

Specified Agile Performance

The 8645A provides specified signal performance in both static and agile operation. Fully-synthesized outputs with high timebase accuracy are standard when not frequency hopping. The Fast Hop mode activates a frequency-lock loop to allow frequency switching as fast as 15 μ s from 128 to 2060 MHz. Over the frequency range of 8 to 2060 MHz, the fastest switching time is 85 μ s and outputs below 8 MHz require 500 μ sec. Frequency accuracy of each output is better than ± 2 ppm while in Fast Hop mode. At each frequency, a specific amplitude can be assigned within a 20 dB range for performance tests versus amplitude while frequency hopping. For a full test of a receiver, up to 4000 frequencies can be entered and sequences of up to 8000 frequency settings can be specified. Performance parameters such as phase noise, spurious, amplitude accuracy and modulation remain high-quality and are completely specified while fast hopping to insure confident test results.

Flexible, High-Performance Modulation

For receiver measurements, the 8645A offers independent or simultaneous FM and AM for both static and hopped frequency tests. The modulating signal can be the internal 0.1 Hz to 400 kHz synthesizer or an external input that allows FM deviations up to 20 MHz at rates up to 10 MHz. In Fast Hop operation, maximum deviation is 3.5 MHz with 10 MHz rates. AM is available with up to 100 kHz rates and 99% depth. Pulse modulation allows a 35 dB on/off ratio with 100 ns rise/fall times.

Complete Control of Frequency Hopping

The 8645A offers flexible and comprehensive control of the frequency hopping output. Parameters can be entered from the front panel, through the GPIB port or using TTL inputs on the rear panel. Extensive hopped-frequency simulations including hop frequencies, amplitude, dwell times, hop rate, modulation and so forth can be

entered into nonvolatile memory from the front panel. Activating a hop sequence requires only a press of the Hop key. Agile control is available by a computer with the added advantage of using the Hewlett-Packard Systems Language (HP-SL). For real-time control, rear-panel inputs accept TTL signals for triggering, dwell time and frequency selection to allow direct connection with the hardware under test. With this wide choice of control, use of the 8645A can be readily customized to a wide variety of test situations from benchtop use to ATE systems.

Specifications

Frequency

Range: 251.46485 kHz to 1030 MHz; 251.46485 kHz to 2060 MHz with Option 002 or with 11845A 2 GHz retrofit kit installed

Frequency Bands: The exact endpoints of each frequency band can be determined by dividing the 1030 to 2060 MHz band by two for each band decrease. The specifications use approximate endpoints

Phase Offset: Adjustable in 1 degree increments

Reference Oscillator Stability, Option 001: $< 5 \times 10^{-10}$ /day aging

Fast-Hop Operation

Frequency Switching Time: 128 to 2060 MHz: $< 15 \mu$ s, 8 to 2060 MHz:

$< 85 \mu$ s, 0.25 to 2060 MHz: $< 500 \mu$ s. Option 002: add 5 μ s

Frequency Hop Range: 0.25 to 2060 MHz. With FM on, limited to any three consecutive frequency bands

Frequency Accuracy¹: ± 2 ppm of carrier frequency

Amplitude Accuracy: ± 1 dB, > -127 dBm output

(± 1.5 dB, > -127 dBm output when amplitude level is varied up to -5 dB from the constant learned value during Fast Hop)

Channel and Sequence Tables: In Fast Hop, each specific frequency and amplitude to be output is entered into a Channel Table. The order of channels to be output is entered into a Sequence Table

Maximum Number of Channels: 4000

Maximum Number of Channels in Sequence Table: 8000

Hop-Rate Range: Fixed rates from 8 Hz to 50 kHz using internal timer. An external input allows more range and variable rates

Dwell-Time Range: Fixed times of 6.4 μ sec to 99 ms using the internal timer. External input allows longer and variable dwell

Learn-Cycle Time: Typically, 10 seconds to 3.5 minutes, depending on sequence size

Fast-Hop Bus: Allows real-time selection of any channel for output. Typically, frequency switching time increases by 5 μ s

Modulation: Internal or external AM, FM, or simultaneous AM/FM

Output Level: Allowed amplitude variation of all channels entered is 0 to 20 dB. Output level is reduced by > 60 dB while switching between channels. External dc AM can be used to shape the output

Spectral Purity

SSB Phase Noise (CW, AM, or FM² operation):

Carrier Frequency (MHz)	Standard Operation		Fast Hop 20 kHz (dBc/Hz)
	20 kHz (dBc/Hz)	100 kHz (dBc/Hz)	
1030 to 2060	-120	-127	-116
515 to 1030	-127	-134	-123
257 to 515	-132	-137	-128
128 to 257	-136	-140	-133
64 to 128	-139	-141	-137
32 to 64	-141	-141	-139
16 to 32	-142	-142	-141
8 to 16	-143	-143	-142
4 to 8	-144	-144	-143
Less than 4 MHz	-144	-144	-144

Harmonics: < -30 dBc, output ≤ 10 dBm. Option 002, output > 8 dBm: < -30 dBc, 0.25 to 1030 MHz; < -25 dBc, 1030 to 2060 MHz.

Subharmonics: None, < 515 MHz; < -60 dBc, 515 to 1030 MHz;

< -40 dBc, > 1030 to 2060 MHz

Nonharmonics: > 20 kHz offset³: < -100 dBc, < 1030 MHz; < -94 dBc, > 1030 to 2060 MHz

¹ Typically, $+2$ ppm of carrier frequency multiplied by the temperature change in $^{\circ}$ C must be added if ambient temperature changes occur between the learn operation and the conclusion of frequency hopping. FM at minimum deviation.

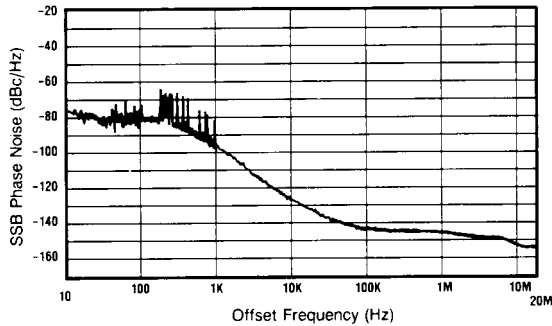
² FM at minimum deviation.

³ Typically, nonharmonic spurs at all offsets are < 30 dB above the instrument's phase noise level as measured in a 1 Hz bandwidth.

Residual FM¹ (CW, AM, FM² operation):

Carrier Frequency (MHz)	Post Detection Bandwidth	
	0.3 to 3 kHz (Hz rms)	0.05 to 15 kHz (Hz rms)
0.25 to 257	<1	<1.2
257 to 515	<1.2	<2
515 to 1030	<2	<4
1030 to 2060	<4	<8

Typical SSB Phase Noise and Spurs at 1 GHz:



Residual AM: <0.01% AM rms, 0.3 to 3 kHz post detection BW
 Typical SSB AM Noise Floor, Offsets >100 kHz: <-157 dBc/Hz at +16 dBm output, 0.25 to 1030 MHz. <-150 dBc/Hz at +13 dBm output, 1030 to 2060 MHz

Output

Maximum Level: +16 dBm, 0.25 to 1030 MHz; Option 002: +14 dBm, 0.25 to 1030 MHz. +13 dBm, above 1030 MHz.

Minimum Level: -137 dBm

Absolute Accuracy: ± 1 dB, output ≥ -127 dBm

Reverse Power Protection: 50 watts from a 50 Ω source, 25 Vdc

Typical Third Order Intermodulation: <-50 dBc, outputs <8 dBm

Typical Output Level Overrange: 2 dB more than maximum level

Typical SWR and Output Impedance: <1.7:1 at <-2 dBm; 50 Ω

Modulation

External Modulation Input: Coupling is ac or dc for AM, FM, and phase modulation. Pulse modulation input is dc coupled. Displayed deviation or depth corresponds to ± 1 V external input.

Simultaneous Modulation: AM/FM, AM/Phase, AM/Pulse, FM/Pulse, Phase/Pulse, AM/FM/Pulse, AM/Phase/Pulse

Simultaneous Internal/External Modulation: FM and Phase

Amplitude Modulation

Depth: 0 to 99.9%, for output $\leq \pm 7$ dBm

AM Indicator Accuracy: $\pm 6\%$ of setting + 2%, (AM), up to 90% depth and 1 kHz rate for carrier frequencies >1 MHz. When amplitude level is varied up to -5 dB from the constant learned value during Fast Hop: $\pm 7\%$ of setting + 1% AM) up to 80% depth, 1 kHz rate

Distortion, at 400 Hz and 1 kHz Rates:

Depth	Carrier Frequency	
	0.25 to 1030 MHz	1030 to 2060 MHz
0 to 30%	<2%	<5%
30 to 70%	<3%	<5%
70 to 90%	<5%	<8%

3 dB Bandwidth³: >5 kHz, 0.25 to 8 MHz. >50 kHz, 8 to 128 MHz; >100 kHz, 128 to 2060 MHz

Incidental Phase Modulation: <0.2 rad peak, at 30% depth and 1 kHz
 Typical External Input Impedance: 600 Ω

Frequency Modulation

FM Deviation and Rate: In the highest frequency band of 1030 to 2060 MHz, the maximum FM peak deviation is 20 MHz for standard operation and 3.52 MHz for Fast Hop. Maximum FM rate (3 dB bandwidth) in the 515 to 1030 MHz band and above is 10 MHz. Divide rate and deviation by two for each frequency band decrease.

FM Indicator Accuracy: $\pm 10\%$, <50 kHz rate and <10% of maximum deviation (<50% of maximum deviation in Fast Hop)

FM Distortion: Rates 20 Hz to 100 kHz: <2.7%, deviation <2% of maximum available (Fast Hop: <10% of maximum deviation)

Carrier Frequency Accuracy in FM: $\pm 0.4\%$ of deviation setting, ac- or dc-coupled. Typically add 1% of deviation in Fast Hop

Incidental AM: <0.5%, deviation limited to <6% of max. or 20 kHz
 Typical External FM Group Delay: 30 μ s for rates 20 Hz to 20 kHz, decreases to <1 μ s at rates >200 kHz. Fast Hop: <1 μ s

Typical External FM Input Impedance: 50 or 600 Ω

Pulse Modulation

On/Off Ratio: >35 dB

Rise/Fall Time: <100 ns, between 10% and 90% response points

Maximum Pulse Repetition Frequency: 1 MHz

Minimum Pulse Width: 0.5 μ s

Typical Output Level Accuracy: ± 2 dB

Typical External Input Levels and Impedance: On: >3.0 V peak; Off: <0.8 V peak. Damage level: $\geq \pm 10$ V peak. 600 Ω .

Internal Modulation Source

Waveforms: Sine, square, sawtooth, and white Gaussian noise

Frequency Range: Sine, white Gaussian noise: 0.1 Hz to 400 kHz.

Square, sawtooth: 0.1 Hz to 50 kHz.

Frequency Accuracy: Same as internal reference oscillator

Output Level: Typically, 1 V_{pk} max. into 600 Ω . Accuracy: ± 20 mV.

Output Level Resolution: 2 mV. Typical impedance: 600 Ω .

Distortion: <0.1%, output at 1 V peak and ≤ 15 kHz

Frequency Sweep

Phase Continuous Sweep: Linear sweep with times from 10 ms to 10 s, not dependent on span. Maximum span is 40 MHz from 1030 to 2060 MHz frequency band, divided by two for each band decrease.

Fast Hop Sweep: Linear or log stepped with times from 10 ms to 100 s.

Number of steps varies with time selected. Typical time per step is 30 μ s for outputs within 128 to 2060 MHz, 170 μ s for 8 to 2060 MHz, and 650 μ s for 0.25 to 2060 MHz.

Sweep Control and Markers: X-axis: 0 to +10 V. Z-axis: +5 V retrace, +1 V trace, 0 V markers. Three markers available.

General

Remote Control: GPIB (IEEE-488.2-1987). The control language used is the Hewlett-Packard Systems Language (HP-SL). All front-panel functions except power switch and knob. A unique Fast Hop bus interface accepts TTL levels for frequency agile control.

Operating Temperature Range: 0° F to +55° F

Leakage: Meets MIL-STD-461B-RE02 and FTZ 1046

Storage Registers: 10 full function and 40 freq./ampl. locations

Memory Erasure: All memory contents according to MIL-STD-380-380

Size: 177 mm H x 426 mm W x 624 mm D (7 in x 16.8 in x 24.6 in)

Weight: Net, 31 kg (69 lb); shipping, 42 kg (95 lb)

Key Literature

8645A Agile Signal Generator Data Sheet, p/n 5953-8498E

8645-1 Communications-Agile Operation of the 8645A Product Note, p/n 5951-6711

Ordering Information

8645A Agile Signal Generator

8645A-001 High-Stability Timebase

8645A-002 2 GHz Output

8645A-003 RF Connectors on Rear Panel Only

8645A-907 Front Handle Kit (5062-3990)

8645A-908 Rack Flange Kit (5062-3978)

8645A-909 Rack Flange Kit with Front Handles (5062-3984)

8645A-910 Provides an additional operation/calibration manual (08645-90023) and 2 service manuals

8645A-915 Add Service Manual (08645-90104)

¹ Specified for 48 to 63 Hz power line. Typical for 400 Hz power line and Fast Hop operation.

² Deviation <0.1% of maximum available.

³ Lower 3 dB bandwidth limit is 0 Hz for dc coupling and typically 20 Hz for ac coupling.

83650B/L

- +10 dBm to -110 dBm (Option 001) calibrated output power
- -50 dBc harmonics <26.5 GHz typical
- SSB phase noise <-80 dBc at 10 GHz and 10 kHz offset
- Complete analog sweeper
- 1 Hz frequency resolution (Option 008)
- Pulse, amplitude and frequency modulation (83650B series only)



The 83650B/L series for the winning combination of precision, versatility and flexibility

83650B/L Synthesized Swept Signal and CW Generator Series

5

The 8360 family consists of the general-purpose B-model series and the L-model (without modulation) series. They combine the excellent frequency resolution, level control, signal purity, and modulation capabilities you expect of a high-performance synthesized signal generator with the speed and convenience of a sweep oscillator. They are ideal for the demanding requirements of signal simulation, local oscillator, and stimulus/response component or subsystem test applications.

The Agilent 8360 family offers a choice of models to meet a variety of application requirements. Ultra-broadband frequency coverage for 10 MHz to 50 GHz is available in coax using a 2.4-mm precision connector. The 8360 can also be customized with 1 Hz frequency resolution, fast pulse, a synthesized internal modulation generator and a blank front panel for automated test applications.

Flexible and Upgradeable for Growth

The 8360 is designed to facilitate future growth. The hardkey and softkey front-panel design offers easily-accessible functions that are simple to use. Softkey flexibility and modular architecture provide upgrade capability, while retaining system compatibility. The family delivers the cost-effective and state-of-the-art performance you need today, while protecting your investment in the future.

Pulse, Scan, Amplitude, and Frequency Modulation (83650B only)

High-performance pulse modulators with >80 dB on/off ratio, and rise/fall times <10 ns (Option 006), make the 83650B suitable for the most demanding pulse modulation applications.

In addition to its linear AM mode (100%/V), the 83650B offers a scan modulation mode (10 dB/V). Both modes have dc-coupled amplitude modulation capability with a 3 dB bandwidth of 100 kHz, and 99.7% (50 dB) of modulation depth. Pulse and amplitude modulation capabilities can be used independently and simultaneously.

The 83650B also offers dc-coupled frequency modulation capabilities with rates up to 8 MHz.

Specifications Summary

Frequency

Range (by model): 83650B 10 MHz to 50 GHz, 83650L 10 MHz to 50 GHz
Resolution: 1 kHz (1 Hz with Option 008)

Internal Reference Oscillator

Frequency: 10 MHz
Timebase Stability
Aging Rate: 5×10^{-10} /day; 1×10^{-7} /year
Temperature Effects: 1×10^{-10} /°C
Line Voltage Effects: 5×10^{-10} (10° C change in voltage)

CW and Manual Modes

Accuracy: Timebase stability $\times f_c$
Switching Time
• For Steps Within a Frequency Band: 15 ms + 5 ms/GHz step size
• Maximum, or Across Band Switch Points: 50 ms
• Step or List Modes Within a Frequency Band: 5 ms + 5 ms/GHz step size

Step Sweep Mode

Accuracy: Timebase stability $\times f_c$
Minimum Step Size: Same as frequency resolution
Number of Points: 2 to 801
Switching Time: Same as CW
Dwell Time: 100 μ s to 3.2 s

List Mode

Accuracy: Timebase stability $\times f_c$
Minimum Step Size: Same as frequency resolution
Number of Points: 1 to 801
Switching Time: Same as CW
Dwell Time: 100 μ s to 3.2 s

Ramp Sweep Mode

Accuracy: (Sweep time \geq 100 ms and \leq 5 s)
Sweep Widths $>n \times 10$ MHz: Lesser of 1% of sweep width or $n \times 1$ MHz + 0.1% of sweep width
Sweep Time: 10 ms to 100 s, 300 MHz/ms maximum rate

Output

Output Power

Maximum Levelled (dBm)	Standard	Option 006 (B models only)
83650B/L		
Output Frequencies <26.5 GHz	+10	+10
Output Frequencies \geq 26.5 GHz and <40 GHz	+5	+5
Output Frequencies \geq 40 GHz	+2.5	+2.5

Minimum Settable Output Power

- Standard: -20 dBm
- Option 001: -110 dBm
- Resolution: 0.02 dB

Output Connector

Nominal output impedance 50 ohms (2.4-mm male front panel)

Spectral Purity

Spurious Signals (dBc)

Output Frequencies	83650B/L
Harmonics	
<2.0 GHz	
Standard	-30 ¹
Option 006	-30 ¹
≥2.0 GHz and <26.5 GHz	
Standard	-50
Option 006	-50
≥26.5 GHz	
Standard	-40
Option 006	-40
Subharmonics	
<7 GHz	None
≥7 and ≤20 GHz	-50
≥20 GHz and ≤40 GHz	-40 ²
>40 GHz	-35 ²

Nonharmonically Related

10 MHz to <2.0 GHz²: -60
 ≥2.0 to <20 GHz: -60
 >20 GHz to ≤26.5 GHz: -58
 >26.5 to ≤40 GHz: -54
 ≥40 GHz to ≤50 GHz: -52

Single-Sideband Phase Noise (dBc/Hz)

Frequency Range	Offset from Carrier			
	100 Hz	1 kHz	10 kHz	100 kHz
10 MHz to <7 GHz	-70	-78	-86	-107
7 GHz to <13.5 GHz	-64	-72	-80	-101
13.5 GHz to 20 GHz	-60	-68	-76	-97
>20 GHz to <26.5 GHz	-58	-66	-74	-95
26.5 GHz to <38 GHz	-54	-62	-70	-91
38 GHz to 50 GHz	-52	-60	-68	-89

Modulation (83650B only)

All modulation specifications are only applicable to the 83650B. Pulse modulation specifications apply for output frequencies 400 MHz and above.

Pulse (83650B only)	Standard	Option 006
On/Off Ratio	80 dB	80 dB
Rise/Fall Times	25 ns	10 ns
Minimum Width		
Internally Leveled	1 μs	1 μs
Search Mode		
Output Frequencies <2.0 GHz	50 ns	50 ns
Output Frequencies ≥2.0 GHz	50 ns	15 ns
ALC Off Mode		
Output Frequencies <2.0 GHz	50 ns	50 ns
Output Frequencies ≥2.0 GHz	50 ns	15 ns

AM and Scan (83650B only)

Bandwidth (3 dB, 30% depth, modulation peaks 3 dB below maximum rated power): dc to 100 kHz

Modulation Depth

- Normal Mode: -20 dBm to maximum available power
- Deep Mode: 50 dB below maximum available power

Sensitivity

- Linear: 100%/volt
- Exponential: 10 dB/volt

FM (83650B only)

Locked Mode

- Maximum Deviation: ±8 MHz
- Rates (3 dB bandwidth, 500 kHz deviation): 100 kHz to 8 MHz

Unlocked Mode

Maximum Deviation

- At rates ≤100 Hz: ±75 MHz
- At rates >100 Hz: ±8 MHz

Rates (3 dB bandwidth, 500 kHz deviation): dc to 8 MHz

Sensitivity: 100 kHz, 1 MHz, or 10 MHz/volt, switchable

Accuracy (1 MHz rate, 1 MHz deviation): 10%

Internal Modulation Generator (Option 002)

AM, FM Modulation Signals (83650B only)

Internal Waveforms: Sine, square, triangle, ramp, noise

Rate

Range:

- Sine: 1 Hz to 1 MHz
- Square, triangle, ramp: 1 Hz to 100 kHz

Resolution: 1 Hz

Depth, deviation

Range: Same as the base instrument

Resolution: 0.1%

Accuracy: Same as the base instrument

Pulse (83650B only)

Modes: Free-run, gated, triggered, delayed

Period Range: 300 ns to 400 ms

Width Range: 25 ns to 400 ms

Resolution: 25 ns

Accuracy: 5 ns

Video Delay

Internal Sync Pulse: 0 to 400 ms

Externally-supplied Sync Pulse: 225 ns to 400 ms

Weight and Dimensions

Net Weight: 27 kg (60 lb)

Dimensions: 178 mm H x 425 mm W x 648 mm D (7.0 in x 16.75 in x 25.5 in)

Key Literature

Brochure, p/n 5964-6793E

Technical Specifications, p/n 5964-6162E

Configuration Guide, p/n 5964-6062E

Ordering Information

83650B 10 MHz to 50 GHz

83650L 10 MHz to 50 GHz

The following options apply to all models:

Option 001 Adds Step Attenuator

Option 002 Adds Internal Modulation Generator (83650B only)

Option 004 Rear-Panel RF Output

Option 006 Fast-Pulse Modulation (83650B only)

Option 008 1 Hz Frequency Resolution

Option 700 MATE System Compatibility

Option 806 Rack Slide Kit

Option 908 Rack Flange Kit

Option 910 Extra Operating and Service Manuals

Option 913 Rack Flange Kit

Upgrades

Model and frequency upgrades are available. Please contact your Agilent sales representative for details.

Dedicated 8510 System Source Models⁴

83621B 45 MHz to 20 GHz

83631B 45 MHz to 26.5 GHz

83651B 45 MHz to 50 GHz

¹ Specification is -20 dBc below 50 MHz.

² Specifications typical below 0 dBm.

³ Specification applies at output levels 0 dBm and below.

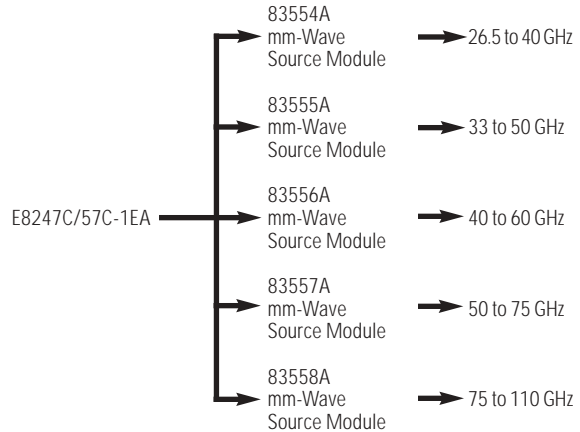
⁴ No modulation, no front panel.

83554A
83555A
83556A
83557A
83558A

- 26.5 to 110 GHz frequency range
- Leveled high output power
- Can be driven by many Agilent microwave sources
- Source module removable up to one meter length
- Low entry cost



83558A mm-wave source module. 75 GHz to 110 GHz



All at a Lower Cost

The 83550 series source modules combine performance and quality with a low cost of entry. This is possible because the source modules are backward-compatible with existing Agilent microwave sources. Thus you can generate a full waveguide band of millimeter-wave frequencies for just the cost of a source module. Also, the cost of ownership is reduced even further by the two-year warranty on the microcircuits of the 83550 series source modules.

General Specifications

Waveguide Output Connector

83554A: EIA size WR 28 waveguide; JAN UG-599 flange
83555A: EIA size WR 22 waveguide; JAN UG-383 flange
83556A: EIA size WR 19 waveguide; JAN UG-383 (mod.) flange
83557A: EIA Size WR 15 waveguide; JAN UG-385 flange
83558A: EIA Size WR 10 waveguide; JAN UG-387 flange

Weight: Net, 1.7 kg (4 lb)

Size: Module, 80 mm H x 80 mm W x 210 mm D (3.15 in x 3.15 in x 8.27 in)

Furnished with Each Source Module: Operating and Service Manual, Modification Procedures for 0.5 V/GHz Output, Type-N RF Cable, Module Base Assembly, Synthesizer Interface Cable

Key Literature

83557A/83558A Data Sheet, p/n 5958-0398
83554A/83555A/83556A, MM-Wave Source Modules Data Sheet, p/n 5954-8364D

www.agilent.com/find/signalgenerator

Ordering Information

83554A 26.5 to 40.0 GHz mm-Wave Source Module
83555A 33.0 to 50.0 GHz mm-Wave Source Module
83556A 40.0 to 60.0 GHz mm-Wave Source Module
83557A 50.0 to 75.0 GHz mm-Wave Source Module
83558A 75.0 to 110.0 GHz mm-Wave Source Module

83550 Series Millimeter-Wave Source Modules

The five 83550 series millimeter-wave source modules provide a simple approach to extend the frequency range of 11 to 20 GHz sources to cover 26.5 to 40 GHz (83554A), 33 to 50 GHz (83555A), 40 to 60 GHz (83556A), 50 to 75 GHz (83557A) and 75 to 110 GHz (83558A) bands. The 83550 series source modules offer leveled high output power, full waveguide band frequency coverage and the high-frequency accuracy and resolution of the driving microwave source.

High-Output Power

Leveled-output power from the source modules is rated at +9 dBm for the 83554A, +3 dBm for the 83555A, +3 dBm for the 83556A, +3 dBm for the 83557A, and 0 dBm for the 83558A. This high-output power can permit the source module to serve as a mixer LO in some applications and also expands the available dynamic range in frequency response measurements.

83550 Series Millimeter-Wave Source Modules

Agilent PSG Signal Generators	83554A	83555A	83556A	83557A	83558A
Frequency Characteristics					
Range	26.5 – 40 GHz	33 – 50 GHz	40 – 60 GHz	50 – 75 GHz	75 – 110 GHz
Maximum leveled power	9 dBm	3 dBm	3 dBm	3 dBm	0 dBm
Power level accuracy at 0dBm	±2.0 dB	±2.0 dB	±2.0 dB	±2.0 dB	±2.0 dB
Power flatness (maximum leveled power)	±1.5 dB	±1.5 dB	±1.5 dB	±2.0 dB	±2.0 dB
Source Output SWR					
Leveled	≤2.0 dB	≤2.0 dB	≤2.0 dB	≤2.0 dB	≤2.0 dB
External Pulse Modulation					
Rise/fall time (typical)	40 ns	40 ns	50 ns	50 ns	50 ns
Minimum RF Pulse Width					
(typical)	500 ns	500 ns	500 ns	1 us	1 us
On/off ratio (typical)	>80 dB	>80 dB	>80 dB	>80 dB	>80 dB
Pulse Repetition Frequency					
Leveled (typical)	100 Hz – 500 kHz	100 Hz – 500 kHz	100 Hz – 500 kHz	100 Hz – 500 kHz	100 Hz – 500 kHz
Unleveled (typical)	100 Hz – 5 MHz	100 Hz – 5 MHz	100 Hz – 5 MHz	100 Hz – 5 MHz	100 Hz – 5 MHz



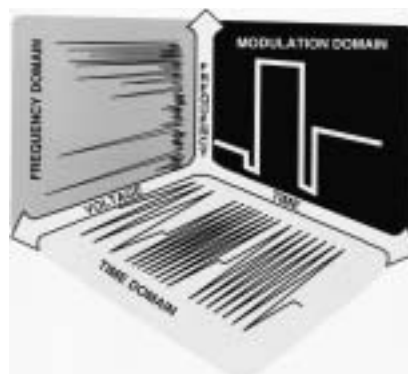
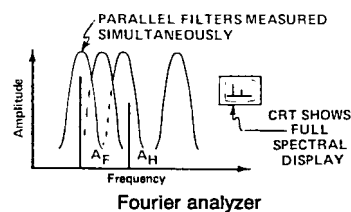
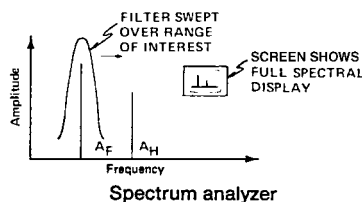
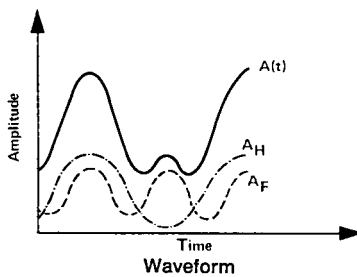
Signal Analyzers

Agilent Technologies offers a complete line of signal analyzers to provide frequency-, time-, order-, angle-, and modulation-domain measurement capability. This section is devoted primarily to the frequency domain. It includes spectrum analyzers, dynamic signal analyzers, vector signal analyzers, and modulation domain analyzers. Each type of instrument has distinctive capabilities that make it the preferred instrument for a particular measurement application.

The spectrum analyzer is a swept-tuned, super heterodyne receiver that provides a display of amplitude versus frequency. It is essentially a frequency-selective, peak-responding voltmeter calibrated to display the rms value of a sine wave. The spectrum analyzer can show the individual frequency components that make up a complex signal. The swept receiver technique used in Agilent spectrum analyzers enables frequency-domain measurements to be made over a large dynamic range and a wide frequency range (3 Hz to 325 GHz).

The Fourier and vector analyzers use digital sampling and mathematical transformation techniques to form a Fourier spectrum of a signal. This method is useful for measuring signals from a few μHz to >6 GHz, and provides frequency, amplitude, and phase information. With its real-time signal analysis capability, the Fourier analyzer is able to capture periodic as well as random transient events.

The modulation analyzer is based on Agilent's counter/timer technology and offers another way of looking at frequency or time interval measurements. The Modulation Domain analyzer shows you frequency or time-interval measurements versus time in the Modulation Domain.



Modulation Analyzer

Spectrum Analyzers

Spectrum analyzers take advantage of the frequency-conversion properties of the swept-tuned super heterodyne receiver to make significant contributions to frequency-domain signal analysis. The following are some of the measurements that can be made with spectrum analyzers:

- Absolute and relative frequency
- Absolute and relative amplitude
- Noise
- Spurious and distortion products
- AM, FM, pulsed RF and digital modulation
- Stimulus-response (scalar)
- Electromagnetic compatibility (EMC)

These measurements are possible because spectrum analyzers have the following characteristics available:

- Broad frequency coverage from 3 Hz to 325 GHz
- Wide amplitude range from -168 dBm to $+30$ dBm provides excellent sensitivity for low signal detection and wide dynamic range for distortion analysis
- Excellent frequency stability and amplitude accuracy
- High resolution of frequency and amplitude through digital IF bandwidths
- Digital modulation analysis
- Tracking generators for scalar measurements
- Measurement personalities provide application specific measurements of phase noise, noise figure, spurious responses, fault location, cdmaOne, cdma2000, 1xEV-DO, GSM/GPRS/EDGE, W-CDMA, EVM analysis, NADC, PDC and Bluetooth.

These capabilities allow spectrum analyzers to provide frequency-domain signal analysis for numerous applications, including the manufacture and maintenance of digital wireless equipment, microwave communication links, radar, telecommunications equipment, CATV systems and broadcast equipment, mobile communication systems, EMI diagnostic testing, component testing, lightwave measurements and signal surveillance.

In addition to the swept-tuned frequency mode, spectrum analyzers can also be used in the fixed-tuned mode (zero span) to provide time-domain measurement capability much like that of an oscilloscope.

With the addition of computers, the capability of spectrum analyzers can be greatly enhanced. Computers can be used to directly control the operation of spectrum analyzers over GPIB or LAN.

Application areas that require accurate, high-speed, repetitive measurements, physical separation of the operator and the analyzer, unattended operation or operation by personnel with limited technical skills are all candidates for automation.

Areas that benefit significantly from automated spectrum analysis include:

- EMC testing
- Frequency spectrum monitoring
- Production testing of RF or microwave components, subsystems, or systems
- Remote-site testing

The basic measurement capabilities of the spectrum analyzer, combined with its ability to automate and interface with other GPIB instruments and peripherals, make this instrument ideal for many general-purpose and specialized applications.

EMC Analyzers

Based on a spectrum analyzer platform, the E7400A series of EMI/EMC analyzers provide the functionality required for pre-compliance EMI measurements to 26.5 GHz for conducted and radiated emissions. Quasi-peak detectors and compliance based EMI bandwidths along with a suite of built-in EMI measurements facilitate the evaluation

of EMI performance on products during their development phase. Troubleshooting designs is enhanced through the E7400A spectrum analyzer functionality along with accessories like the 11940A/11941A close-field probes.

Dynamic Signal (Fourier) Analyzers

Fourier analyzers offer fast, high-resolution spectrum and network analysis. Unlike conventional swept analyzers, Fourier-based analyzers can measure dynamic signals because they measure all frequencies simultaneously, not one at a time.

Fourier analyzers characterize signals using digital signal-processing techniques based on the Discrete Fourier Transform. For a complete description of these techniques, see Application Note 243, The Fundamentals of Signal Analysis.

Fourier analyzers are especially useful on low-frequency signals (<100 kHz) or where very fast measurements are desired. They can improve measurement speed from a factor of 10 to 100, and allow accurate measurements on frequencies as low as a few μHz . Signal components as closely spaced as 20 μHz can be clearly resolved and accurately measured.

Since both the magnitude and phase of each frequency component are measured, the Fourier analyzer can measure the statistical properties of signals, or the joint properties or relationships of two or more signals. Applications include acoustic, modal, vibration, or rotating machine analysis. In addition, various types of modulation can be detected and measured.

Simultaneous measurement of magnitude and phase on two or more channels provides high-quality network measurements. Transfer functions or frequency response can be easily measured, and the use of band-limited or band-translated random noise as the stimulus allows the entire frequency span of interest to be measured at once. Measurement of the coherence function can provide an indication of the validity of many network measurements.

Vector Signal Analyzers

Vector signal analyzers extend the capabilities available in a spectrum analyzer. Though similar to Fourier analyzers, vector signal analyzers provide capabilities throughout the RF range, offering fast, high-resolution spectrum measurements, demodulation, and advanced time-domain analysis. They are especially useful for characterizing complex signals such as burst, transient, or modulated signals used in communications, video, broadcast, sonar, and ultrasound imaging applications.

The vector signal analyzer is also capable of in-depth modulation analysis. Since it captures signal phase along with magnitude it is particularly well suited to analyzing digitally modulated signals. This capability is available in several forms. It can be in general-purpose flexible demodulation suited to demodulating a wide range of modulation signal types. It can be in wireless communication standards based tests along with additional diagnostic capabilities. And, it can be in pass/fail testing to a communication standard. Vector signal analyzers are especially useful when a broad range of measurements are required, for example in the development of digital communication systems.

Modulation Domain Analyzers

Modulation-domain analyzers represent an extension of Agilent's counter/timer technology. They provide helpful views of the frequency, phase, or timing of a signal versus time. They also provide histograms and statistical analyzes, making it easy to quickly analyze measurement data. Modulation-domain analyzers allow you to directly view frequency switching and settling of VCOs, PLLs and synthesizers. They also make it easy to analyze complex phase and frequency modulations found in communications systems.

Signal Analyzer Selection Guide

Spectrum Analyzers¹ (data given for center frequency = 1 GHz)

Frequency Range	Resolution Bandwidth Range	Maximum Sensitivity (displayed average noise level)	Maximum Dynamic Range 2nd/3rd order	Amplitude Accuracy (±)	Available Measurement Personalities and Software	Model Number	Page
Basic Performance Portable							
9 kHz to 1.5 GHz	1 kHz to 5 MHz	-117 dBm	76 dB/83 dB	1.1 dB	Cable TV, BenchLink Web Remote software	E4411B	171
9 kHz to 3.0 GHz	1 kHz to 5 MHz	-117 dBm	78.5 dB/83 dB	1.1 dB	Cable TV, BenchLink Web Remote software	E4403B	171
9 kHz to 26.5 GHz	1 kHz to 5 MHz	-116 dBm	78 dB/82 dB	1.1 dB	Cable TV, BenchLink Web Remote software	E4408B	171
Mid-Performance Benchtop							
10 Hz to 500 MHz	1 Hz to 1 MHz	-145 dBm	95 dB/100 dB	0.8 dB	Time gating spectrum analysis	4395A ²	216
2 Hz to 1.8 GHz	1 kHz to 3 MHz	-147 dBm	86 dB/102 dB	1.0 dB	Time gating spectrum analysis	4396B ²	218
Mid-Performance Portable							
9 kHz to 1.5 GHz	1 Hz to 5 MHz	-136/-152* dBm (-150/-166* dBm typical)	85.5 dB/99.7 dB	1.0 dB	Phase Noise, CATV/Broadcast TV, Fault Location	E4401B	176
1 MHz to 1.8 GHz	30 Hz to 3 MHz	-88 dBmV	76 dB/88 dB	1.7 dB	FCC report generator software, BenchLink measurement software	8591C	203
100 Hz to 3.0 GHz	1 Hz to 5 MHz	-136/-152* dBm (-150/-166* dBm typical)	90.5 dB/99 dB	1.0 dB	Phase Noise, <i>Bluetooth</i> , GSM, GPRS, cdmaOne, EVM Analysis, CATV/Broadcast TV, Fault Location	E4402B	176
100 Hz to 6.7 GHz	1 Hz to 5 MHz	-135/-151* dBm (-149/-167* dBm typical)	90 dB/98 dB	1.0 dB	Phase Noise, <i>Bluetooth</i> , GSM, GPRS, cdmaOne, EVM Analysis, CATV/Broadcast TV, Fault Location	E4404B	176
100 Hz to 13.2 GHz	1 Hz to 5 MHz	-135/-151* dBm (-149/-167* dBm typical)	90 dB/98 dB	1.0 dB	Phase Noise, <i>Bluetooth</i> , GSM, GPRS, cdmaOne, EVM Analysis, CATV/Broadcast TV, Fault Location	E4405B	176
100 Hz to 26.5 GHz (to 325 GHz with external mixing)	1 Hz to 5 MHz	-135/-151* dBm (-149/-167* dBm typical)	90 dB/98 dB	1.0 dB	Phase Noise, <i>Bluetooth</i> , GSM, GPRS, cdmaOne, EVM Analysis, CATV/Broadcast TV, Fault Location	E4407B	176
High Performance Portable							
30 Hz to 2.9 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-151 dBm	95 dB/108 dB	1.9 dB	Phase Noise, Spurious Response, Digital Radio	8560EC	180
30 Hz to 6.5 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-145 dBm	88.5 dB/103 dB	1.9 dB	Phase Noise, Spurious Response, Digital Radio	8561EC	180
30 Hz to 13.2 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-151 dBm	95 dB/108 dB	2.1 dB	Phase Noise, Spurious Response, Digital Radio	8562EC	180
30 Hz to 26.5 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-149 dBm	94 dB/107 dB	2.1 dB	Phase Noise, Spurious Response, Digital Radio	8563EC	180
30 Hz to 40 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-145 dBm	92 dB/104 dB	1.8 dB	Phase Noise, Spurious Response, Digital Radio	8564EC	180
30 Hz to 50 GHz (to 325 GHz with external mixing)	1 Hz to 2 MHz	-145 dBm	92 dB/104 dB	1.8 dB	Phase Noise, Spurious Response, Digital Radio	8565EC	180
High-Performance Benchtop							
3 Hz to 6.7 GHz	1 Hz to 8 MHz	-154/-168* dBm	103 dB/113 dB	0.62 dB (0.24 dB 95% Confidence)	Noise Figure, Phase Noise, W-CDMA, GSM/EDGE, 1xEV-DO, cdma2000, cdmaOne, NADC, PDC	E4443A	185
3 Hz to 13.2 GHz	1 Hz to 8 MHz	-154/-168* dBm	103 dB/113 dB	0.62 dB (0.24 dB 95% Confidence)	Noise Figure, Phase Noise, W-CDMA, GSM/EDGE, 1xEV-DO, cdma2000, cdmaOne, NADC, PDC	E4445A	185
3 Hz to 26.5 GHz	1 Hz to 8 MHz	-154/-168* dBm	103 dB/113 dB	0.62 dB (0.24 dB 95% Confidence)	Noise Figure, Phase Noise, W-CDMA, GSM/EDGE, 1xEV-DO, cdma2000, cdmaOne, NADC, PDC	E4440A	185
3 Hz to 44 GHz	1 Hz to 8 MHz	-153/-167* dBm	102.5 dB/113 dB	0.62 dB (0.24 dB 95% Confidence)	Noise Figure, Phase Noise, W-CDMA, GSM/EDGE, 1xEV-DO, cdma2000, cdmaOne, NADC, PDC	E4446A	185
3 Hz to 50 GHz	1 Hz to 8 MHz	-135/-167* dBm	102.5 dB/113 dB	0.62 dB (0.24 dB 95% Confidence)	Noise Figure, Phase Noise, W-CDMA, GSM/EDGE, 1xEV-DO, cdma2000, cdmaOne, NADC, PDC	E4448B	185

*Optional built-in-preamp

¹ Data shown here is for comparison purposes only. Consult data sheets for more complete specifications.² Combination vector-network, impedance and spectrum analyzer.

Dynamic Signal Analyzers

Frequency Range	Channel Match	Frequency Resolution in Lines	Real-time Bandwidth	Dynamic Range	Amplitude Accuracy* (±)	Model Number	Page
0.000122 Hz to 102.4 kHz	±0.04 dB, ±0.5°	100 to 1600	25.6 kHz	80 dB (90 dB typical)	0.15 dB	35670A	344

*Relative accuracy = relative frequency response + lesser of either scale fidelity or IF gain accuracy.

Vector Signal Analyzers

Frequency Range	Maximum Analysis Bandwidth	Sensitivity (displayed average noise level)	Dynamic Range (3 rd order IMD)	Modulation Analysis	Signal Capture Memory	Model Number	Page
7 MHz to 4 GHz	10 MHz	-136 dBm/Hz (at 1 GHz)	-68 dBc (W-CDMA ACPR)	9 standards-based measurement personalities personalities with setups, tests and pass/fail limits for digital wireless communications	Not applicable	E4406A	192
3 Hz to 50 GHz*	Up to 6.0 GHz*	-168 dBm/Hz* (at 1 GHz)	-70 dBc*	PC software linked to ESA,PSA, E4406A analyzers or Infiniium series oscilloscopes. Flexible, in-depth digital demodulation (24 demodulators) and 25 wireless format-based measurement setups.	Up to 1.2 GB (384 Msa, complex)	89601A	195
dc to 40 MHz	39 MHz	-151 dBm/Hz	-70 dBc**	Flexible, in-depth digital demodulation (24 demodulators) and 25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89610A	195
52 to 88 MHz (or frequency range of external tuner)	36 MHz	-159 dBm/Hz	-70 dBc**	Flexible, in-depth digital demodulation (24 demodulators) and 25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89611A	195
dc to 2.7 GHz	36 MHz	-158 dBm/Hz (at 1 GHz)	-70 dBc**	Flexible, in-depth digital demodulation (24 demodulators) and 25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89640A	195
dc to 6 GHz	36 MHz	-157 dBm/Hz (at 1 GHz)	-70 dBc**	Flexible, in-depth digital demodulation (24 demodulators) and 25 wireless format-based measurement setups	Up to 1.2 GB (384 Msa, complex)	89641A	195
dc to 10 MHz	10 MHz	-144 dBm/Hz	-75 dBc**	Flexible, in-depth digital demodulation (13 demodulators) and >8 wireless format-based measurement setups	Up to 1 Msa (complex)	89410A	197
dc to 2.65 GHz	8 MHz	-159 dBm/Hz	-75 dBc**	Flexible, in-depth digital demodulation (13 demodulators) and >8 wireless format-based measurement setups	Up to 1 Msa (complex)	89441A	197
dc to 2.65 GHz	8 MHz	-159 dBm/Hz	-75 dBc**	Flexible, in-depth digital demodulation (8 demodulators) and >5 video format-based measurement setups	Up to 1 Msa (complex)	89441V	197

*Depends on analyzers or oscilloscopes linked to 89601A PC software.

**2 tones at 6 dB below full scale (-31 dBm at input)

Modulation Domain Analyzers

Frequency Range	Resolution freq./time	Sample Rate	Memory Size	Analysis and Displays	Model Number	Page
10 Hz to 200 MHz (2.5 GHz option)	10 digits/200 ps	2.5 M (8 M rep.)	8 K (32 K option)	Frequency and time interval vs. time, histograms, statistics (digital RF communications option)	53310A	68

VCO/PPL Signal Test System

Frequency Range	Maximum Sensitivity (depends on offset frequency)	Functions Available	Model Number	Page
10 MHz to 12.6 GHz	-147 dBc/Hz @ offset freq. 100 kHz to 10 MHz (as phase noise measurement performance)	Frequency, power level, C/N ratio (phase noise), FM deviation and dc consumption current	4352S VCO/PLL Signal Test System	269

EMI/EMC Analyzers

Frequency Range	Maximum Sensitivity (displayed average noise level)	Maximum Dynamic Range 3rd order	Amplitude Accuracy (±)	Resolution Bandwidth Range	Model Number	Page
9 kHz to 1.5 GHz	≤-150 dBm	+13.5 dBm TOI	1.0 dB	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7401A	200
100 Hz ¹ to 3.0 GHz	≤-150 dBm	+12.5 dBm TOI	1.0 dB	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7402A	200
100 Hz ¹ to 6.7 GHz	≤-150 dBm	+12.5 dBm TOI	1.0 dB	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7403A	200
100 Hz ¹ to 13.2 GHz	≤-150 dBm	+12.5 dBm TOI	1.0 dB	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7404A	200
100 Hz ¹ to 26.5 GHz	≤-150 dBm	+12.5 dBm TOI	1.0 dB	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)	E7405A	200

¹With the Option UKB

²With the Option 1D5

- Frequency range of 9 kHz to 1.5 GHz, 3.0 GHz, and 26.5 GHz
- ± 1.1 dB absolute amplitude accuracy
- Rugged, portable package follows you from lab, to factory, to field
- ≥ 28 measurement updates/second to the display, > 30 measurement updates/second over GPIB
- Affordable, basic performance



E4403B

ESA-L Series Spectrum Analyzers

Now get quick and accurate results every time, at an affordable price. It has the performance of a high-quality spectrum analyzer and the rugged ease of use expected in a field instrument.

Fast Measurements

The ESA-L Series gives you ≥ 28 measurement updates/second to the display and ≥ 30 measurement updates/second over GPIB. Also, the state-of-the-art 4 ms sweep time reduces test time and increases throughput.

Accurate Results

The continuously phase-locked synthesizer adds stability and repeatability to frequency measurements, and the automatic background alignment offers continuous calibration. Plus, you'll have specified performance only 5 minutes after power-up. This includes ± 1.1 dB absolute amplitude accuracy up to 3.0 GHz and ± 2.6 dB up to 26.5 GHz.

Portable Operation

Optional snap-on battery eliminates the restrictions of power cords. The optional 12 V-dc power cable allows direct operation from automotive and truck batteries.

Rugged Packaging and Construction

Ideal for field environments, the ESA-L Series instruments have a sealed front panel, louvered air vents and side-mounted fan to protect the instrument in a wide range of weather conditions. Rubber-encased front and rear frames resist the rigors of transportation.

Easy to Use

The built-in help button gives key function and remote programming commands which eliminates the need to carry manuals. In addition, testing is simplified with built-in limit lines and pass/fail messages. The built-in disk drive makes saving and moving measurement results to your PC quick and easy.

Low Cost

All this at a very affordable price, with a standard 3 year global warranty.

PC Software for the ESA-L Series

IntuiLink PC software provides easy transfer of ESA measurement trace data directly into MS Excel spreadsheets or screen images into MS Word documents for analysis, archiving, presentations, or printing. Transfer measurement results over GPIB, RS232, or LAN (using two PCs or an E2050A GPIB/LAN adapter). Save and restore analyzer states. Unattended operation with repetitive sequence of measurement transfers by date and time. IntuiLink is included standard in all ESA-L Series.

Frequency Specifications

Frequency Range

E4411B: 50 ohms: 9 kHz to 1.5 GHz
 E4411B: 75 ohms (Option 1DP): 1 MHz to 1.5 GHz
 E4403B: 9 kHz to 3.0 GHz
 E4408B: 9 kHz to 26.5 GHz

Band	LO harmonic-N	Center Frequency
0	1-	9 kHz to 3.0 GHz
1	1-	2.85 GHz to 6.7 GHz
2	2-	6.2 GHz to 13.2 GHz
3	4-	12.8 GHz to 19.2 GHz
4	4-	18.7 GHz to 26.5 GHz

Frequency Reference

Aging: $\pm 2 \times 10^{-6}$ /year
 Settability: $\pm 5 \times 10^{-7}$
 Temperature Stability: $\pm 5 \times 10^{-6}$

Frequency Readout Accuracy

(Start, Stop, Center, Marker): $\pm(\text{frequency readout} \times \text{frequency reference error}^1 + 0.75\% \text{ of span} + 15\% \text{ of RBW} + 10 \text{ Hz} + 1 \text{ Hz} \times N^2)$

Marker Frequency Counter

Resolution: Selectable from 1 Hz to 100 kHz
 Accuracy: $\pm(\text{marker frequency} \times \text{frequency reference error}^1 + \text{counter resolution})$

Frequency Span

Range: 0 Hz (zero span), and
 E4411B: 100 Hz to 1.5 GHz
 E4403B: 100 Hz to 3.0 GHz
 E4408B: 100 Hz to 26.5 GHz
 Resolution: $2 \text{ Hz} \times N^2$
 Accuracy: $\pm 1\%$ of span

Sweep Time

Range: 4 ms to 4000 s
 Accuracy: $\pm 1\%$
 Sweep Trigger: Free Run, Single, Line, Video, External, Delayed, Offset
 Offset Trigger Range: $\pm 327 \text{ ms}$ to $\pm 323 \text{ ks}$
 Sweep (Trace) Points: 401

Resolution Bandwidth

Range:
 (-3 dB bandwidth): 1 kHz to 3 MHz, in 1-3-10 sequence, and 5 MHz.
 (-6 dB bandwidth, EMI): 9 kHz, 120 kHz
 Accuracy:
 (1 kHz to 3 MHz RBW): $\pm 15\%$
 (5 MHz RBW): $\pm 30\%$
 Selectivity (60 dB/3 dB bandwidth ratio): $< 15:1$, characteristic

Video Bandwidth Range (-3 dB)

30 Hz to 1 MHz in 1-3-10 sequence. 3 MHz, characteristic.

Stability

Noise Sidebands (offset from CW signal, 1 kHz RBW, 30 Hz VBW and sample detector)
 $\geq 10 \text{ kHz}$: $\leq -90 \text{ dBc/Hz} + (20 \text{ Log } N^2 \text{ for frequencies } > 6.7 \text{ GHz})$
 $\geq 20 \text{ kHz}$: $\leq -100 \text{ dBc/Hz} + (20 \text{ Log } N^2 \text{ for frequencies } > 6.7 \text{ GHz})$
 $\geq 30 \text{ kHz}$: $\leq -106 \text{ dBc/Hz} + (20 \text{ Log } N^2 \text{ for frequencies } > 6.7 \text{ GHz})$
 $\geq 100 \text{ kHz}$: $\leq -113 \text{ dBc/Hz} + (20 \text{ Log } N^2 \text{ for frequencies } > 6.7 \text{ GHz})$

Residual FM

1 kHz RBW, 1 kHz VBW: $\leq 150 \text{ Hz peak-to-peak} \times N^2 \text{ in } 100 \text{ ms}$

System-Related Sidebands, offset from CW signal

$\geq 30 \text{ kHz}$: $\leq -65 \text{ dBc} + (20 \text{ Log } N^2 \text{ for frequencies } > 6.7 \text{ GHz})$

Amplitude Specifications

Absolute Amplitude Accuracy

Overall Amplitude Accuracy²: $\pm(0.6 \text{ dB} + \text{absolute frequency response})$
 At reference settings³: $\pm 0.4 \text{ dB}$

Measurement Range

Displayed average noise level to maximum safe input level

Input Attenuator Range:

E4411B: 0 to 60 dB, in 5 dB steps
 E4403B, E4408B: 0 to 65 dB, in 5 dB steps

ESA-L Series
 E4411B
 E4403B
 E4408B

ESA-L Series
E4411B
E4403B
E4408B

Maximum Safe Input

Average Continuous Power:

E4411B: (≥ 15 dB attenuation): +30 dBm (1 W)E4403B, E4408B: (≥ 5 dB attenuation): +30 dBm (1 W)

Peak Pulsed Power:

E4411B: (≥ 15 dB attenuation): +30 dBm (1 W)E4403B, E4408B: (≥ 30 dB attenuation): +50 dBm (100 W)**1 dB Gain Compression:** (Total power at input mixer)³

E4411B, E4403B: 0 dBm;

E4408B: (50 MHz to 6.7 GHz): 0 dBm, (6.7 GHz to 13.2 GHz): -3 dBm,

(13.2 GHz to 26.5 GHz): -5 dBm

Displayed Average Noise Level (Input terminated, 0 dB attenuation, 30 Hz VBW, sample detector, 1 kHz RBW, reference level = -70 dBm)

E4411B:

400 kHz to 10 MHz: ≤ -115 dBm10 MHz to 500 MHz: ≤ -119 dBm500 MHz to 1.0 GHz: ≤ -117 dBm1.0 GHz to 1.5 GHz: ≤ -113 dBm

E4403B:

10 MHz to 1 GHz: ≤ -117 dBm1 GHz to 2.0 GHz: ≤ -116 dBm2.0 GHz to 3.0 GHz: ≤ -114 dBm

E4408B:

10 MHz to 1.0 GHz: ≤ -116 dBm1.0 GHz to 2.0 GHz: ≤ -115 dBm2.0 GHz to 6.0 GHz: ≤ -112 dBm6.0 GHz to 12.0 GHz: ≤ -110 dBm12.0 GHz to 22.0 GHz: ≤ -107 dBm22.0 GHz to 26.5 GHz: ≤ -101 dBm**Display Range**

Log Scale: 0 to -85 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; ten divisions displayed

Linear Scale: ten divisions

Scale Units: dBm, dBmV, dB μ V, V, and W**Absolute Frequency Response** (Referenced to 50 MHz, 10 dB attenuation, 20 °C to 30 °C)9 kHz to 3.0 GHz: ± 0.5 dB3.0 GHz to 6.7 GHz: ± 1.5 dB6.7 GHz to 26.5 GHz: ± 2.0 dB**Resolution Bandwidth Switching Uncertainty** (at reference level and 1 kHz RBW)3 kHz to 3 MHz RBW: ± 0.3 dB5 MHz RBW: ± 0.6 dB**Reference Level**

Range: -149 dBm to maximum mixer level + attenuator setting

Resolution

Log Scale: ± 0.1 dBLinear Scale: $\pm 0.12\%$ of reference level

Accuracy: (at a fixed frequency, a fixed attenuation, and referenced to -35 dBm)

Reference Level - Input Attenuator Setting:

-10 dBm to > -60 dBm: ± 0.3 dB-60 dBm to > -85 dBm: ± 0.5 dB-85 dBm to > -90 dBm: ± 0.7 dB**Display Scale Switching Uncertainty**Linear to Log Switching: ± 0.15 dB at reference level

Log Scale Switching: No error

Display Scale Fidelity

Log Maximum Cumulative

0 to -80 dB from reference level: $\pm (0.3 \text{ dB} + 0.01 \times \text{dB from reference level})$

Log Incremental Accuracy

0 to -80 dB from reference level: $\pm 0.4 \text{ dB}/4 \text{ dB}$ Linear Accuracy: $\pm 2\%$ of reference level**Spurious Responses**

Second Harmonic Distortion

E4411B:

2 MHz to 750 MHz < -75 dBc for -40 dBm signal at input mixer³

E4403B, E4408B:

10 MHz to 500 MHz < -60 dBc for -30 dBm signal at input mixer³500 MHz to 1.5 GHz < -70 dBc for -30 dBm signal at input mixer³1.5 GHz to 2.0 GHz < -80 dBc for -10 dBm signal at input mixer³2.0 GHz to 13.25 GHz < -95 dBc for -10 dBm signal at input mixer³

Maximum Achievable Second Order Dynamic Range

E4411B: (at 1 GHz) 76 dB (+35 dBm, SHI)

E4403B: (at 1 GHz) 78.5 dB (+40 dBm, SHI)

E4408B: (at 1 GHz) 78 dB (+40 dBm, SHI)

Third Order Intermodulation Distortion

E4411B:

10 MHz to 1.5 GHz < -75 dBc for two -30 dBm signals at input mixer³, > 50 kHz separation

E4403B, E4408B:

100 MHz to 6.7 GHz < -75 dBc for two -30 dBm signals at input mixer³, > 50 kHz separation6.7 GHz to 26.5 GHz < -70 dBc for two -30 dBm signals at input mixer³, > 50 kHz separation

Maximum Achievable Third Order Dynamic Range

E4411B: (at 1 GHz) 83 dB (+7.5 dBm TOI)

E4403B: (at 1 GHz) 83 dB (+7.5 dBm TOI)

E4408B: (at 1 GHz) 82 dB (+7.5 dBm TOI)

Other Input-Related Spurious

E4411B: < -65 dBc, 30 kHz \leq offset ≤ 1.2 GHz, for -20 dBm signal at input mixer³E4403B, E4408B: < -65 dBc, > 30 kHz offset, for -20 dBm signal at input mixer³**Residual Responses** (Input terminated and 0 dB attenuation): < -90 dBm**AM Demod:** Tune and listen to AM signals**Options****Tracking Generator Specifications (Option 1DN or IDQ)****Output Frequency Range**E4411B: 50 Ω (Option 1DN): 9 kHz to 1.5 GHzE4411B: 75 Ω (Option 1DQ): 1 MHz to 1.5 GHz

E4403B, E4408B: (Option 1DN): 9 kHz to 3.0 GHz

Output Power Level RangeE4411B: 50 Ω (Option 1DN): 0 to -70 dBm (20 °C to 30 °C)E4411B: 75 Ω (Option 1DQ): +42.75 to -27.25 dBmVE4403B, E4408B: 50 Ω (Option 1DN): -2 to -66 dBm**Dynamic Range:** Output power level - displayed average noise level**General Specifications****Measurement Speed** (Characteristic)

	E4411B	E4403B	E4408B
Local measurement and display update rate ⁶	≥ 35 /sec	≥ 30 /sec	≥ 28 /sec
Remote measurement and GPIB transfer rate ⁷	≥ 30 /sec	≥ 30 /sec	≥ 30 /sec
RF center frequency tuning time ⁸	≤ 90 ms	≤ 90 ms	≤ 90 ms

Temperature Range

Operating: 0 °C to + 55 °C

Disk Drive: 10 °C to 40 °C

Storage: -40 °C to + 75 °C

Audible Noise (ISO 7779)Sound pressure at 25 °C: < 40 dBA (< 5.3 Bels power)**Military Specification:** Has been type tested to the environmental specifications of MIL-PRF-28800F Class 3**EMI Compatibility:** Conducted and radiated emission is in compliance with CISPR Pub.11/1990 Group 1 Class A**Power Requirements**

ac Voltage: 90 to 132 Vrms, 195 to 250 Vrms

Frequency: 47 to 440 Hz, 47 to 66 Hz

Power Consumption, On: < 300 WPower Consumption, Standby: < 5 W

dc Voltage: 12 to 20 Vdc

Power Consumption: < 200 W**Weight (without options)**

E4411B: 13.2 kg (29.1 lb), characteristic

E4403B: 15.5 kg (34.2 lb), characteristic

E4408B: 17.1 kg (37.7 lb), characteristic

Dimensions

Height: 222 mm (8.75 in)

Width: 373 mm (14.7 in) w/o handle, 408 mm (16.1 in) w/handle

Depth: 409 mm (16.1 in) w/o handle, 516 mm (20.3 in) w/handle

Ordering Information

E4411B 9 kHz to 1.5 GHz ESA-L Portable Spectrum Analyzer
E4403B 9 kHz to 3.0 GHz ESA-L Portable Spectrum Analyzer
E4408B 9 kHz to 26.5 GHz ESA-L Portable Spectrum Analyzer

Options

To add options to a product, use the following ordering scheme:
 Model: E44xxB (xx = 11, 03 or 08)

Example options: E4411B-1DN, E4408B-230

E44xxB-A4H GPIB and parallel (Centronics) interfaces
E44xxB-1AX RS-232 and parallel (Centronics) interfaces
E44xxB-A4J IF, Sweep, and Video Ports
E44xxB-1DN 50-Ohm tracking generator (9 kHz to 1.5 GHz for E4411B)(9 kHz to 3.0 GHz for E4403B and E4408B)
E44xxB-1DP 75 Ohm Input Impedance (1 MHz to 1.5 GHz) (E4411B only)
E44xxB-1DQ 75 Ohm Tracking Generator (1 MHz to 1.5 GHz) (requires Option 1DP)
E44xxB-A5D 12 Vdc power cable
E44xxB-1D7 50 to 75 Ohm matching pad (type N(m) to BNC (f))
E44xxB-UK9 Front panel protective cover
E44xxB-1CP Rackmount kit with handles and slides
E44xxB-0BW Assembly level service guide and CD-ROM with adjustments
E44xxB-UK6 Commercial calibration certificate with data
E44xxB-0B0 Delete manuals, keep CD-ROM manual
E44xxB-0BV Component level service documentation
E44xxB-AXT Add hard transit case
E44xxB-AYT Grey soft carrying/operating case
E44xxB-AYU Yellow soft carrying/operating case
E44xxB-042 Custom Analyzer backpack (grey)
E44xxB-044 Custom Analyzer backpack (yellow)
E44xxB-BAB 3.5 mm Input connector (E4408B only)
E44xxB-230 BenchLink web remote control software
E44xxB-290 8590 series programming code compatibility

Accessories

87405A Pre-amplifier (10 MHz to 3 GHz, 24 dB gain) (fastened to RF input, powered from analyzer)
85905A 75 Ohm pre-amplifier (45 MHz to 1 GHz, 20 dB gain) (powered from analyzer)
41800A Active probe (5 Hz to 500 MHz)
85024A High frequency active probe (300 kHz to 3 GHz)
E1779A Snap-on battery pack

¹Frequency reference error = (aging rate x period of time since adjustment + settability + temperature stability).

²N = Harmonic mixing mode. N = 1 for E4411B and E4403B.

³Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuator. (dB). For RBW \leq 30 kHz, maximum input signal amplitude must be \leq reference level + 10 dB.

⁴For reference level 0 to –50 dBm: input attenuation, 10 dB; 50 MHz; RBW, 1 kHz; VBW, dc coupled, 1 kHz; log range 0 to –50 dB; sweep time coupled, signal input, 0 to –50 dBm; span, \leq 20 kHz, 20° C to 30° C.

⁵For reference level –25 dBm for E4411B, –20 dBm for E4403B and E4408B: input attenuation 10 dB; center frequency 50 MHz; resolution bandwidth 1 kHz; video bandwidth 1 kHz; span 2 kHz; sweep time coupled; signal at reference level.

⁶Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz and spans >10 MHz and \leq 600 MHz (>102 MHz and \leq 400 MHz E4401B).

⁷Factory preset, display Off, single sweep, markers Off, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, span = 20 MHz, and stop frequency \leq 3 GHz.

⁸Factory preset, display Off, markers Off, single sweep, auto align Off, segmented sweep Off, RBW = 1 MHz, sweep points = 101, span = 20 MHz, stop frequency \leq 3 GHz, and center frequency tune step size = 50 MHz.

E4444A BenchLink Spectrum

Analyzer Software

Agilent BenchLink Spectrum Analyzer provides an easy-to-use communications link between your PC and the 8560-series, 8590-series, ESA-E/L series portable spectrum analyzers and E7400 series EMC analyzers. BenchLink Spectrum Analyzer is a member of the Agilent BenchLink family of PC/basic instrument connectivity solutions, and takes full advantage of the Windows interface to easily transfer screen images or trace data via GPIB or RS-232 interfaces.

BenchLink Spectrum Analyzer makes it easy to capture, analyze and document measurement results in your PC. Agilent has done all the programming for you.

You'll be able to transfer:

- Screen images – you can transfer a picture of the spectrum analyzer screen to your PC for viewing, annotation, storage, or printing. BenchLink Spectrum Analyzer provides convenient annotation tools, and Windows makes it easy to cut and paste your annotated image into other applications like word processing, presentation, and graphics packages or e-mail. You can also save your image in PCX, TIF, GIF, and BMP formats. You'll find documenting measurement results to be fast and simple
- Trace data – BenchLink Spectrum Analyzer transfers the trace frequency/amplitude pairs of data from your spectrum analyzer to your PC for further review and analysis. Once the trace data is captured, you can use pan and zoom and trace markers in BenchLink to analyze the trace. Additionally, the frequency/amplitude pairs of trace data can be easily copied as comma-separated-values to spreadsheets or other analysis programs using files or the Windows clipboard

The software runs on MS Windows 3.1, Windows 3.11, Windows 95, Windows 98, Windows NT 4.0, Windows 2000, and Windows XP and includes a complete context-sensitive on-line help system. System requirements are IBM PC compatible with at least 486-25 MHz processor, 8 MB ram, and 3 MB disk space available.

Ordering Information

E4444A BenchLink Spectrum Analyzer Software

Remote Operation Software for the 8590 Series

iPanels software for MS Windows 95/NT provides remote operation for 8590 series spectrum analyzers (with GPIB or RS-232 interface). The virtual 8590 series instrument panel created on your PC monitor is easily controlled with a mouse as if you were sitting in front of the analyzer. Remote functionality through modem or LAN varies for different analyzer models and options. Contact Hamilton Software for analyzer compatibility and product details.

Hamilton Software
 Santa Rosa, CA, USA
 (707) 542-2700
<http://www.hamsoft.com>

ESA-L Series
 E4411B
 E4403B
 E4408B
 E4444A

ESA-E Series

- 40 updates/sec measurement speed
- ± 1 dB amplitude accuracy
- Optional 1 Hz resolution bandwidth filter
- 108 dB third order dynamic range
- Field rugged portability
- Six-slot option card cage
- Mid-performance analyzers



5

ESA-E Series Spectrum Analyzers

The Agilent ESA-E Series general purpose, portable spectrum analyzers offer a wide range of performance, features, and flexibility previously unavailable in this price range. Five models offer frequency ranges starting at 9 kHz and ending between 1.5 GHz and 26.5 GHz.

Fast Measurement Speed

The 1 ms RF sweep time and up to 40 measurements per second gives you virtual real-time measurement response. This means you spend less time testing or tuning circuits. High-speed remote measurements and data transfer of up to 40 measurements per second reduce critical test time in automatic test environments. Optional 25 ns time-domain sweep time illuminates fast changing signals in the time domain.

Highly Accurate

A continuously phase-locked synthesizer operating over the entire sweep provides improved frequency accuracy, stability, and repeatability. The outstanding amplitude accuracy of ± 1 dB up to 3 GHz and ± 2.5 dB up to 26.5 GHz adds measurement confidence, improved yield and reduced test margins. The amplitude correction factor capability lets users remove frequency-related effects.

Automatic background alignment provides continuous calibration between sweeps, which means the full accuracy is maintained without operator intervention.

Digital Resolving Power

With the optional digital resolution bandwidth (RBW) filters (1 Hz to 300 Hz), you obtain finer resolving power to separate and measure closely spaced signals. A narrow shape factor (5:1) aids measurement of small signals close to the carrier. These digital RBW filters sweep up to 220 times faster than their analog equivalents, while improving sensitivity.

Wide Dynamic Range

108 dB maximum 3rd order dynamic range (+12 dBm TOI) and the 5 dB step attenuator let you see low-level distortion. Spur searching is enhanced with the -166 dBm sensitivity, optional built-in preamp, and the fast measurement speed. Up to 120 dB of calibrated display range allows simultaneous display of large and small signals.

Rugged Portability

Take the analyzer's lab grade performance into the field protected by rubber encased frames, rain-resistant front panel, and shielded vents. A snap on battery provides up to 1.9 hours of cordless operation and 12 Vdc capability allows operation with automotive electrical systems. Five-minute warm-up offers full measurement accuracy without waiting. And, automatic background alignment maintains the full measurement accuracy over time and varying temperatures.

Flexible Platform

The ESA-E Series can be configured specifically for your application as well as protect your investment into the future. The six-slot option card cage allows you to choose only the performance you need now and upgrade in the future. This scalable performance in combination with Agilent measurement personalities, downloaded into the internal memory, can transform the analyzer into an application focused solution, for example, cdmaOne or GSM measurements.

A wide variety of plug-in option boards provide even more measurement capability. Most option boards are easily installed into the built-in card cage and are retrofittable.

Options include:

- Digital narrow resolution bandwidth filters of 1, 3, 10, 30, 100, 200 EMI and 300 Hz
- Time-gated spectrum analysis
- FM demodulation/deviation plus tune and listen
- TV trigger with color picture on screen
- 1.5/3.0 GHz built-in tracking generators
- Pre-amplifier (1.5/3.0 GHz fully calibrated)
- 100 Hz low frequency operation
- High stability frequency reference
- Fast time-domain sweeps to 25 ns
- Battery pack/12 VDC operation
- External mixing capability to 325 GHz
- Digital demodulation communication hardware
- 75 Ω input
- Web remote connectivity software

Features

- Segmented sweep saves measurement and setup time by viewing, in one sweep, only the frequency spans of interest. Paste together up to 32 discontinuous frequency or zero spans in one sweep. Eliminate the need for sweeping through unwanted frequencies and for multiple setups
- Variable sweep (trace) points, ranging from 101 to 8192 points, optimize measurements for frequency resolution and accuracy versus speed
- Multiple detector types including peak, negative peak, sample, rms and average
- 16.8 cm, high-resolution color display with wide viewing angle make it easy to identify signals of interest
- The next generation user interface improves ease-of-use. Built-in help gives immediate assistance without manuals. When manuals are needed they are provided in printed form, on CD-ROM and on the Internet
- One-button RF power measurements with preset radio standard setups for channel power, ACP, OBW, CCDF, harmonic distortion and spurious emissions providing fast repeatable measurements
- Multiple limit lines with margins and pass/fail messages simplify production testing. Built-in frequency counter with 1 Hz resolution precisely measures individual signals
- 3 year global warranty lowers cost of ownership

PC Connectivity

Store up to 200 traces or states or multiple measurement personalities in user memory. Use the floppy disk drive or IntuiLink for storing and transferring measurement results to a PC. SCPI remote control language, IVI-COM drivers and VXIplug&play drivers enhance remote program development.

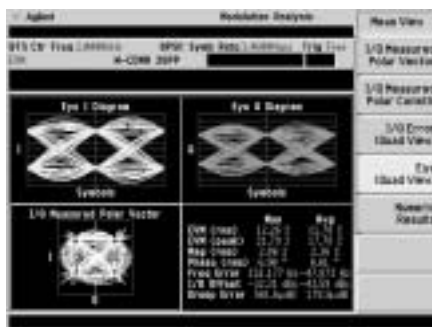
IntuiLink PC software provides easy transfer of ESA measurement trace data directly into MS Excel spreadsheets or screen images into MS Word documents for analysis, archiving, presentations, or printing. Transfer measurement results over GPIB, RS232, or LAN (using two PCs or an E2050A GPIB/LAN adapter). Save and restore analyzer states. Unattended operation with repetitive sequence of measurement transfers by date and time. IntuiLink is included standard.

Combine the ESA-E Series optional hardware configurations with downloadable measurement personalities to create application-specific solutions.

Measurement Personalities

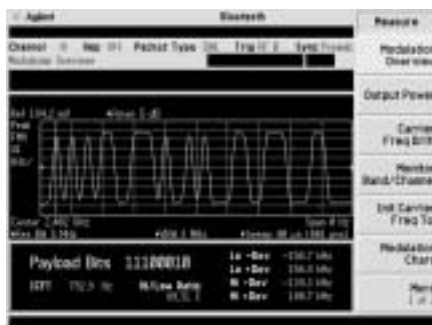
For a variety of applications Agilent offers unique software programs (provided on 3.5-inch disks) designed specifically for the ESA-E Series. Downloaded into analyzer memory, each measurement personality provides measurement setups, routines, and results specific to your application, including a user interface with application related terminology.

- Easy to use, one-button measurements
- Complex algorithms executed with a button press
- Improved accuracy and repeatability
- Operator independent results
- Decreased training time
- Improved productivity



EVM Modulation Analysis

Options 229 (measurement personality) and B74 (RF and digital demodulation hardware) combine to allow measurements of EVM and related metrics for all major 2G/3G formats. Constellation and eye diagrams are provided to help verify modulation quality. For full flexible demodulation and analysis, the free link to 89601A VSA software is included.



Bluetooth

Options 304 (measurement personality and digital demodulation hardware) provides one-button standard compliant *Bluetooth* transmitter measurements.

GSM/GPRS

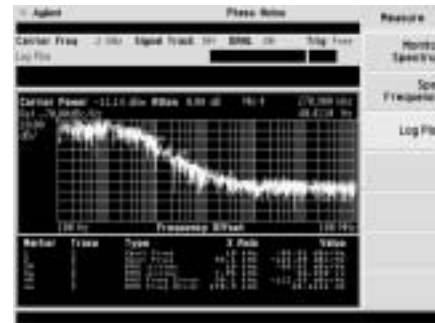
Options BAH (measurement personality) and B74 (RF and digital demodulation hardware) provide one-button standard compliant GSM measurements. See page 179 for more information.

cdmaOne

Options BAC (measurement personality) and B74 (RF and digital demodulation hardware) provide one-button standard compliant cdmaOne measurements. See page 179 for more information.

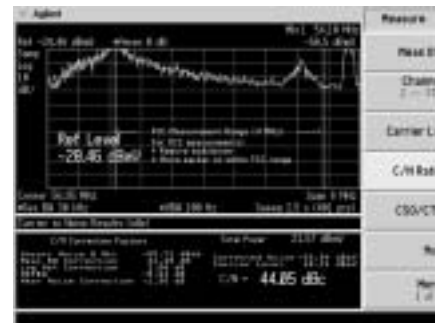
Cable Fault Location

Options 225 (measurement personality), 1DN (tracking generator), and B7K (measurement kit) combine to identify distance-to-cable discontinuities for fault location and troubleshooting of cable installation and maintenance. Includes table of common cable types with their loss and velocity factors.



Phase Noise

Option 226 (measurement personality) provides a log plot of phase noise in dBc/Hz versus offset frequency. Includes spot frequency readout and RMS phase noise integrated over a specified range, displayed in radians and degrees.



Cable TV Service and Installation

Option 227 (CATV measurement personality) provides Cable TV operators fast, accurate, and rugged spectrum analysis for field installation, ingress evaluation, and troubleshooting. One-button measurements include video carrier levels and frequencies, carrier-to-noise, CSO/CTB, hum and, with options B7B and BAA, TV trigger and picture on screen.

E4401B
E4402B
E4404B
E4405B
E4407B



ESA-E Series

Specifications

All specifications apply over 0°C to +55°C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 5 minutes after the analyzer is turned on, and after ALIGN NOW [RF] has been run.

5

Frequency Specifications

Frequency Range

E4401B	50 Ω	9 kHz to 1.5 GHz
	75 Ω	1 MHz to 1.5 GHz
E4402B	Option UKB	9 kHz to 3.0 GHz
E4404B	Band	100 Hz to 3.0 GHz
	0	9 kHz to 3.0 GHz (dc coupled)
	Option UKB	100 Hz to 3.0 GHz
	0	100 kHz to 3.0 GHz (ac coupled)
	1	2.85 GHz to 6.7 GHz
E4405B	Band	LO harmonic = N
	0	1-
	Option UKB	1-
	0	1-
	1	1-
	2	2-
E4407B	Band	LO harmonic = N
	0	1-
	Option UKB	1-
	1	1-
	2	2-
	3	4-
	4	4-
External Mixing (Opt AYZ)		18 GHz to 325 GHz
Frequency Reference		(Opt. 1D5)
Aging	±2 × 10 ⁻⁶ /year	±1 × 10 ⁻⁷ /year
Temperature Stability	±5 × 10 ⁻⁶	±5 × 10 ⁻⁸
Settability	±5 × 10 ⁻⁷	±1 × 10 ⁻⁸
Frequency Readout		
Accuracy (Start, Stop, Center, Marker)	±(frequency indication × frequency reference error ¹ + 0.5% of span + 15% of RBW + 10 Hz + span ÷ sweep points - 1)	
Marker Frequency Counter²		
Accuracy ³	±(marker frequency × frequency reference error ¹ + counter resolution)	
Counter Resolution	Selectable from 1 Hz to 100 kHz	
Frequency Span		
Range	0 Hz (zero span), 100 Hz to the range of the spectrum analyzer	
Resolution	2 Hz × N ⁴	
Accuracy (8192 sweep points)	±0.5% of span + 2 × span ÷ sweep points - 1	

Frequency Sweep Time

Range	1 ms to 4000 s
Span = 0 Hz	10 μs to 4000 s
(Opt. AYZ)	50 ns to 4000 s (RBW ≥ 1 kHz, 2pts.)
(Opt. B7D)	25 ns to 4000 s (RBW ≥ 1 kHz, 2pts.)
Accuracy	±1%
Sweep Trigger	Free run, Single, Line, Video, External, Offset, Delay, Gate (Opt. 1D6), and TV (Opt. B7B)
Offset trigger range	±327 ms to ±12.3 μs
Sweep (trace) point range	Span > 0Hz 101 to 8192
	Span = 0Hz 2 to 8192

Resolution Bandwidth (RBW)

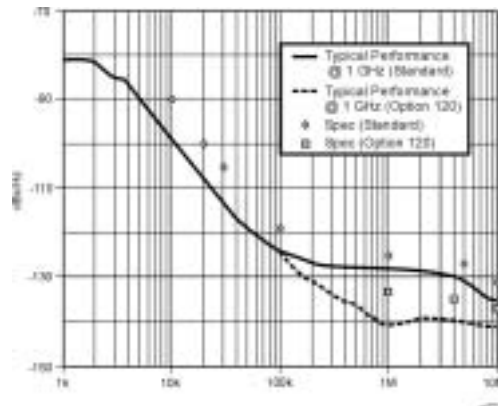
Range	1 kHz to 5 MHz (-3 dB) in 1-3-10 sequence.
	9 kHz and 120 kHz (-6 dB) EMI bandwidths.
(Opt. 1DR)	Adds 10, 30, 100, and 300 Hz (-3 dB) bandwidths and 200 Hz (-6 dB) EMI bandwidth.
(Opt. 1D5 + 1DR)	Adds 1, 3 Hz (-3 dB) bandwidths)
Accuracy	
1 kHz to 3 MHz RBW	±15%
5 MHz	±30%
10 Hz to 300 Hz RBW	±10%
(Opt. 1DR)	

Selectivity (Characteristic) -60 dB/-3 dB

10 Hz to 300 Hz (Opt. 1DR)	<5:1
1 kHz to 5 MHz	<15:1

Video Bandwidth

Range	30 Hz to 3 MHz ⁵ in 1-3-10 sequence
(Opt. 1DR)	Adds 1, 3, 10 Hz for RBW < 1 kHz
Stability	Noise sidebands (1 kHz RBW, 30 Hz VBW and sample detector)
≥10 kHz offset from CW signal	≤ -90 dBc/Hz + (20 Log N ⁴ for frequencies > 6.7 GHz)
≥20 kHz offset from CW signal	≤ -100 dBc/Hz + (20 Log N ⁴ for frequencies > 6.7 GHz)
≥30 kHz offset from CW signal	≤ -104 dBc/Hz + (20 Log N ⁴ for frequencies > 6.7 GHz)
≥100 kHz offset from CW signal	≤ -113 dBc/Hz + (20 Log N ⁴ for frequencies > 6.7 GHz)



Residual FM

1 kHz RBW, 1 kHz VBW	≤ 150 × N ⁴ Hz pk-pk in 100 ms
(Opt. 1D5)	≤ 100 × N ⁴ Hz pk-pk in 100 ms
(Opt. 1DR, 1DE)	≤ 2 × N ⁴ Hz pk-pk in 20 ms

System-Related Sidebands (offset from CW signal)

≥30 kHz	≤ -65 dBc + (20 Log N ⁴ for frequencies > 6.7 GHz)
---------	---

Amplitude Specifications

Amplitude Range

Measurement Range	Displayed average noise level to maximum safe input level
Input Attenuator range	
E4401B	0 to 60 dB, in 5 dB steps
E4402B/04B/05B/07B	0 to 65 dB, in 5 dB steps

Maximum Safe Input Level	
Average Continuous Power	(input attenuator ≥15 dB)
E4401B	+30 dBm (1 W)
E4401B (75 Ω Opt. 1DP)	+75 dBmV (0.4 W)
E4402B/04B/05B/07B	(input attenuator ≥5 dB)
	+30 dBm (1 W)
Peak Pulse Power	(input attenuator ≥15 dB)
E4401B	+30 dBm (1 W)
E4401B (75 Ω Opt. 1DP)	+75 dBmV (0.4 W)
E4402B/04B/05B/07B	(input attenuator ≥30 dB)
	+50 dBm (100 W)
dc	
E4401B (75 Ω Opt. 1DP)	100 Vdc
E4401B, E4402B	100 Vdc
E4404B, E4405B	0 Vdc (dc coupled)
	50 Vdc (ac coupled)
E4407B	0 Vdc
1 dB Gain Compression (total power at input mixer ⁵)	
≥50 MHz	0 dBm
≥6.7 GHz	-3 dBm
≥13.2 GHz	-5 dBm

Displayed Average Noise Level (dBm)
(Input terminated, 0 dB attenuation, sample-detector, 30/1 Hz VBW)

	1 kHz RBW	10 Hz RBW (Opt. 1DR)	10 Hz RBW w/ preamp (Opt. 1DS) typical	1 Hz RBW (Opt. 1DR, 1D5) typical
E4401B				
400 kHz to 10 MHz	≤-115	≤-134	≤-155	≤-149
10 MHz to 500 MHz	≤-119	≤-138	≤-156	≤-151
500 MHz to 1 GHz	≤-117	≤-136	≤-156	≤-150
1 GHz to 1.5 GHz	≤-114	≤-133	≤-155	≤-148
E4402B				
100 Hz to 9 kHz (Opt. UKB)	—	≤-93	—	≤-103
9 kHz to 100 kHz	—	≤-109	—	≤-119
100 kHz to 1 MHz	—	≤-135	—	≤-145
1 MHz to 10 MHz	≤-120	≤-139	≤-152	≤-149
10 MHz to 1 GHz	≤-117	≤-136	≤-156	≤-150
1 GHz to 2 GHz	≤-116	≤-135	≤-156	≤-150
2 GHz to 3 GHz	≤-114	≤-133	≤-154	≤-150
E4404/05/07B				
100 Hz to 9 kHz (Opt. UKB)	—	≤-93	—	≤-103
9 kHz to 100 kHz	—	≤-109	—	≤-119
100 kHz to 1 MHz	—	≤-135	—	≤-145
1 MHz to 10 MHz	≤-120	≤-139	≤-155	≤-149
10 MHz to 1 GHz	≤-116	≤-135	≤-157	≤-149
1 GHz to 2 GHz	≤-116	≤-135	≤-155	≤-150
2 GHz to 3 GHz	≤-112	≤-131	≤-152	≤-148
3 GHz to 6 GHz	≤-112	≤-131	≤-138	≤-148
6 GHz to 12 GHz	≤-111	≤-130	≤-137	≤-147
12 GHz to 22 GHz	≤-107	≤-126	≤-134	≤-107
22 GHz to 26.5 GHz	≤-106	≤-125	≤-132	≤-142

Display Range

Log scale	0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; ten divisions displayed	
RBW ≤300 Hz (Opt. 1DR)	0 to -120 dB from reference level is calibrated	
RBW ≥1 kHz	0 to -85 dB from reference level is calibrated	
Linear scale	10 divisions	
Scale units	dBm, dBmV, dBμV, Volts, Watts, and Hz	
Marker Readout Resolution		
Log scale	0.04 dB	
Linear scale	0.01% of reference level	
Fast sweep times for zero span (Opt. AYY)		
Log scale		
0 to -85 dB from ref. level	0.3 dB	
Linear scale	0.3% of reference level	
Frequency Response		
	Absolute ⁷	Relative Flatness ⁸
20 °C to 30 °C (30 Hz ⁶) 100 Hz to 3.0 GHz (Opt. UKB)	±0.5 dB	±0.5 dB

9 kHz to 3.0 GHz	±0.46 dB	±0.5 dB	E4401B
	(±0.14 dB typical)		E4402B
3.0 GHz to 6.7 GHz	±1.5 dB	±1.3 dB	E4404B
6.7 GHz to 26.5 GHz	±2.0 dB	±1.8 dB	E4405B
0 °C to 55 °C			E4407B
(30 Hz ⁶) 100 Hz to 3.0 GHz (Opt. UKB)	±1.0 dB	±1.0 dB	
9 kHz to 3.0 GHz	±0.76 dB	±1.0 dB	
3.0 GHz to 6.7 GHz	±2.5 dB	±1.5 dB	
6.7 GHz to 26.5 GHz	±3.0 dB	±2.0 dB	

Input Attenuation Switching Uncertainty at 50 MHz

Attenuation setting	
0 dB to 5 dB	±0.3 dB
10 dB	Reference
15 dB	±0.3 dB
20 to 60 dB (E4401B)	±(0.1 dB + 0.01 x attenuator setting)
20 to 65 dB	±(0.1 dB + 0.01 x attenuator setting)

Overall Amplitude Accuracy⁹

At Reference Settings ¹³	±0.34 dB
-------------------------------------	----------

RF Input VSWR (at tuned frequency) 10 dB atten.

100 kHz to 6.7 GHz	≤1.4:1 ⁶
--------------------	---------------------

Resolution Bandwidth Switching Uncertainty

(Referenced to 1 kHz RBW, at reference level)

10 Hz to 3 MHz RBW	±0.3 dB
5 MHz	±0.6 dB

Reference Level

Range -149.9 dBm to maximum mixer level + attenuator setting

Resolution ±0.1 dB for log scale, ±0.12% of reference level for linear scale

Accuracy (reference level attenuator setting)

-10 dBm to -60 dBm	±0.3 dB
-60 dBm to -85 dBm	±0.5 dB
-85 dBm to -90 dBm	±0.7 dB

Display Scale Fidelity

Log maximum cumulative	
0 dB to -85 dB	±(0.3 dB + 0.01 x dB from ref. level)
0 dB to -98 dB (Opt 1DR)	±(0.3 dB + 0.01 x dB from ref. level)
98 dB to -120 dB (Opt 1DR)	±(2 dB + 0.01 x dB from ref. level) ⁶

Log incremental accuracy

0 dB to -80 dB	±0.4 dB/4 dB from reference
----------------	-----------------------------

Linear Accuracy

	±2% of reference level
--	------------------------

Linear to Log Switching

	±0.15 dB at reference level
--	-----------------------------

Uncertainty

Log Scale Switching

	No error
--	----------

Spurious Responses

Second Harmonic Distortion

E4401B	
2 MHz to 750 MHz	<-75 dBc for -40 dBm tone at input mixer ⁵ . (+35 dBm SHI)
E4402/04/05/07B	
10 MHz to 500 MHz	<-65 dBc for -30 dBm tone at input mixer ⁵ . (+35 dBm SHI)
500 MHz to 1.5 GHz	<-75 dBc for -30 dBm tone at input mixer ⁵ . (+45 dBm SHI)
1.5 GHz to 2.0 GHz	<-85 dBc for -10 dBm tone at input mixer ⁵ . (+75 dBm SHI)
>2.0 GHz	<-100 dBc for -10 dBm tone at input mixer ⁵ (or below displayed average noise level). (+90 dBm SHI)

Third Order Intermodulation Distortion

E4401B	
10 MHz to 1.5 GHz	<-80 dBc for two -30 dBm tones at input mixer ⁵ and >50 kHz separation. (+13.5 dBm TOI, +19 dBm typical ¹⁴)
E4402B/04B/05B/07B	
100 MHz to 6.7 GHz	<-84 dBc for two -30 dBm tones at input mixer ⁵ and >50 kHz separation. (+11 dBm TOI, +18 dBm typical ¹⁴)
>6.7 GHz	<-75 dBc for two -30 dBm tones at input mixer ⁵ and >50 kHz separation. (+7.5 dBm TOI, +11 dBm typical ¹⁴)
Other Input Related Spurious (in band)	
>offset 30 kHz	<-65 dBc, for -20 dBm tones at input mixer ⁵ .

Residual Responses (input terminated and 0 dB attenuation)

150 kHz to 6.7 GHz	<-90 dBm
--------------------	----------

ESA-E Series

General Specifications

Temperature Range				
Operating		0 °C to +55 °C		
Disk Drive		10 °C to 40 °C		
Storage		–40 °C to +75 °C		
EMI Compatibility		Conducted and radiated interference is in compliance with CISPR Pub. 11/1990 Group 1 Class A		
Audible Noise (ISO 7779)		<40 dBA sound pressure and <4.6 Bels power		
Military Specification		Has been type tested to the environmental specifications of MIL-PRF-28800F class 3		
Power Requirements				
On (Line 1)				
AC Operation				
Voltage, frequency		90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz		
Power consumption		<300 W		
Standby (Line 0)				
Power consumption		<5 W		
DC Operation				
Voltage		12 to 20 Vdc		
Power Consumption		<200 W		
Measurement Speed⁶		E4401B	E4402B	E4404B, E4405B, E4407B
Local measurement rate ¹⁰	≥50/s	≥45/s		≥40/s
Remote measurement and GPIB transfer rate ¹¹	≥45/s	≥45/s		≥40/s
RF center frequency tuning time ¹⁵	≤75 ms	≤75 ms		≤75 ms
Data Storage (nominal)				
Internal		200 traces or states		
External (Floppy)		200 traces or states		
Downloadable Program Memory		8.0 MB (nominal)		
Weight (without options)⁶				
E4401B		13.2 kg		(29.1 lb)
E4402B		15.5 kg		(34.2 lb)
E4404B/05B/07B		17.1 kg		(37.7 lb)
Dimensions				
w/o handle		222 mm H x 409 mm D x 373 mm W (8.88 in x 16.36 in x 14.92 in)		
w/handle (max.)		222 mm H x 516 mm D x 408 mm W (8.88 in x 20.64 in x 16.32 in)		

Option Specifications

Option 1DN and 1DQ Tracking Generator

Frequency Range

E4401B		
Opt. 1DN, (50 Ω)		9 kHz to 1.5 GHz
Opt. 1DQ, (75 Ω)		1 MHz to 1.5 GHz
E4402B/04B/05B/07B		
Opt. 1DN, (50 Ω)		9 kHz to 3.0 GHz
Resolution BW Range		1 KHz to 5 MHz
Output Level		
Range		
E4401B		
Opt. 1DN		0 to –70 dBm
Opt. 1DQ		+42.75 to –27.25 dBmV
E4402B/04B/05B/07B		
		–2 to –66 dBm

Dynamic Range

Maximum output power-Displayed Average Noise Level

¹Frequency reference error = (aging rate x period of time since adjustment + settability + temperature stability).²Not available in RBW <1 kHz (Option 1DR).³Marker level to DANL >25dB, Frequency offset = 0 Hz, RBW/Span ≥0.002.⁴N = LO harmonic mixing mode.⁵Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuator (dB).⁶Characteristic.⁷Referenced to amplitude at 50 MHz.⁸Reference to midpoint between highest and lowest frequency response deviations.⁹For reference levels 0 to –50 dBm; RBW, 1 kHz; Video BW, 1 kHz; Scale Log, Log range 0 to –50 dB; Sweep time coupled; Signal input, 0 to –50 dBm; Span, ≤20 kHz; Input attenuation 10 dB, 20 °C to 30 °C.¹⁰Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, sweep points = 101, and spans >10 MHz and ≤600 MHz (>102 MHz and ≤400 MHz E4401B).¹¹Factory preset, display Off, single sweep, markers Off, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, sweep points = 101, and span = 20 MHz and stop frequency ≤3 GHz.

Ordering Information

E4401B ESA-E 1.5 GHz Spectrum Analyzer
E4402B ESA-E 3.0 GHz Spectrum Analyzer
E4404B ESA-E 6.7 GHz Spectrum Analyzer
E4405B ESA-E 13.2 GHz Spectrum Analyzer
E4407B ESA-E 26.5 GHz Spectrum Analyzer

Options

To add options to a product, use the following ordering scheme:

Model: E440xB (x = 1, 2, 4, 5 or 7)

Example options: E4402B-1DR, E4407B-B74

E440xB-0B0 Delete printed manual set (retains CD-ROM manual)**E440xB-0B1** Add manual set**E440xB-0BV** Component level service documentation**E440xB-0BW** Assembly level service guide and CD-ROM with adjustments**E440xB-1AX** RS-232 and Parallel printer interface

(includes RS-232 cable and IntuiLink software)

E440xB-1CP Rackmount and handle kit with slides**E440xB-1D5** High stability time base**E440xB-1D6** Time-gated spectrum analysis**E440xB-1D7** 50 Ω/75 Ω matching pad with dc block**E440xB-1DN** 1.5 GHz tracking generator (E4401B only)**E440xB-1DN** 3 GHz tracking generator**E440xB-1DP** 75 Ω input (E4401B only)**E440xB-1DQ** 75 Ω tracking generator (E4401B only)**E440xB-1DR** Narrow resolution bandwidths**E440xB-1DS** 1.5 GHz Preamplifier (E4401B only)**E440xB-1DS** 3.0 GHz Preamplifier**E440xB-A4H** GPIB and parallel printer interfaces

(includes IntuiLink software)

E440xB-A4J IF, sweep and video ports**E440xB-A5D** 12 Vdc power cable**E440xB-AXT** Transit case**E440xB-AYT** Grey soft carrying/operating case**E440xB-AYU** Yellow soft carrying/operating case**E440xB-AYX** Fast zero-span sweeps**E440xB-B74** RF/Digital communication hardware**E440xB-B75** Performance Bundle (1D5+1DR+1DS)**E440xB-BAA** FM Demodulation/Deviation**E440xB-BAB** APC 3.5mm Connector (E4407B only)**E440xB-BAC** cdmaOne Measurement Personality**E440xB-BAH** GSM Measurement Personality**E440xB-UK6** Commercial Calibration Certificate**E440xB-UK9** Front panel cover**E440xB-B7B** TV Trigger with color picture on screen (requires Opt. BAA)**E440xB-AYZ** External Mixing (E4407B only)**E440xB-UKB** 100 Hz Low frequency extension

(unavailable in E4401B)

E440xB-042 Custom analyzer backpack (grey)**E440xB-044** Custom analyzer backpack (yellow)**E440xB-060** Low emissions shielding**E440xB-B7K** Cable fault location measurement kit**E440xB-225** Cable fault location measurement personality**E440xB-226** Phase noise measurement personality**E440xB-227** Cable TV service and installation measurement personality**E440xB-228** Bluetooth measurement personality**E440xB-229** Modulation analysis measurement personality**E440xB-230** BenchLink web remote control software**E440xB-266** HP 8566/68 programming code compatibility**E440xB-290** 8590 series programming code compatibility**E440xB-304** Bluetooth premium option bundle**E1779A** Battery pack**41800A** Active Probe (5 Hz to 500 MHz)**85024A** Active Probe (300 kHz to 3 GHz)**11742A** dc blocking capacitor, M–F APC 3.5 mm

connector (45 MHz to 26.5 GHz)

11693A Limiter, M–F Type N connector (100 MHz to 12.4 GHz)¹²In time domain sweeps.¹³Settings are: Reference level –20 dBm (–25 dBm E4401B); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; span 2 kHz; sweep time coupled, sample detector; signal at reference level.¹⁴20 °C to 30 °C.¹⁵Factory preset, display Off, markers Off, single sweep, auto align Off, segmented sweep Off, RBW = 1 MHz, sweep points = 101, and span = 20 MHz, stop frequency ≤3 GHz, and center frequency tune step size = 50 MHz.

- One-button CDMAOne and GSM measurements
- Root cause analysis and troubleshooting
- Rugged and portable for field use

Transmitter Testing Measurement Personalities

Transmitter test measurement personalities customize the ESA-E Series spectrum analyzers by adding industry standard one-button test capability. The versatile ESA-E Series card cage architecture and floppy disk drive makes it easy to add application-specific measurement hardware and software. The rugged, portable ESA-E Series spectrum analyzers with optional measurement personalities and battery pack are ideal for on-site testing of transmitters in the most demanding environments.



E4402B

ESA-E Series with cdmaOne Measurement Personality

Simplify your measurements of cellular, PCS and other spread spectrum transmitters based on cdmaOne standards. The ESA-E Series measurement personality provides both frequency- and modulation-domain measurements including digital demodulation for rho and code domain measurements. The functionality also includes in- and out-of-band spurious measurements.

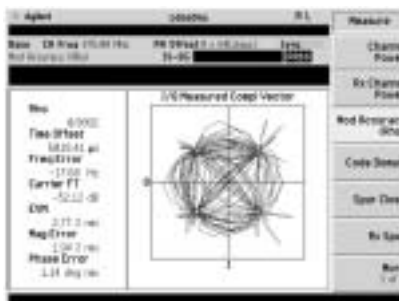
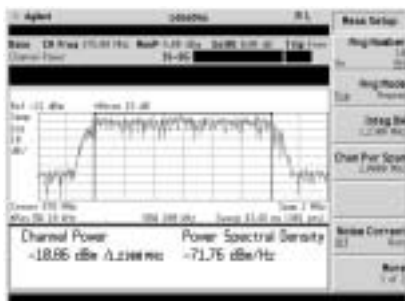
Measurements

- Channel power
- Receive channel power
- Modulation quality (rho)
- Code domain power
- Spurious emissions in- and out-of -band
- Occupied bandwidth
- Harmonics
- Monitor channel/band
- ACPR

Recommended Configuration

E4402B, E4404B, E4405B, or E4407B portable spectrum analyzer with the following options:

- E440xB-BAC CDMAOne measurement personality
- E440xB-B74 RF and digital communications hardware



ESA-E Series with GSM Measurement Personality

Making complex GSM measurements is easy using the ESA-E Series spectrum analyzer with the GSM measurement personality. One-button tests verify the performance of GSM transmitters for P-GSM, E-GSM, R-GSM, DCS1800, and PCS1900 systems.

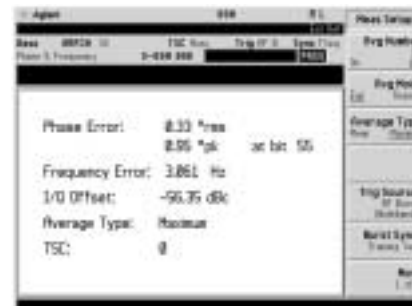
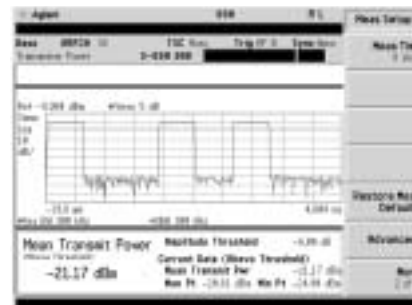
Measurements

- Transmit power
- Phase and frequency error
- Output RF spectrum
- Power versus time
- Spurious emissions in- and out- of-band
- Distance to fault (requires optional tracking generator)
- Monitor/channel band
- Power steps

Recommended Configuration

E4402B, E4404B, E4405B, or E4407B portable spectrum analyzer with the following options:

- E440xB-BAH GSM measurement personality
- E440xB-B74 RF and digital communications hardware
- E440xB-1DN Tracking generator (for distance to fault)



E4402B
E4404B
E4405B
E4407B

8560EC
8561EC
8562EC
8563EC
8564EC
8565EC

- Continuous 30 Hz to 2.9, 6.5, 13.2, 26.5, 40, or 50 GHz sweeps
- Resolution bandwidths of 1 Hz to 100 Hz digitally implemented for measurement speed
- Best-in-class performance in phase noise and dynamic range
- Precision timebase and 1 Hz counter resolution
- Adjacent channel power, channel power, carrier power and gated video measurements standard
- Class 3 MIL-rugged
- Color screen
- VGA output



8560EC

5

8560EC Series Spectrum Analyzers

The 8560EC series portable spectrum analyzers offer the measurement capabilities and performance traditionally found only in larger, more expensive benchtop analyzers. These spectrum analyzers combine outstanding phase noise, sensitivity, 1 Hz resolution bandwidths and wide dynamic range in a Class 3 MIL-rugged package built to withstand harsh environmental conditions.

Capabilities for RF Communications

The ability to measure adjacent channel power (ACP) on wireless telephones, pagers and other transmitters is critical in both R&D and manufacturing. The 8560EC series spectrum analyzers offer a complete solution for ACP testing of burst carrier signals using digital modulation such as is used in NADC-TDMA, GSM, DECT, CT2-CAI, PDC and PHS systems. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate and easy-to-use ACP measurement capability. Measure W-CDMA adjacent channel power ratio (ACPR) with a dynamic range of at least 70 dB using the 8563E-K35 ACPR test set.

Another standard feature is the ability to measure from 0.10 to 99.99 percent occupied bandwidth.

Time-gated signal analysis is another standard feature that allows you to easily measure time-varying signals such as pulsed RF, time-division multiple access (TDMA), interleaved and burst-modulated. The 85902A burst carrier trigger can supply a TTL trigger signal.

8560EC series specifications have been enhanced. Now, you can get better phase noise, sensitivity, dynamic range and frequency response from this high performance portable spectrum analyzer family.

The 8562EC spectrum analyzer provides a 13.2 GHz frequency range with increased dynamic range and third-order intercept (TOI) capability. This allows wireless communications engineers to test high-performance components in burst operation systems.

With the 85672A spurious response measurements utility, you can use 8560EC series spectrum analyzers to make fast and easy spurious response tests.

For more information on RF communications measurement capabilities, refer to page 184.

Fast Digital Resolution Bandwidths

Digitally-implemented resolution bandwidths of 1, 3, 10, 30 and 100 Hz allow the 8560EC series spectrum analyzers to sweep from 3 to 600 times faster than is possible with comparable analog filters. A narrow 5:1 shape factor allows you to view close-in, low-level signals easily. Digital bandwidths also provide the spectrum analyzer with a full 100 dB on-screen calibrated display.

PC Software for 8560EC Series

The Agilent BenchLink Spectrum Analyzer PC software provides an easy-to-use communications link between your PC and the 8560EC series spectrum analyzers. Taking full advantage of the Windows interface, you can easily transfer screen images or trace data via the GPIB interface, thereby making it easy to capture, analyze and document measurement results in your PC. For more information, see page 173.

Precision Frequency and Amplitude

Measure frequencies accurately using the built-in frequency counter. A standard precision frequency reference, with an aging rate of 1×10^{-7} per year, and 1 Hz counter resolution provide confidence in measurement accuracy. At 1 GHz, frequency accuracy of ± 135 Hz after a 15-minute warmup is achieved.

Amplitude measurement uncertainty can be reduced using the amplitude correction (AMPCOR) feature. AMPCOR allows you to enter up to 200 amplitude correction points to compensate for sources of amplitude uncertainty, such as cable losses, preamplifier gain and spectrum analyzer frequency response. After developing a table of correction data, amplitudes that have been referenced to a power meter can be read directly on the spectrum analyzer display.

Digitized, Fast Time-Domain Sweeps

Digitized fast time-domain (zero span) sweeps use markers, trace math, trace storage and get hardcopy output, for measurements such as rise/fall times, pulse widths and time between events.

8560EC and 8561EC RF Spectrum Analyzers

The 8560EC and 8561EC offer excellent performance for RF design, manufacturing and service applications. The 8560EC has a frequency range of 30 Hz to 2.9 GHz, and the 8561EC extends this range up to 6.5 GHz. Both have synthesized tuning for drift-free accurate measurements.

8562EC RF Spectrum Analyzer

The 8562EC is a high-performance spectrum analyzer that provides the frequency and dynamic range needed for today's high-speed digital wireless communication applications. It allows manufacturing and R&D engineers to test network components with state-of-the-art performance. The 8562EC has a frequency range of 30 Hz to 13.2 GHz, which covers the spur-search ranges specified by leading standards organizations in Europe and in the United States.

8563EC Microwave Spectrum Analyzer

The 8563EC extends the outstanding features and capabilities of the 8560EC Series RF spectrum analyzers into the microwave frequency range. The 8563EC has a standard frequency range of 9 kHz to 26.5 GHz (preselected from 2.75 GHz to 26.5 GHz), with optional low-end frequency coverage to 30 Hz. The image-enhanced, double-balanced harmonic mixer of the 8563EC achieves noise-figure performance similar to that of a fundamentally-mixed front end.

8564EC and 8565EC Millimeter-Wave Spectrum Analyzers

Whether you want to measure the third harmonic of a 15 GHz oscillator or the noise sidebands of a 38 GHz carrier, the 8564EC and 8565EC make spectrum analysis easier than ever before. A single coaxial connection is all you need to measure signals from 30 Hz to 50 GHz. Preselection minimizes images and multiple responses at higher frequencies.

The 8564EC has a frequency range of 9 kHz to 40 GHz, the 8565EC of 9 kHz to 50 GHz. Both have optional low-end coverage to 30 Hz and are preselected above 2.75 GHz.

8563E-K35 Adjacent Channel Power Ratio Test Set

Use this special option with the 8561EC/62EC/63EC/64EC/65EC spectrum analyzers to increase the dynamic range of ACP measurements. 8563E-K35 uses an alternate first converter mixer with custom filtering to increase the spectrum analyzer's ACPR measurement dynamic range. The dynamic range becomes at least 70 dB for systems with a guard band between channels of 900 kHz or greater. This meets the needs of emerging W-CDMA specifications. Control menus are integrated into the spectrum analyzer softkeys making the test set easy to use.

11970 Series and 11974 Series Millimeter-Wave Mixers

For millimeter-wave measurements¹, preselection can be extended to 75 GHz using the 11974 mixers. Unpreselected frequency range can be extended to 110 GHz using the 11970 series mixers, and to 325 GHz using mixers from other manufacturers.

85620A Mass Memory Module

This standard plug-in module adds measurement personality capability, enough memory to store 100 traces, memory-card capability and computer capability, without an external controller. Create complex measurement routines and save them as single-key measurements stored on memory cards or in the module's 128 KB of battery-backed RAM. A clock/calendar and automatic save and execute functions let you configure the spectrum analyzer for unattended, automatic measurements.

85629B Test and Adjustment Module

This accessory for the 8560EC/61EC/63EC (limited use on 8562EC/64EC) makes it easier to service your spectrum analyzer. The module plugs into the rear panel of the instrument and automates high-level diagnostics, self tests and adjustment procedures. It performs more than 1,000 troubleshooting adjustments. Readjustments are fast and accurate because the module controls internal analyzer settings as well as external test equipment.

85710A Digital Radio Measurement Personality

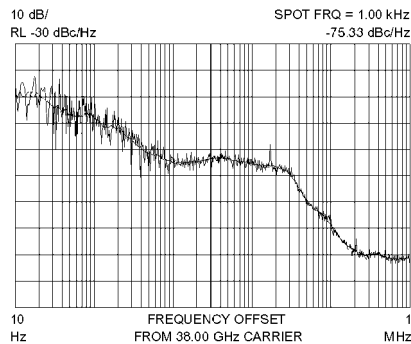
The 85710A Digital Radio Measurement Personality customizes the 8560EC Series spectrum analyzers for digital radio measurements. It contains five agency masks for testing to U.S. FCC, U.K. and FRG

Traditional Chinese URL www.agilent.com.tw/find/products

specifications. A compare-to-mask function allows you to characterize spectral emissions. Other functions include mean power level, transient analysis monitoring and frequency-response measurements. You can also create and store your own custom masks.

85671A Phase Noise Measurement Utility

This downloadable program transforms your 8560EC Series spectrum analyzer into a phase noise tester. It eliminates the task of hand-drawing phase noise plots. To measure oscillator phase noise, you can generate graphs of phase noise (dBc/Hz) versus log offset frequency without having to manually tune to multiple frequency offsets. Other productivity features include direct phase noise readout, variable filtering (for controlling trade-offs between measurement repeatability and speed), calculation of RMS noise (displayed in radians and degrees), spot-frequency measurements (phase noise measurements at a single offset frequency) and digitized hardcopy and storage.



Use the 85671A phase noise utility to easily characterize noise sidebands of an oscillator.

85672A Spurious Response Measurements Utility

The 85672A is a downloadable program on a card that inserts directly into any 8560EC Series spectrum analyzer. This test utility provides fast and easy spurious response test capability for all of 8560EC Series spectrum analyzers. Test setup time can be drastically reduced for manufacturing and R&D engineers with this one-button solution. 85672A offers five preprogrammed tests: third-order intermodulation product/third order intercept (TOI), harmonics and total-harmonic distortion (THD), discrete sideband spurs, general-spur search and mixing products.

Scalar Network Analysis Capability

The 85640A tracking generator and the optional built-in tracking generator for the 8560EC both cover 300 kHz to 2.9 GHz, providing 8560EC Series spectrum analyzers with scalar measurement capability.

Specifications

Frequency

Frequency Range (internal mixing)

8560EC: 30 Hz to 2.9 GHz

8561EC: 30 Hz to 6.5 GHz

8562EC: 30 Hz to 13.2 GHz

8563EC: 9 kHz to 26.5 GHz; 30 Hz to 26.5 GHz (Option 006)

8564EC: 9 kHz to 40 GHz; 30 Hz to 40 GHz (Option 006)

8565EC: 9 kHz to 50 GHz; 30 Hz to 50 GHz (Option 006)

Frequency Range (external mixing): 18 GHz to 325 GHz in 12 wave-guide bands (not available with 8560EC Option 002)

Frequency Reference Accuracy		Option 103
Temperature Stability	$\pm 1 \times 10^{-8}$	$\pm 1 \times 10^{-6}$
Aging (per year)	$\pm 1 \times 10^{-7}$	$\pm 2 \times 10^{-6}$
Stability	$\pm 1 \times 10^{-8}$	$\pm 1 \times 10^{-6}$

Warmup (nominal), 5 minute $\pm 1 \times 10^{-7}$; 15 minute $\pm 1 \times 10^{-8}$

Frequency Readout Accuracy (N = L0 Harmonic)

Span > 2 MHz x N: \pm (freq. readout x freq. ref. accuracy + 5% x span + 15% x RBW + 10 Hz)

Span \leq 2 MHz x N: \pm (freq. readout x freq. ref. accuracy + 1% x span + 15% x RBW + 10 Hz)

For more information, visit our web site:

<http://www.agilent.com/find/8560>

Simplified Chinese URL www.agilent.com.cn/find/products

8560EC
8561EC
8562EC
8563EC
8564EC
8565EC

8560EC
8561EC
8562EC
8563EC
8564EC
8565EC

Marker Count Accuracy (S/N ≥ 25 dB): ±(marker freq. x freq. ref. accuracy + 2 Hz x N + 1 LSD)

Counter Resolution: Selectable from 1 Hz to 1 MHz

Frequency Span

- Range: 0 Hz, 100 Hz to maximum frequency

Sweep Time

- Range
 - Span = 0 Hz: 50 μs to 6,000 s
 - Span ≥ 100 Hz: 50 ms to 100 ks

Accuracy (span = 0 Hz)

- Sweep Time > 30 ms: ±1% digital
- Sweep Time < 30 ms: ±10% analog; ±0.1% digital

Sweep Trigger: Delayed, free run, single, line, video, external

Resolution Bandwidth:

- Range (–3 dB): 1 Hz to 1 MHz in a 1, 3, 10 sequence and 2 MHz
- Accuracy
 - 1 Hz to 300 kHz: ±10%; 1 MHz: ±25%; 2 MHz: +50%, –25%
- Selectivity (–60 dB/–3 dB)
 - RBW ≥ 300 Hz: <15:1; RBW ≤ 100 Hz: <5:1

Video Bandwidth Range: 1 Hz to 3 MHz in a 1, 3, 10 sequence

Noise Sidebands (center frequency ≤ 1 GHz)

Offset	Non-Option 103	Option 103
100 Hz	<–88 dBc/Hz	<–70 dBc/Hz
1 kHz	<–97 dBc/Hz	<–90 dBc/Hz
10 kHz	<–113 dBc/Hz	<–113 dBc/Hz
100 kHz	<–117 dBc/Hz	<–117 dBc/Hz

Residual FM (zero span): <1 Hz p-p in 20 ms; <0.25 Hz p-p in 20 ms (nominal); <10 Hz p-p in 20 μs (Option 103)

Amplitude

Range: Displayed average noise level to +30 dBm

Maximum Safe Input Level

- Average Continuous Power: +30 dBm (1W, input atten. ≥ 10 dB)
- Peak Pulse Power (<10 μs pulse width and <1% duty cycle): +50 dBm (100 W, input atten. ≥ 30 dB)
- DC Volts: <±0.2 V (dc-coupled); <±50 V (ac-coupled, 8560EC, 8561EC and 8562EC only)

1 dB Gain Compression

- 10 MHz to 2.9 GHz: mixer level ≤ –5 dBm
- 2.9 to 6.5 GHz (8561EC): mixer level ≤ –3 dBm
- 2.9 to 6.5 GHz (8562EC/63EC/64EC/65EC): mixer level ≤ 0 dBm
- >6.5 GHz: ≤ –3 dBm (8562EC/63EC); ≤ 0 dBm (8564EC/65EC)

Displayed Average Noise Level (0 dB input atten., 1 Hz RBW¹)

Frequency	8560EC/ 61EC	8562EC	8563EC	8564EC/ 65EC
30 Hz	–90 dBm	–90 dBm	–90 dBm	–90 dBm
1 kHz	–105 dBm	–105 dBm	–105 dBm	–105 dBm
10 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
100 kHz	–120 dBm	–120 dBm	–120 dBm	–120 dBm
1 to 10 MHz	–140 dBm	–140 dBm	–140 dBm	–140 dBm
10 MHz to 2.9 GHz	–149 dBm ⁹	–149 dBm	–149 dBm	–145 dBm
2.9 to 6.5 GHz	–145 dBm ²	–148 dBm	–148 dBm	–147 dBm
6.5 to 13.2 GHz	—	–145 dBm	–145 dBm	–143 dBm
13.2 to 22.0 GHz	—	—	–140 dBm	–140 dBm
22.0 to 26.5 GHz	—	—	–139 dBm	–136 dBm
26.5 to 31.15 GHz	—	—	—	–139 dBm
31.15 to 40.0 GHz	—	—	—	–130 dBm
40.0 to 50.0 GHz	—	—	—	–127 dBm ³

¹ 10 Hz RBW (Min. RBW with Option 103) add 10 dB to noise floor

² 8561EC only

³ 8565EC only

⁴ 8563EC/64EC/65EC only

⁵ 8563EC only

⁶ 8564EC/65EC only

⁷ Except 8561EC

⁸ For 8561EC: –145 dBm

⁹ T0I reference to single tone

Spurious Responses	Mixer Level	Distortion
General Spurious	–40 dBm	<(–75+20 log N) dBc
Second Harmonic Dist.		
20 MHz to 1.45 GHz ⁷	–40 dBm	<–79 dBc
1 MHz to 1.45 GHz	–40 dBm	<–72 dBc
1.45 GHz to 3.25 GHz ²	–20 dBm	<–72 dBc
1.45 GHz to 2.0 GHz ⁴	–10 dBm	<–85 dBc
2 GHz to 6.6 GHz ⁷	–10 dBm	<–100 dBc
2.0 GHz to 13.25 GHz ⁵	–10 dBm	<–100 dBc
2.0 GHz to 20 GHz ⁶	–10 dBm	<–90 dBc
20 GHz to 25 GHz ³	–10 dBm	<–90 dBc
3rd Order Intermodulation⁹		
20 MHz to 2.9 GHz ⁷	–30 dBm	<–82 dBc
1 MHz to 2.9 GHz	–30 dBm	<–78 dBc
2.9 GHz to 6.5 GHz	–30 dBm	<–90 dBc
6.5 GHz to 26.5 GHz	–30 dBm	<–75 dBc
26.5 GHz to 40 GHz ⁸	–30 dBm	<–85 dBc (nominal)
40 GHz to 50 GHz ³	–30 dBm	≤ –85 dBc (nominal)
Images		
10 MHz to 26.5 GHz	–10 dBm	<–80 dBc
26.5 GHz to 50 GHz	–30 dBm	<–60 dBc
Multiples and Out-of-Band Responses		
10 MHz to 26.5 GHz	–10 dBm	<–80 dBc
26.5 GHz to 50 GHz	–30 dBm	<–55 dBc

Residual Responses (>200 kHz, N=1): <–90 dBm

Display

- Viewing area: Approx. 7 cm (V) x 9 cm (H)
- Scale calibration: 10 x 10 divisions
- Log scale: 10, 5, 2, 1 dB per division
- Linear scale: 10% of ref. level per division

Display Scale Fidelity

- Log: ±0.1 dB/dB to a maximum of ±0.85 dB, 0 to –90 dB; maximum of ±1.5 dB, 0 to –100 dB (RBW ≤ 100 Hz)
- Linear: ±3 % of reference level

Reference Level Range: Log = –120 to +30 dBm in 0.1 dB steps;

- Linear = 2.2 μV to 7.07 V in 1% steps

Frequency Response, Relative (10 dB input atten.)

Frequency	8560EC	8561EC	8562EC	8563EC	8564EC/ 65EC
100 MHz to 2.0 GHz	±0.7 dB	±1.0 dB	±0.9 dB	±1.0 dB	±0.9 dB
30 Hz to 2.9 GHz	±1.0 dB	±1.0 dB	±1.25 dB	±1.25 dB	±1.0 dB
2.9 GHz to 6.5 GHz	—	±1.5 dB	±1.5 dB	±1.5 dB	±1.7 dB
6.5 GHz to 13.2 GHz	—	—	±2.2 dB	±2.2 dB	±2.6 dB
13.2 GHz to 22.0 GHz	—	—	—	±2.5 dB	±2.5 dB
22.0 GHz to 26.5 GHz	—	—	—	±3.3 dB	±3.3 dB
26.5 GHz to 31.15 GHz	—	—	—	—	±3.1 dB
31.15 GHz to 40.0 GHz	—	—	—	—	±2.6 dB
40.0 GHz to 50.0 GHz	—	—	—	—	±3.2 dB ³

Calibrator Output: 300 MHz x (1 ±freq. ref. acc’y), –10 dBm: <±0.3 dB

Input Attenuator

- Range
 - 8560EC/61EC/62EC/63EC: 0 to 70 dB in 10 dB steps
 - 8564EC/65EC: 0 to 60 dB in 10 dB steps
- Switching Uncertainty (ref. to 10 dB, 30 Hz to 2.9 GHz): <±0.6 dB/10 dB step, ±1.8 dB max.
- Repeatability: ±0.1 dB (nominal)

IF Gain Uncertainty (10 dB atten., 0 to –80 dBm ref. level): <±1 dB

Resolution Bandwidth Switching Uncertainty: <±0.5 dB

Pulse Digitization Uncertainty (pulse response mode, PRF ≥ 720/sweep time, RBW ≤ 1 MHz): <1.25 dB pk-pk (Log); <4 % of reference level pk-pk (Linear)

Time-Gated Spectrum Analysis

Gate Delay	Edge Mode	Level Mode
Range	3 μs to 65.535 ms	≤0.5 μs
Resolution	1 μs	
Accuracy (from gate trigger input to pos. edge of gate output):	<±1 μs	

Gate Length

Range: 1 μs to 65.535 ms
Resolution: 1 μs
Accuracy (from pos. edge to neg. edge of gate output): <±1 μs

¹ Millimeter-wave coverage is not available with Option 002 on the 8560EC.

Delayed Sweep**Trigger Modes:** Free run, line, external, video**Range:** 2 μ s to 65.535 μ s; Option 007, Sweeptime <30 μ s;–9.9 μ s to +65.535 μ s; Sweeptime \geq 30 μ s, +2 μ s to +65.535 μ s**Resolution:** 1 μ s**Accuracy:** \pm 1 μ s**Demodulation** (Spectrum)**Modulation Type:** AM and FM**Audio Output:** Speaker and phone jack with volume control**Inputs and Outputs** (All values nominal)**Front-Panel Connectors****RF Input** (50 Ω)

8560EC/61EC/62EC/63EC, Type-N female

8563EC Option 026, APC-3.5 male

8564EC/65EC, 2.4-mm male

VSWR (\geq 10 dB atten.): <1.5:1 below 2.9 GHz; <2.3:1, \geq 2.9 GHz**LO Emission Level** (average with 10 dB atten.): <–80 dBm**Second IF Input** (SMA female, 50 Ω)

• Frequency: 310.7 MHz

• Full Screen Level: –30 dBm

• Gain Compression: –20 dBm

First LO Output (SMA female, 50 Ω)

• Frequency: 3.0 to 6.8107 GHz

• Amplitude: 16.5 dBm \pm 2 dB; +14.5 dBm \pm 3 dB (Option 002)**Cal Output:** BNC female, 50 Ω **Probe Power:** +15 Vdc, –12.6 Vdc, and GND (150 mA maximum each)**Rear Panel Connectors****10 MHz Reference In/Out** (shared BNC female, 50 Ω)• Output Freq. Accuracy: 10 MHz \pm (10 x MHz freq. ref. acc'y)

• Output Amplitude: 0 dBm

• Input Amplitude: –2 to +10 dBm

Video Output (BNC, 50 Ω)• Amplitude (RBW \geq 300 Hz): 0 to +1 V full scale**LO Sweep I FAV Output** (shared BNC female, 2 k Ω)

• Amplitude (LO sweep): 0 to 10 V, no load

Blanking/Gate Output: Shared BNC female, 50 Ω , TTL output**External/Gate Trigger Input** (shared BNC female, >10 k Ω): settable to high TTL or low TTL**GPIO** (IEEE-488 bus connector)**Interface Functions:** SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C1, C28, E1**Interface Functions** (For 8562EC): SH1, AH1, T6, LE0, RL1, PP1, DC1, DT1, C1, C28, TE0, SR1**General Specifications****Environmental**

- Military Specs: Class 3 MIL-rugged
- Calibration Interval: Two years (8560EC/61EC/62EC/63EC); One year (8564EC/65EC)
- Warmup Time: 5 minutes in ambient conditions
- Temperature: 0° to +55° C (operating); –40° to +71° C (not operating)
- Humidity: 95% at 40° C for five days
- Rain Resistance: Drip-proof at 16 liters/hour/sq. ft.
- Altitude: 15,000 ft. (operating); 50,000 ft. (not operating)
- Pulse Shock (half sine): 30 g for 11 ms duration
- Transit Drop: 8-inch drop on six faces and eight corners

Electromagnetic Compatibility: Conducted and radiated interference in compliance with CISPR Pub. 11 (1990). Meets MIL-STD-461C, part 4, with certain exceptions.**Power Requirements**

- 115 Vac Operation: 90 to 140 V rms, 3.2 A rms max., 47 to 440 W
- 230 Vac Operation: 180 to 250 V rms, 1.8 A rms max., 47 to 66 W
- Maximum Power Dissipation:** 180 W (8560EC/61EC/62EC/63EC); 260 W (8564EC/65EC)

Audible Noise (nominal): <5.0 Bels power at room temp. (ISO DP7779)**Dimensions** (w/o handle, feet, cover): 187 mm H x 337 mm W x 461 mm D (7.48 in x 13.34 in x 18.44 in)**Weight** (carrying, nominal)

- Agilent 8560EC/61EC/62EC/63EC: 16.3 kg (36 lbs)
- Agilent 8564EC/65EC: 17.3 kg (38 lbs)

Option 002 Built-in Tracking Generator (8560EC only)**Frequency****Range:** 300 kHz to 2.9 GHz**Accuracy** (after peaking): \pm (freq. ref. accuracy x tuned freq. +5% x span +295 Hz)**Tracking Drift** (nominal): Usable in 1 kHz RBW after 5-min. warmup; usable in 300 Hz RBW after 30-min. warmup**Minimum RBW:** 300 Hz**Amplitude****Output Level:** –10 to +1 dBm; –10 to 2.8 dBm, typical**Resolution:** 0.1 dB**Accuracy** (25° C \pm 10° C)• Vernier: \pm 0.2 dB/dB, \pm 0.5 dB max.• Absolute: \pm 0.75 dB• Level Flatness: \pm 2.0 dB**Dynamic Range:** 95 dB at 300 kHz to 1 MHz; 115 dB at 1 MHz to 2.0 GHz; 110 dB at 2.0 GHz to 2.9 GHz**Power Sweep:** 10 dB range, 0.1 dB resolution**Inputs/Outputs****RF Output** (front panel): Type-N female, 50 Ω (nominal)**Ext. ALC Input** (rear panel): BNC female; use with negative detector**Key Literature**

8560EC Series Configuration Guide, p/n 5968-8155E

8560EC Series Brochure, p/n 5968-9328E

8563E-K35 Product Overview, p/n 5966-2913E

8560EC Series Technical Specifications, p/n 5968-8156E

85671A Product Overview, p/n 5091-7089E

85672A Product Overview, p/n 5965-1337E

85710A Technical Data, p/n 5952-1452

For more information on compatible printers, visit our web site:

<http://www.agilent.com/find/pcg>**Ordering Information**

8560EC Spectrum Analyzer, 30 Hz to 2.9 GHz

8561EC Spectrum Analyzer, 30 Hz to 6.5 GHz

8562EC Spectrum Analyzer, 30 Hz to 13.2 GHz

8563EC Spectrum Analyzer, 9 kHz to 26.5 GHz

8564EC Spectrum Analyzer, 9 kHz to 40 GHz

8565EC Spectrum Analyzer, 9 kHz to 50 GHz

Options

To add options to a product, use the following ordering scheme:

Model: 856xEC (x = 0, 1, 2, 3, 4 or 5)

Example options: 8563EC-006, 8560EC-002

856xEC-001 Add Second IF Output (310.7 MHz); Rear Panel Connector

856xEC-002 Built-In Tracking Generator (8560EC)

856xEC-005 Add Alternate Sweep Out (cannot be used with Opt 002)

856xEC-006 Low End Range to 30 Hz (8563EC/64EC/65EC)

856xEC-008 Add Signal Identification

856xEC-026 APC-3.5 mm Input Connector (8563EC)

856xEC-042 Gray Spectrum Analyzer Backpack

856xEC-044 Yellow Spectrum Analyzer Backpack

856xEC-103 Delete Precision Frequency Reference

856xEC-104 Do Not Include Mass Memory Module

856xEC-B70 BenchLink Spectrum Analyzer Software

856xEC-908 Rackmount Kit without Handles

856xEC-909 Rackmount Kit with Handles

856xEC-910 Extra Manual Set

856xEC-915 Service Guide

856xEC-916 Extra Quick Reference Guide (English)

856xEC-1BP MIL-STD-45662A Calibration with test data

856xEC-UK6 Commercial Calibration (with data)

856xE-K35 ACPR Test Set (8561EC/62EC/63EC/64EC/65EC)

Accessories

85629B Test and Adjustment Module

85640A Tracking Generator (300 kHz to 2.9 GHz)

8449B 1 to 26.5 GHz Preamp

85700A 32 KB RAM Memory Card

85702A 128 KB RAM Memory Card

85671A Phase Noise Measurements Utility

85672A Spurious Response Measurements Utility

85710A Digital Radio Measurement Personality

85901A Portable AC Power Source

85902A Burst Carrier Trigger

8560EC

8561EC

8562EC

8563EC

8564EC

8565EC

- Accurate, automated ACP measurements on TDMA and TDD signals
- Measure according to NADC-TDMA, PDC, PHS, and other standards
- Measurement accelerators speed up ACP testing
- Carrier on/off power
- Total channel power, percent occupied bandwidth
- Burst-timing measurements



Setup menu for adjacent channel power measurements

In addition to the standard analog method for making ACP measurements (used for FM mobile telephones and continuous digital formats), the analyzers support four other methods used for burst-carrier measurements of TDMA and TDD signals:

- Peak (for PDC and PHS)
- Two-bandwidth (for PDC)
- Time-gated (for NADC-TDMA)
- Burst-power (an Agilent proprietary method)

The burst-power method overcomes many of the problems of the other standards, and is suitable for all formats. These methods can easily be adapted to measure other transmitters besides those used for cellular or cordless telephones. Configuration parameters that can be set by the user include channel spacing and bandwidth, number of alternate channels, burst period and width, and values for root-raised-cosine frequency weighting. Measurement results can be displayed in both graphic and tabular formats for ease of data interpretation and documentation. Measurement accelerators are available that give ACP results in just a few seconds, allowing real-time transmitter adjustments.

Carrier Power

The carrier power feature provides the user with a quick means of measuring the average “on” and “off” power of the burst carrier. This measurement is performed in the time domain, using zero span.

Channel Power

The channel power feature quickly provides the user with information on total power within a specified channel bandwidth, as well as power density within the channel. This feature greatly simplifies this common measurement, as the spectrum analyzer automatically performs the necessary integration across the desired frequency band.

Occupied Bandwidth

Occupied bandwidth is a way of determining the spectral spread of a signal. It is defined as the bandwidth which contains the specified percent of the total transmitted power. The user may specify the percentage to be anywhere from 0.1 to 99.99 percent.

Burst Timing

Complete timing measurements can be made on the burst-carrier signal using digitized, fast time-domain (zero span) sweeps. Using sweep times as fast as 50 μ s, edge times, burst width, and time between bursts can easily be measured.

More Information

More information about the 8560EC series spectrum analyzers, including ordering information, can be found on page 180.

Accurate and Easy-to-Use Power Measurements Using the 8560EC Series Spectrum Analyzers

Many wireless communications systems employ burst-carrier techniques such as time division multiple access (TDMA) and time division duplex (TDD) to maximize system capacity. The 8560EC series spectrum analyzers offer power measurements for both continuous and burst signals that are accurate, and easy to make. Measurement capability includes adjacent channel power (ACP), carrier power, channel power, and occupied bandwidth. These analyzers provide the greatest measurement flexibility and RF performance, making them powerful tools for R&D designers working with current wireless standards, or on systems with standards still under development.

The 8562EC Spectrum Analyzer

The 8562EC Spectrum Analyzer was designed specifically for digital communications. Its frequency coverage of 13.2 GHz means that now you can use the same analyzer for harmonic and spurious testing both in- and out-of-band. The increased dynamic range and third-order intercept (TOI) capability allows wireless communications engineers to test high-performance components in burst operation systems. See page 180 for details.

Measurement Utility Increases Speed and Repeatability

The 85672A Spurious Response Measurements Utility makes measurements fast and easy with the touch of a button. Works on all 8560EC series spectrum analyzers. See page 181 for details.

Adjacent Channel Power

The ability to measure ACP on wireless telephones, pagers, and other transmitters is critical in R&D, manufacturing and in the field. The 8560EC series spectrum analyzers provide ACP measurements for a variety of wireless communication systems, including support for NADC-TDMA, PDC, and PHS digital formats. Many of the implementation difficulties of the established standards have been addressed, providing fast, accurate, and easy-to-use ACP measurements. Use an 8560EC series spectrum analyzer with the 8563EC-K35 APCR test set to meet the needs of the emerging W-CDMA specifications.

- Exceptionally fast low-level spur search
- All-digital IF gives superior accuracy and linearity
- One-button RF power measurements with format-based setups
- Optional built-in phase noise and noise figure measurement personalities
- Optional measurement personalities for digital modulation analysis for 2G/3G applications



PSA Series Spectrum Analyzer

PSA Series High-Performance Spectrum Analyzer

The Agilent PSA series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a versatile feature set, and a leading-edge combination of flexibility, speed, accuracy, and dynamic range.

Measurement Accuracy

The PSA Series' modern instrument architecture features an all-digital IF section, a highly accurate internal reference signal, and automatic internal alignment processes to achieve unsurpassed accuracy, guaranteed by Agilent's high standards for meeting our published specifications.

Measurement Speed and Dynamic Range

The PSA Series spectrum analyzer is designed to optimize measurements for speed and dynamic range. With a 2-dB step attenuator and 160 resolution bandwidth settings (in 10% steps), you can customize each of your measurements to achieve the best combination of speed and dynamic range.

Swept Tuned or FFT Analysis

With the all-digital IF, the PSA can perform both swept or FFT measurements. FFT capability can significantly reduce the sweep time in narrow span measurements and low-level spur searches.

Phase Noise Optimization

Increase the dynamic range of your close-to-carrier measurements with the phase noise optimization feature of the PSA Series. Depending on how close to or far from the carrier you are measuring, the PSA has different LO phase lock loop configurations to reduce phase noise and therefore increase the dynamic range of your measurement.

Gated Sweep

Analyzer time varying signals such as pulsed RF, time division multiple access (TDMA), interleaved and burst-modulated with gated sweep capability. This type of time gating makes fast spectrum measurements on burst signals without interference from switching the carrier on and off.

One-Button Power Measurements

The PSA Series offers a standard suite of flexible, one-button RF and microwave power measurements with format based setups. With Power Suite, measurements that were once difficult and tedious to make are now executed with a single button press and provide easy-to-read results.

One-button measurements include:

- channel power
- occupied bandwidth
- adjacent channel power (ACP)
- multi-carrier ACP
- power statistics (CCDF)
- harmonic distortion
- burst power
- third order intercept (TOI)
- spurious emissions
- spectrum emission mask

Format-based setups for:

- IS-95A
- IS-95C
- 3GPP W-CDMA
- NADC
- *Bluetooth*
- W-LAN (802.11a/b/g)
- DVB-T
- J-STD-008
- GSM/EDGE
- cdma2000
- PDC
- TETRA
- W-LAN HiperLAN/2

Measurements Beyond Spectrum Analysis

The PSA Series offers a variety of optional measurement personalities to expand measurement capability. A measurement personality is a software program that can transform the spectrum analyzer into another type of test instrument, essentially giving it another "personality". You can make the most challenging measurements very easily and with the same instrument you use for spectrum analysis. Perform phase noise measurements for oscillator tests, measure the noise figure of your amplifier, or even perform modulation analysis on your 2G or 3G signal. If you have a proprietary modulated signal that you want to test, you can link the PSA to the 89601A vector signal analysis software for flexible demodulation and analysis.

Connectivity

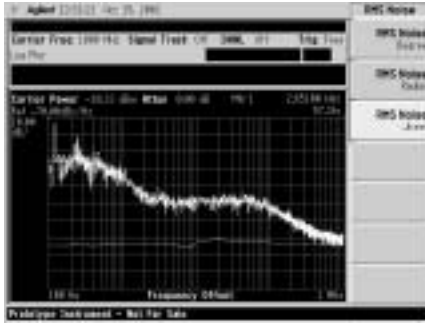
The PSA Series has built-in capability to network with PCs, printers, software programs, and test systems. Features include IVI-COM drivers for developing measurement routines and collecting results, IntuiLink connectivity software to transfer measurement results and screen captures directly into Microsoft® Excel and Word, a floppy disk drive to store results and display data, and GPIB and 10 baseT LAN for SCPI programming. You can also operate the analyzer remotely, anywhere in the world, using our BenchLink Web Remote control software (Option 230).

Upgrade from the HP8566B or HP8568B Analyzer

The PSA Series spectrum analyzers now offer programming code compatibility with the HP 8566/68B legacy spectrum analyzers. Option 266 was created to allow users with those legacy instruments to upgrade their automated test equipment (ATE) systems with modern and supportable ESA-E or PSA Series spectrum analyzers as the HP 8566/68B instruments reach the end of their formal support lives.

E4440A
E4443A
E4445A
E4446A
E4448A

Measurement Personalities



Phase Noise (Option 226)

This optional, built-in measurement personality consolidates advanced spectrum analysis capability and phase noise measurements into a single oscillator test. This flexible tool can quickly and easily generate plots of phase noise in dBc/Hz versus log offset frequency or measure jitter or make continuous spot frequency phase noise measurements.

5

Noise Figure (Option 219)

The noise figure measurement personality provides fast, one-button noise figure and gain measurements from 200 kHz up to 26.5 GHz. DUT setup menus help guide you easily through amplifier and mixer measurements, and a built-in measurement uncertainty calculator makes it easy to qualify your measurement system. An optional internal preamplifier (Option 1DS) improves instrument uncertainty to ± 0.05 dB for frequencies up to 3 GHz, so you can conveniently and accurately measure devices with low noise figure.

Digital Demodulation Hardware (Option B7J)

This option is required for all the cellular communications measurement personalities. It supplies a 1-dB electronic step attenuator for automatic optimization of speed and dynamic range and the basic measurement personality that provides spectrum and waveform analysis and I/Q pairs (10 MHz, 3 dB bandwidth) over GPIB or LAN.



W-CDMA (Option BAF)

The complexity of W-CDMA demands the flexibility and depth of demodulation capability provided by this measurement personality. Perform the following measurements on the HPSK uplink or downlink QPSK signals:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite rho and EVM)
- channel power
- adjacent channel power leakage ratio (ACLR)
- intermodulation distortion
- multi-carrier power
- spectrum emission mask
- occupied bandwidth
- CCDF

GSM with EDGE

This option includes both Global System for Mobile Communications (GSM) and Enhanced Data Rates for GSM Evolution (EDGE) measurements. The following measurements are quick, easy to make, and standards-based:

- transmit power
- power versus time (PvT)
- phase and frequency error
- EDGE EVM
- output RF spectrum (ORFS)
- transmitter band spurious

cdma2000

The cdma2000 measurement personality offers the logical upgrade path from IS-95 to IS-2000 testing. Measurements support the forward and reverse links:

- code domain analysis
- QPSK EVM
- modulation accuracy (composite rho and EVM)
- channel power
- adjacent channel power ratio
- intermodulation distortion
- spectrum emission mask
- occupied bandwidth
- CCDF

1xEV-DO

The evolution to cdma2000 with 1xEV-DO introduces unique measurement capability. The following measurements are based on TIA/EIA/IS-2000.2 standards and are available for the forward and reverse link signals:

- code domain power
- modulation accuracy (composite rho)
- QPSK EVM
- PvT
- channel power
- intermodulation distortion
- spurious emissions and ACP
- occupied bandwidth
- CCDF

cdmaOne

Built on Agilent's pioneering efforts in CDMA measurement techniques, this personality provides quick and easy measurement setups for the TIA/EIA/IS-95 standards:

- modulation accuracy (rho)
- code domain analysis
- channel power
- adjacent channel power ratio
- close-in spurious

NADC/PDC

Both the North American Digital Cellular (NADC) and Personal Digital Cellular (PDC) measurement personalities are included in this option. The NADC measurements are structured according to the IS-136 TDMA standard. Measurements included in this option are:

- adjacent channel power
- error vector magnitude
- occupied bandwidth (for PDC)

Frequency Specifications

Frequency Range

E4443A	(DC coupled) 3 Hz to 6.7 GHz (AC coupled) 10 MHz to 6.7 GHz
E4445A	(DC coupled) 3 Hz to 13.2 GHz (AC coupled) 10 MHz to 13.2 GHz
E4440A	(DC coupled) 3 Hz to 26.5 GHz (AC coupled) 10 MHz to 26.5 GHz
E4446A	(DC coupled) 3 Hz to 44 GHz
E4448A	(DC coupled) 3 Hz to 50 GHz

Band	Harmonic Mixing Mode (N)	Frequency Range
0	1-	3 Hz to 3 GHz
1	1-	2.85 GHz to 6.6 GHz
2	2-	6.2 GHz to 13.2 GHz
3	4-	12.8 GHz to 19.2 GHz
4	4-	18.7 GHz to 26.8 GHz
5	4+	26.4 GHz to 31.15 GHz
6	8-	31.0 GHz to 50.0 GHz

Frequency Reference

Accuracy	$\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}]$
Aging rate	$\pm 1 \times 10^{-7}/\text{year}$
Temperature stability	$\pm 1 \times 10^{-8}$ (20° C to 30° C) $\pm 5 \times 10^{-8}$ (0° C to 55° C)
Calibration accuracy	$\pm 7 \times 10^{-8}$

Frequency Readout Accuracy (start, stop, center, marker)
 $\pm(\text{marker frequency} \times \text{frequency reference accuracy} + 0.25 \text{ percent} \times \text{span} + 5 \text{ percent} \times \text{RBW} + 2 \text{ Hz} + 0.5 \times \text{horizontal resolution}^*)$
 *Horizontal resolution is span/(sweep points - 1)

Marker Frequency Counter

Accuracy	$\pm(\text{marker frequency} \times \text{frequency reference accuracy} + 0.100 \text{ Hz})$
Delta counter accuracy	$\pm(\text{delta frequency} \times \text{frequency reference accuracy} + 0.141 \text{ Hz})$
Counter resolution	0.001 Hz

Frequency Span (FFT and swept mode)

Range	0 Hz (zero span), 10 Hz to maximum frequency of model
Resolution	2 Hz
Accuracy	$\pm[0.2 \text{ percent} \times \text{span} + \text{span}/(\text{sweep points} - 1)]$

Sweep Time and Triggering

Range:	
Span = 0 Hz	1 μ s to 6000 s
Span \geq 10 Hz	1 ms to 2000 s
Accuracy	
Span \geq 10 Hz, sweep	± 0.01 % nominal
Span \geq 10 Hz, FFT	± 40 % nominal
Span = 0 Hz	± 0.01 % nominal
Trigger	Free run, line, video, RF burst, external front, external rear
Trigger delay	
Span = 0 Hz, or FFT	-150 ms to +500 ms
Span \geq 10 Hz, swept	1 μ s to 500 ms
Resolution	0.1 μ s

Sweep (trace) Point Range

Span = 0 Hz	2 to 8192
Span \geq 10 Hz	101 to 8192

Gated FFT

Maximum span	10 MHz
Delay range	-150 to +500 ms
Delay resolution	100 ns or 4 digits whichever is more
Gate duration	1.83/RBW ± 2 % nominal

Resolution Bandwidth (RBW)

Range (-3.01 dB bandwidth)	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz
Bandwidth accuracy (power):	
RBW range:	
1 Hz to 51 kHz	± 0.5 % (± 0.022 dB)
56 kHz to 75 kHz	± 1.0 % (± 0.044 dB)
82 kHz to 330 kHz	± 0.5 % (± 0.022 dB)
360 kHz to 1.2 MHz (<3 GHz CF)	± 1.0 % (± 0.044 dB)
1.3 MHz to 2.0 MHz (<3 GHz CF)	± 0.07 dB nominal
2.2 MHz to 6.0 MHz (<3 GHz CF)	± 0.02 dB nominal

Bandwidth accuracy (-3.01 dB):	
RBW range 8 MHz (<3 GHz CF)	± 15 % nominal
Selectivity (-60 dB/-3 dB)	4:1:1 nominal

Information Bandwidths

Maximum FFT width	10 MHz
I/Q waveform digital output bandwidth (Option E444xA-B7J)	10 MHz
321.4 MHz IF output:	
-1 dB bandwidth	20 to 30 MHz nominal
-3 dB bandwidth	30 to 60 MHz nominal
70 MHz IF output (Option E444xA-H70):	
-1 dB bandwidth	20 to 30 MHz nominal
-3 dB bandwidth	30 to 60 MHz nominal

Video Bandwidth (VBW)

Range	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz and wide open
Accuracy	± 6 % nominal

Stability

Noise sidebands (20° C to 30° C, CF = 1 GHz)		
Offset	Specification	Typical
100 Hz	-91 dBc/Hz	-97 dBc/Hz
1 kHz	-103 dBc/Hz	-107 dBc/Hz
10 kHz	-114 dBc/Hz	-117 dBc/Hz
30 kHz	-114 dBc/Hz	-117 dBc/Hz
100 kHz	-120 dBc/Hz	-123 dBc/Hz
1 MHz	-144 dBc/Hz	-146 dBc/Hz
		-148 dBc/Hz nominal
6 MHz	-151 dBc/Hz	-152 dBc/Hz
		-156 dBc/Hz nominal
10 MHz	-151 dBc/Hz	-152 dBc/Hz
		-157.5 dBc/Hz nominal

Residual FM <(1 Hz X N) p-p in 1 s
 See frequency range for N (harmonic number)

Amplitude Specifications

Amplitude Range	
Measurement range	Displayed average noise level (DANL) to maximum safe input level 0 to 70 dB in 2 dB steps
Input attenuator range	
Maximum Safe Input Level	
Average total power	+30 dBm (1 W)
Preamp (Option E444xA-1DS)	+25 dBm
Peak pulse power	
<10 μ s pulse width, <1 % duty cycle and input attenuation ≥ 30 dB	+50 dBm (100 W)
DC volts:	
DC coupled	$\leq \pm 0.2$ Vdc
AC coupled (E4443A, E4445A, E4440A only)	± 100 Vdc

1 dB Gain Compression (Two-Tone)

	Total Power at Input Mixer
20 MHz to 200 MHz	0 dBm
	+3 dBm nominal
200 MHz to 3 GHz	+3 dBm
	+7 dBm nominal
3 GHz to 6.6 GHz	+3 dBm
	+4 dBm nominal
6.6 GHz to 26.5 GHz	-2 dBm
	0 dBm nominal
26.5 GHz to 50 GHz	0 dBm nominal
Preamp on (Option E444xA-1DS):	
10 MHz to 200 MHz	-30 dBm nominal
200 MHz to 3 GHz	-25 dBm nominal

Typical Gain Compression (Two-Tone)

	Mixer Level	Compression
20 MHz to 200 MHz	0 dBm	<0.5 dB
200 MHz to 6.6 GHz	+3 dBm	<0.5 dB
6.6 GHz to 26.5 GHz	-2 dBm	<0.4 dB

E4440A
E4443A
E4445A
E4446A
E4448A

E4440A
E4443A
E4445A
E4446A
E4448A

Displayed Average Noise Level (DANL)

(Input terminated, sample or average detector, averaging type = Log, 20 to 30°C, zero span, swept normalized to 1 Hz RBW, 0 dB attenuation)

E4443A/E4445A/E4440A		Typical
3 Hz to 1 kHz	—	-110 dBm nominal
1 kHz to 10 kHz	—	-130 dBm nominal
10 kHz to 100 kHz	-135 dBm	-142 dBm
100 kHz to 1 MHz	-145 dBm	-149 dBm
1 MHz to 10 MHz	-150 dBm	-153 dBm
10 MHz to 1.2 GHz	-155 dBm	-156 dBm
1.2 GHz to 2.5 GHz	-154 dBm	-155 dBm
2.5 GHz to 3.0 GHz	-153 dBm	-154 dBm
3 GHz to 6.6 GHz	-152 dBm	-153 dBm
6.6 GHz to 13.2 GHz	-150 dBm	-152 dBm
13.2 GHz to 20 GHz	-147 dBm	-149 dBm
20 GHz to 26.5 GHz	-143 dBm	-145 dBm

Preamp ON (Option E4443/5/0A-1DS)		
100 kHz to 200 kHz	-161 dBm	-164 dBm
200 kHz to 500 kHz	-164 dBm	-167 dBm
500 kHz to 10 MHz	-166 dBm	-168 dBm
10 MHz to 1.1 GHz	-169 dBm	-170 dBm
1.1 GHz to 2.5 GHz	-168 dBm	-169 dBm
2.5 GHz to 3.0 GHz	-166 dBm	-167 dBm

E4446A/E4448A		
3 Hz to 1 kHz	—	-110 dBm nominal
1 kHz to 10 kHz	—	-130 dBm nominal
10 kHz to 100 kHz	-140 dBm	-143 dBm
100 kHz to 1 MHz	-145 dBm	-150 dBm
1 MHz to 10 MHz	-150 dBm	-155 dBm
10 MHz to 1.2 GHz	-154 dBm	-155 dBm
1.2 GHz to 2.2 GHz	-153 dBm	-154 dBm
2.2 GHz to 3 GHz	-152 dBm	-153 dBm
3 GHz to 6.6 GHz	-151 dBm	-152 dBm
6.6 GHz to 13.2 GHz	-146 dBm	-149 dBm
13.2 GHz to 20 GHz	-145 dBm	-147 dBm
20 GHz to 22.5 GHz	-143 dBm	-146 dBm
22.5 GHz to 26.8 GHz	-140 dBm	-144 dBm
26.8 GHz to 31.15 GHz	-142 dBm	-145 dBm
31.15 GHz to 36 GHz	-134 dBm	-136 dBm
36 GHz to 38 GHz	-129 dBm	-132 dBm
38 GHz to 44 GHz	-131 dBm	-134 dBm
44 GHz to 49 GHz	-128 dBm	-131 dBm
49 GHz to 50 GHz	-127 dBm	-130 dBm

Preamp ON (Option E4446/8A-1DS)		
100 kHz to 200 kHz	-160 dBm	-164 dBm
200 kHz to 500 kHz	-163 dBm	-167 dBm
500 kHz to 10 MHz	-164 dBm	-168 dBm
1 MHz to 10 MHz	-167 dBm	-169 dBm
10 MHz to 1.2 GHz	-167 dBm	-169 dBm
1.2 GHz to 2.2 GHz	-166 dBm	-168 dBm
2.2 GHz to 3.0 GHz	-164 dBm	-166 dBm

Display Range

Log scale	0.1 to 1 dB/division in 0.1 dB steps 1 to 20 dB/division in 1 dB steps (10 display divisions)
Linear scale	10 divisions
Scale units	dBm, dBmV, dBuV, V, and W

Frequency Response

(10 dB input attenuation, 20 to 30°C, preselector centering applied)

E4443A/E4445A/E4440A		Typical
3 Hz to 3 GHz	±0.38 dB	±0.11 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.0 dB
22 GHz to 26.5 GHz	±2.50 dB	±1.3 dB
E4446A/E4448A		
3 Hz to 3 GHz	±0.38 dB	±0.15 dB
3 GHz to 6.6 GHz	±1.50 dB	±0.6 dB
6.6 GHz to 22 GHz	±2.00 dB	±1.2 dB
22 GHz to 26.8 GHz	±2.50 dB	±1.3 dB
26.4 GHz to 31.15 GHz	±1.75 dB	±0.6 dB
31.15 GHz to 50 GHz	±2.50 dB	±1.0 dB

Frequency response at attenuation ≈ 10 dB

(Atten = 20, 30, or 40 dB)

10 MHz to 2.2 GHz	±0.53 dB
2.2 GHz to 3 GHz	±0.69 dB

Preamp on (Option E444xA-1DS), (for all models)

100 kHz to 3 GHz	±0.70 dB	<(±0.30 dB typical)
------------------	----------	---------------------

Input Attenuation Switching Uncertainty

(Attenuator setting ≥2 dB)

At 50 MHz	±0.18 dB
3 Hz to 3 GHz	±0.3 dB nominal
3 GHz to 13.2 GHz	±0.5 dB nominal
13.2 GHz to 26.5 GHz	±0.7 dB nominal
26.5 GHz to 50 GHz	±1.0 dB nominal

Absolute Amplitude Accuracy

(10 dB attenuation, 20 to 30°C, 10 Hz ≤RBW ≤1 MHz, input signal -10 to -50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale)

At 50 MHz	±0.24 dB (±0.06 dB typical)
At all frequencies	±(0.24 dB + frequency response)
	±(0.06 dB + frequency response) typical
3 Hz to 3 GHz (95% confidence)	±0.24 dB
Preamp on (Option E444xA-1DS)	±(0.36 dB + frequency response)
	±(0.09 dB + frequency response) typical

Input Voltage Standing Wave Ratio (VSWR)

(≥8 dB input attenuation)

50 MHz to 3 GHz	<1.2:1 nominal
3 GHz to 18 GHz	<1.6:1 nominal
18 GHz to 26.5 GHz	<1.9:1 nominal
26.5 GHz to 50 GHz	<1.6:1 nominal
Preamp on (50 MHz to 3 GHz)	
(≥10 dB attenuation)	<1.2:1 nominal

Resolution Bandwidth Switching Uncertainty

(referenced to 30 kHz RBW)

1 Hz to 1 MHz RBW	±0.03 dB
1.1 MHz to 3 MHz RBW	±0.05 dB
4, 5, 6, 8 MHz RBW	±1.0 dB

Reference Level

Range:

Log scale	-170 dBm to +30 dBm in 0.01 dB steps
Linear scale	707 pV to 7.07 V in 0.1% steps
Accuracy	0 dB

Display Scale Switching Uncertainty

Switching between linear

and log	0 dB
Log scale/div switching	0 dB

Display Scale Fidelity

≤-20 dBm input mixer level	±0.07 dB total
-20 dBm < mixer level ≤ -10 dBm	±0.13 dB total

Spurious Response (mixer level = -40 dBm)

General spurious:

f < 10 MHz from carrier	(-73 + 20 log N) dBc
f ≥ 10 MHz from carrier	(-80 + 20 log N) dBc
	(-90 + 20 log N) dBc typical

See frequency range for N

Second Harmonic Distortion (SHI)

Model	Distortion (dBc)	SHI (dBm)
E4443A, E4445A, E4440A	-82	+42
10 MHz to 400 MHz (-40 dBm mixer level)		
400 MHz to 1.25 GHz (-40 dBm mixer level)	-92	+52
1.25 GHz to 1.5 GHz (-40 dBm mixer level)	-82	+42
1.5 GHz to 2.0 GHz (-10 dBm mixer level)	-90	+80
2.0 GHz to 13.25 GHz (-10 dBm mixer level)	-100	+90

Model	Distortion (dBc)	SHI (dBm)
E4446A, E4448A	-82	+42
10 MHz to 400 MHz (-40 dBm mixer level)		
400 MHz to 1.25 GHz (-40 dBm mixer level)	-91	+51
1.25 GHz to 1.5 GHz (-40 dBm mixer level)	-81	+41
1.5 GHz to 2.0 GHz (-10 dBm mixer level)	-90	+80
2.0 GHz to 3.25 GHz (-10 dBm mixer level)	-94	+84
3.25 GHz to 13.25 GHz (-10 dBm mixer level)	-96	+86
13.25 GHz to 25 GHz (-10 dBm mixer level)	-100 nominal	+90 nominal

Preamp on (Option E444xA-1DS), (for all models, input preamp level = -45 dBm)

10 MHz to 1.5 GHz	-60 nominal	+15 nominal
-------------------	-------------	-------------

Third-Order Intermodulation Distortion (TOI)

(two -30 dBm tones at input mixer with tone separation >15 kHz, 20 to 30 °C)

Model	Distortion (dBc)	TOI (dBm)
E4443A/E4445A/E4440A	-88	+14 (+17 typical)
10 MHz to 100 MHz	-90	+15 (+18 typical)
100 MHz to 400 MHz	-92	+16 (+19 typical)
400 MHz to 1.7 GHz	-94	+17 (+19 typical)
1.7 GHz to 3.0 GHz	-90	+15 (+18 typical)
3.0 GHz to 6.0 GHz	-76	+8 (+11 typical)
6.0 GHz to 16 GHz	-84	+12 (+14 typical)

Model	Distortion (dBc)	TOI (dBm)
E4446A/E4448A	-90	+15 (+20 typical)
10 MHz to 100 MHz	-92	+16 (+21 typical)
100 MHz to 400 MHz	-94	+17 (+20 typical)
400 MHz to 1.7 GHz	-96	+18 (+21 typical)
1.7 GHz to 3.0 GHz	-92	+16 (+21 typical)
3.0 GHz to 6.0 GHz	-84	+12 (+15 typical)
6.0 GHz to 16 GHz	-84	+12 (+16 typical)
16.0 GHz to 26.5 GHz	-85 nominal	+12.5 nominal
26.5 GHz to 50 GHz		

Preamp on (Option E444xA-1DS, for all models, two -45 dBm tones at preamp input)

10 MHz to 500 MHz	-15 nominal
500 MHz to 3 GHz	-13 nominal

Residual Responses

Input terminated and 0 dB attenuation	
200 kHz to 6.6 GHz	-100 dBm
6.6 GHz to 26.8 GHz	-100 dBm nominal
26.8 GHz to 50 GHz	-90 dBm nominal

Trace Detectors

Normal, peak, sample, negative peak, log power average, RMS average, and voltage average

Option E444xA-1DS, Preamplifier

Frequency range	100 kHz to 3 GHz
Gain	28 dB nominal
Noise figure	7 dB nominal

Measurement Speed

Local measurement and display update rate	≥50/s nominal
Remote measurement and GPIB transfer rate	
101 sweep points	≥45/s nominal
401 sweep points	≥30/s nominal
601 sweep points	≥25/s nominal

Power Suite Measurement Specifications

Channel Power
Amplitude accuracy, W-CDMA or IS95 (20 to 30 °C, mixer level <-20 dBm) ±0.68 dB (±0.21 dB typical)

Occupied Bandwidth
Frequency accuracy ± [span/600] nominal

Adjacent Channel Power
Accuracy, W-CDMA (ACLR) (at specific mixer levels and ACLR ranges):

	Adjacent	Alternate
MS	±0.12 dB	±0.17 dB
BTS	±0.22 dB	±0.22 dB

Dynamic range (typical):
w/o noise correction -74.5 dB -82 dB
w/noise correction -81 dB -88 dB
Offset channel pairs measured 1 to 6

Multi-Carrier Power and ACP

ACPR dynamic range, W-CDMA (5 MHz offset, RRC weighted, 3.84 MHz noise bandwidth):

Two carriers	-70 dB nominal
Four carriers	-68 dB nominal

ACPR accuracy (two carriers, 5 MHz offset, -48 dBc ACPR) ±0.38 dB nominal

Multiple number of carriers measured Up to 12

Power Statistics CCDF

Histogram resolution 0.1 dB

Harmonic Distortion

Maximum harmonic number 10th
Results Fundamental power (dBm), relative harmonics power (dBc), total harmonic distortion in percent

Intermod (TOI)

Measure the third-order products and intercepts from two tones

Burst Power

Methods Power above threshold, power within burst width
Results Single burst output power, average output power, maximum power, minimum power within burst, burst width

Spurious Emission

cdma2000 or W-CDMA (1980 MHz region, 1.2 MHz RBW)
Table driven spurious signals; search across regions.
Relative dynamic range 80.6 dB (82.4 dB typical)
Absolute sensitivity -89.7 dBm (-91.7 dBm typical)

Spectrum Emission Mask (SEM)

cdma2000 (750 kHz offset):
Relative dynamic range (30 kHz RBW) 85.3 dB (88.3 dB typical)
Absolute sensitivity -105.7 dBm (-107 dBm typical)
Relative accuracy ±0.09 dB
3GPP W-CDMA (2.515 MHz offset):
Relative dynamic range (30 kHz RBW) 87.3 dB (89.5 dB typical)
Absolute sensitivity -105.7 dBm (-107.7 dBm typical)
Relative accuracy ±0.10 dB

E4440A
E4443A
E4445A
E4446A
E4448A

E4440A
E4443A
E4445A
E4446A
E4448A**General Specifications****Temperature Range**

Operating	0 °C to +55 °C
Storage	-40 °C to +75 °C

EMI Compatibility

Conducted interference is in compliance with CISPR Pub 11/1990
Group 1 Class A
Radiated emission is in compliance with CISPR Pub 11/1990
Group 1 Class B

Audio Noise

ISO 7779	LNPE <5.0 BELS at 25 °C
----------	-------------------------

Military Specification

Type tested to environmental specifications MIL-PRF-28800F Class 4

Power Requirements

Voltage and frequency:
100 to 132 Vrms, 47 to 66 Hz/360 to 440 Hz
195 to 250 Vrms, 47 to 66 Hz

Power consumption:	
On	<260 watts, no options (<450 watts, all options)
Standby	<20 watts

Weight (without options)

E4443A, E4445A, E4440A	
Net	23 kg (50 lbs) nominal
Shipping	33 kg (73 lbs) nominal
E4446A, E4448A	
Net	24 kg (53 lbs) nominal
Shipping	34 kg (76 lbs) nominal

Dimensions

Height	177 mm (7.0 in)
Width	426 mm (16.8 in)
Length	483 mm (19 in)

Warranty

The E4440A, E4443A, E4445A, E4446A and E4448A are supplied with a three-year warranty.

Calibration Cycle

The recommended calibration cycle is one year. Calibration services are available through Agilent service centers.

Input and Outputs**Front Panel****RF Input**

Connector:	
E4443A/E4445A	Type-N female, 50 Ω
E4440A	Type-N female, 50 Ω
E4440A-BAB	APC 3.5 male
E4446A/E4448A	2.4 mm male, 50 Ω

Probe Power

Voltage/current (nominal)	+15 Vdc, ±7 % at 150 mA max -12.6 Vdc, ±10 % at 150 mA max GND Reserved for future applications
---------------------------	---

Headphone**Ext Trigger Input**

Connector	BNC female
Impedance	10 kΩ nominal
Trigger level	5 V TTL nominal

Rear Panel**10 MHz OUT (switched)**

Connector	BNC female, 50 Ω
Output amplitude	≥0 dBm nominal
Frequency accuracy	10 MHz ±(10 MHz x frequency reference accuracy)

Ext Ref In

Connector	BNC female, 50 Ω
Input amplitude range	-5 to +10 dBm nominal
Input frequency	1 to 30 MHz nominal
Frequency lock range	±5 x 10 ⁻⁶ of specified external reference input frequency

Trigger In

Connector	BNC female
-----------	------------

External trigger input:

Impedance	>10 kΩ nominal
Trigger level	5 V TTL

Trigger 1 and Trigger 2 Outputs

Connector	BNC female
Trigger 1 output:	HSWP (high = sweeping)
Impedance	50 Ω nominal
Level	5 V TTL
Trigger 2 output	Reserved for future applications

Monitor Output

Connector	VGA compatible, 15-pin mini D-SUB
Format	VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB 640 X 480

Resolution**Noise Source Drive Output**

Connector	BNC female
Output voltage	
On	28.0 ±0.1 V (60 mA maximum)
Off	<1 V

Remote Programming**GPIO interface:**

Connector	IEEE-488 bus connector
GPIO codes	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, and C28, DT1, L4, C0
Serial interface connector	9-pin D-SUB male (factory use only)
LAN TCP/IP interface	RJ45 Ethertwist

Parallel Printer Interface Connector**25-pin D-SUB female****321.4 MHz IF Output**

Connector	SMA female, 50 Ω nominal
Frequency	321.4 MHz nominal
Conversion gain	+2 to +4 dB nominal

Key Literature & Web Link

Product Literature

PSA Series, brochure, literature number 5980-1283E
 PSA Series, data sheet, literature number 5980-1284E
 Self-Guided Demonstration for Spectrum Analysis, product note, literature number 5988-0735EN
 Phase Noise Measurement Personality, technical overview, literature number 5988-3698EN
 Noise Figure Measurement Personality, technical overview, literature number 5988-7884EN
 W-CDMA Measurement Personality, technical overview, literature number 5988-2388EN
 GSM with EDGE Measurement Personality, technical overview, literature number 5988-2389EN
 cdma2000 Measurement Personality, technical overview, literature number 5988-3694EN
 1xEV-DO Measurement Personality, technical overview, literature number 5988-4828EN
 cdmaOne Measurement Personality, technical overview, literature number 5988-3695EN
 NADC/PDC Measurement Personality, technical overview, literature number 5988-3697EN
 Optimizing Dynamic Range for Distortion Measurements, product note, literature number 5980-3079EN
 PSA Series Amplitude Accuracy, product note, literature number 5980-3080EN
 PSA Series Swept and FFT Analysis, product note, literature number 5980-3081EN
 PSA Series Measurement Innovations and Benefits, product note, literature number 5980-3082EN
 8 Hints for Millimeter Wave Spectrum Measurements, application note, literature number 5988-5680EN
 PSA Series Spectrum Analyzers, Option H70, 70 MHz IF Output, product overview, literature number 5988-5261EN
 PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software, product note, literature number 5988-5015EN
 89600 Series + PSA, 802.11A and HiperLAN2 ODFM Measurements, product note, literature number 5988-4094EN

Related Literature

Selecting the Right Signal Analyzer for Your Needs, selection guide, literature number 5968-3413E
 BenchLink Web Remote Control Software, product overview, literature number 5988-2610EN
 IntuiLink Software, Data Sheet, Literature Number 5980-3115EN

For more information on the PSA Series, please visit:
www.agilent.com/find/psa

Ordering Information

PSA Series Spectrum Analyzer

E4443A 3 Hz to 6.7 GHz
 E4445A 3 Hz to 13.2 GHz
 E4440A 3 Hz to 26.5 GHz
 E4446A 3 Hz to 44 GHz
 E4448A 3 Hz to 50 GHz

Options

To add options to a product, use the following ordering scheme:
 Model: E444xA (x = 0, 3, 5, 6 or 8)
 Example options: E4440A-B7J, E4448A-1DS

Digital Demodulation Hardware

E444xA-B7J: Digital demodulation hardware (required for digital demodulation measurement personalities)

Digital Demodulation Measurements

E444xA-BAF W-CDMA measurement personality
 E444xA-202 GSM w/ EDGE measurement personality
 E444xA-B78 cdma2000 measurement personality
 E444xA-204 1xEV-DO measurement personality
 E444xA-BAC cdmaOne measurement personality
 E444xA-BAE NADC, PCD measurement personality

General Purpose Measurements

E444xA-226 Phase noise measurement personality
 E444xA-219 Noise figure measurement personality

Amplifiers

E444xA-1DS 100 kHz to 3 GHz built-in preamplifier

Inputs and Outputs

E4440A-BAB Replaces type "N" input connector with APC 3.5 connector

Connectivity Software

E444xA-230 BenchLink Web Remote Control Software

Code Compatibility

E444xA-266 HP 8566B/8568B code compatibility measurement personality

Accessories

E444xA-1CM Rackmount kit
 E444xA-1CN Front handle kit
 E444xA-1CP Rackmount with handles
 E444xA-1CR Rack slide kit
 E444xA-045 Millimeter wave accessory kit
 E444xA-0B1 Extra manual set including CD ROM

Warranty and Service

Standard warranty is 3 years. For warranty and service of 5 years, please order R-51B-001-5F: "3 year Return-to-Agilent warranty extended to 5 years" (quantity = 1).

Calibration¹

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration

R-50C-002 Standards compliant calibration

E444xA-OBW Service manual and calibration software

E444xA-UK6 Commercial calibration certificate with test data

¹Options not available in all countries

E4440A
 E4443A
 E4445A
 E4446A
 E4448A

E4406A VSA Transmitter Tester

- Spectrum, time and code domain measurements
- One-button, standard-based measurements
- Fast measurement speed and excellent accuracy for volume manufacturing
- RF (7 MHz to 4 GHz) and baseband IQ inputs (optional, 5 Hz to 10 MHz)



The Agilent E4406A transmitter tester is a full-featured transmitter tester designed to meet the test needs of wireless equipment developers and manufacturers. The E4406A VSA offers high performance in-band and spectrum measurements for multiple 2G, 2.5G and 3G wireless communications formats with powerful one-button standard-based measurements, and the best combination of speed and accuracy. Its speed and affordable price make it well suited for volume production. Extensive one-button measurement personalities, superior accuracy and optional baseband IQ inputs provide unparalleled convenience for design verification and manufacturing.

The E4406A VSA is easy to use regardless of your level of expertise. Measurements are accessible at the touch of a button and are easily configured with the simple, straightforward menu structure. The VSA comes standard with the following measurement capabilities: spectrum (frequency domain) analysis, waveform (time domain) analysis, adjacent channel power (ACP), complimentary cumulative distribution function (CCDF), channel power, occupied bandwidth, and link capability to the 89601A Vector Signal Analysis software. Agilent continues to improve the E4406A performance by enhancing and upgrading firmware and measurement personalities.

For the latest enhancements of E4406A VSA firmware and personalities, please visit our web site: www.agilent.com/find/vsa

W-CDMA Personality

Option BAF provides W-CDMA transmitter measurements based on the 3GPP Technical Specification Group TS25.141 (2002-06) and TS34.121 (2002-06). Measurements may be performed on the HPSK uplink or downlink QPSK signals. New enhancements to this personality support measurements of compressed mode, all slot formats, discontinuous transmission, STTD antenna, and new measurements of power control (waveform and chip power) and power versus time for periodical burst signals. The system automatically determines active channels on any code layer. It can display the code domain power information in a composite multi-rate view. The composite EVM measurement capability enables users to perform EVM measurements for perch signal and other channels.

Measurements

- Channel power
- Multi-carrier power
- Spectrum emission mask
- Adjacent channel leakage ratio (ACLR)
- Inter-modulation distortion
- Power statistics using the complimentary cumulative distribution function (CCDF)
- Compressed mode
- Modulation accuracy
- QPSK EVM
- Composite EVM
- Code domain analysis
- Occupied bandwidth



cdma2000 Personality

Option B78 provides cdma2000 transmitter measurements based on the 3GPP2 Technical Specification Group CDMA2000 (TSG-C) specifications (C.S0010-A and C.S0011-A, March 2001). Measurements may be performed for the forward and reverse link signals IS-2000 standards. New enhancements to this personality support multi-carrier measurements for code domain, modulation accuracy and QPSK EVM. The advanced code domain analysis algorithms allow the Walsh code to be displayed for either Haddamard or OVSV coding schemes resulting in composite multi-rate views. The decoding algorithm automatically determines active channels of any code layer. The active channel identification allows users to examine and analyze unknown signals easily. The composite EVM feature enables users to perform EVM measurement for the pilot and other channels.

Measurements

- Channel power
- Adjacent channel power ratio (ACPR)
- Spectrum emission mask
- Occupied bandwidth
- Power statistics using the complimentary cumulative distribution function (CCDF)
- Code domain analysis
- Modulation accuracy
- QPSK EVM
- Inter-modulation distortion



cdmaOne Personality

Option BAC provides cdmaOne transmitter measurements based on the IS-95A, J-STD-008, and IS-97D/98D standards. New enhancements to this personality support all radio standards and band classes for ACPR and SpurClose measurements. The supported standards are IS-95A, J-STD-008 and IS-97D IS-98D with Band Class 0 (800 MHz), 1 (1900 MHz), 3 (JTACS) and 4 (Korean PCS). Along with the fast ACPR measurements, this personality features PN (pseudo-noise sequence) search, time offset, and carrier feed-through analysis.

Measurements

- Channel power
- Adjacent channel power ratio (ACPR)
- Spur
- Code domain analysis
- Modulation accuracy

1xEV-DO Personality

Option 204 provides 1xEV-DO transmitter measurements based on 3GPP2 Technical Specification Group cdma2000 (TSG-C) specifications (C.S0032-A and C.S0033-A, December 2001). Measurements may be performed on the forward and reverse link signals. New enhancements to this personality support preamble auto detection of forward link signals, code domain and modulation accuracy of reverse link signals, and multi-carrier measurements. For the forward link, the PvT mask and spurious emissions/ ACP measurement support both idle slot (burst signal) and active slot (full power signal). With the auto-burst search function, users can see the standard-based time mask for the 1xEV-DO idle slot in PvT. Code domain, modulation accuracy (composite rho), and QPSK EVM can also measure for each channel's pilot, MAC, and Data in QPSK/8PSK/16QAM. For the reverse link, code domain and modulation analysis provide powerful modulation analysis functions for transmitter tests.

Measurements

- Channel power
- Power versus time mask Code domain analysis
- Spurious emission & ACP
- Power statistics using the complimentary cumulative distribution function (CCDF)
- Code domain analysis
- Modulation analysis
- QPSK EVM
- Occupied bandwidth
- Inter-modulation distortion



GSM Personality

Option BAH (GSM) and option 202 (EDGE with GSM) provide GSM transmitter measurements based on latest ETSI standards. The GSM (global system for mobile communications) digital cellular standard is a time division multiple access (TDMA) multiplexing scheme that uses Gaussian minimum shift keying (GMSK) modulation. Making GSM measurements and meeting standards requirements presents unique challenges. The personality features easy channel and timeslot selections, configurable PvT masks, and a typical ORFS dynamic range of 90 dB. New enhancements to these personalities support baseband I/Q inputs and faster measurement speed of ORFS and

PFER. The E4406A VSA with option 300 (341.4 MHz IF output) becomes the down converter for ESG (E4438C) with option 300 to perform GSM/EDGE bit error rate test.

Measurements

- GMSK power versus time
- Phase and frequency error (PFER)
- Output RF spectrum (ORFS)
- Channel plans for 400, 700, 800, 900, 1800, 1900 MHz
- Mean transmit carrier power
- GMSK transmitter band spurious
- IQ offset

EDGE (with GSM) Personality

Option 202 (EDGE with GSM) provides EDGE transmitter measurements based on latest standards. The advanced demodulation algorithms allow the users to rapidly view an EDGE constellation diagram and display the EVM results using the industry standard specified measurement filter. New enhancements to these personalities support baseband I/Q input and faster measurement speed of ORFS and PFER.

Measurements

- Error vector magnitude (EVM)
- Output RF spectrum (ORFS)
- IQ offset
- Channel plans for 400, 700, 800, 900, 1800, 1900 MHz
- IQ offset
- Multi slot power versus time
- All GSM measurement of option BAH



NADC/PDC Personality

Option BAE provides both North American Digital Cellular (NADC) and Personal Digital Cellular (PDC) transmitter measurement based on latest standards. The NADC measurements are structured according to the IS-136 TDMA standard.

Measurements

- Adjacent channel power (ACP)
- Modulation quality
- Occupied bandwidth

iDEN Personality

Option HN1 provides iDEN transmitter measurement based on the Motorola iDEN specialized mobile radio format.

Measurements

- Occupied bandwidth
- Adjacent channel power ratio (ACPR)
- Transmitter bit error rate (BER)

E4406A VSA Transmitter Tester

Baseband IQ Inputs

The option B7C baseband IQ inputs enables users to measure the complete path of a receiver or transmitter and directly compare signals both before and after frequency conversion and IQ (de)modulation. Ideally suited for R&D engineers and manufacturing environments, this option allows measurement of baseband I and Q signals in either balanced or unbalanced systems. Input configuration includes 50 Ω unbalanced, 600 Ω balanced, and 1 M Ω balanced or unbalanced – enabling a variety of systems to be directly tested without cumbersome and error-including conversion networks. Applicable in-band 3GPP W-CDMA, cdma2000, EDGE/GSM, and Basic mode measurements are supported via RF and IQ inputs, enabling users to track down signal degradation both before and after RF/IF conversion.

E4406A VSA Transmitter Tester Key Features

- One-button, standard-based measurements for W-CDMA, cdma2000, cdmaOne, 1xEV-DO, GSM, EDGE, NADC, PDC and iDEN
- Pass/fail test with built-in test limits
- Baseband I/Q inputs (option)
- Link to 89601A Vector Signal Analysis software
- GPIB, LAN and parallel interfaces standard
- Built-in 3.5-inch disk drive
- SCPI instrument command
- VXIplug&play drivers
- User upgradeable firmware
- Large high-resolution color LCD display

Frequency Specifications

Frequency Range	
RF input	7 MHz to 314 MHz, 329 MHz to 4 GHz
Baseband IQ input	5 Hz to 5 MHz
Composite IQ input	5 Hz to 10 MHz
Frequency setting resolution	1 Hz
Phase noise (960 MHz)	
1 kHz offset	≤ -87 dBc/Hz
10 kHz offset	≤ -96 dBc/Hz

Amplitude Specifications

Maximum input power	+35 dBm (3.16 W)
Input attenuator	0 to +40 dB, 1 dB steps
Third order intermodulation distortion (50 MHz to 4 GHz, two -10 dBm tones)	
Tone separation ≥ 5 MHz	< -56 dBc (TOI +18 dBm, +23 dBm typical)
Tone separation ≥ 50 kHz	< -54 dBc (TOI +17 dBm, +21 dBm typical)
1 dB gain compression	
2 tones separation ≥ 3 MHz	+2 dBm, +6 dBm (typical)
2 tones separation ≥ 40 MHz	+5 dBm, +10 dBm (typical)
Absolute power measurement accuracy, RF input	
810 MHz to 960 MHz	± 0.6 dB, ± 0.4 dB (typical)
1710 MHz to 2205 MHz	± 0.6 dB, ± 0.4 dB (typical)
1428 MHz to 1503 MHz	± 0.6 dB, ± 0.6 dB (typical)
Displayed average noise level (Input terminated in 50 Ω , 0 dB attenuation, 1 kHz RBW, 10 kHz span)	
20 MHz to 2000 MHz	-106 dBm, -111 dBm (typical)
2000 MHz to 2700 MHz	-103 dBm, -108 dBm (typical)
2700 MHz to 4000 MHz	-98 dBm, -104 dBm (typical)

Physical Specifications

Power requirements	90 to 132 Vrms, 47 to 440 Hz 195 to 250 Vrms, 47 to 66 Hz
Power consumption	<350 W (ON), <20 W (Standby)
Weight (without options)	19 kg (42 lb) net
Dimensions	177 mm H x 426 mm W x 432 mm D (7.0 in H x 16.8 in W x 17 in D)

W-CDMA (Option BAF)

Channel power absolute accuracy	± 0.63 dB, ± 0.41 dB (typical)
Adjacent channel power ratio (ACPR):	
Accuracy (RRC weighted, 3.84 MHz noise bandwidth)	
MS, 5 MHz/10 MHz offset	± 0.2 dB/ ± 0.3 dB
BTS, 5 MHz/10 MHz offset	± 0.93 dB/ ± 0.82 dB
Dynamic range, 5 MHz/10 MHz offset	68 dB (nominal)/72 dB (nominal)
Multi-carrier power:	
ACPR accuracy, two carriers, 5 MHz offset, -48 dBc ACPR	± 0.70 dB (nominal)
ACPR dynamic range, two carriers, 5 MHz offset	-64 dBm (nominal) 5 MHz offset -68 dBm (nominal) 10 MHz offset
Power statistics CCDF histogram resolution	0.01 dB
Occupied bandwidth frequency resolution	100 Hz
Spectrum emission mask (SEM)	
Dynamic range, 2.515 MHz offset	-77.9 dB, -82.8 dB (typical)
Sensitivity, 2.515 MHz offset	-88.9 dBm, -93.9 dBm (typical)
Relative accuracy, display = Abs Peak Pwr	± 0.60 dB, ± 0.40 dB (typical)
Code domain power relative accuracy (Test Model 1 with 32 DPCH, 0 to -30 dBc)	± 0.08 dB (95%)
Symbol power versus time relative accuracy (Test Model 1 with 32 DPCH, 0 to -25 dBc)	± 0.10 dB (95%)
Symbol EVM accuracy (Test Model 1 with 32 DPCH, 0 to -25 dBc)	± 1.0 % (95%)
QPSK downlink EVM accuracy	± 1.0 % (nominal, at EVM of 10%)
Power control & power vs.time absolute power accuracy, 0 to -20 dBm	± 0.7 dB (nominal)
Composite EVM accuracy (Test Model 4)	± 1.0 %

Key Literature & Web Link

E4406A VSA Transmitter Tester Data Sheet, p/n 5968-3030E
 E4406A VSA Transmitter Tester Brochure, p/n 5968-7618E
 E4406A Vector Signal Analyzer Performance Guide using 89601A Vector Signal Analyzer Software
 Spectrum Analyzer Selection Guide, p/n 5968-3413E
 W-CDMA Measurement Personality, technical overview, literature number 5988-2388EN
 GSM with EDGE Measurement Personality, technical overview, literature number 5988-2389EN
 cdma2000 Measurement Personality, technical overview, literature number 5988-3694EN
 1xEV-DO Measurement Personality, technical overview, literature number 5988-4828EN
 cdmaOne Measurement Personality, technical overview, literature number 5988-3695EN
 NADC/PDC Measurement Personality, technical overview, literature number 5988-3697EN

Ordering Information

E4406A VSA Transmitter Tester, 7 MHz to 4 GHz

- E4406A-202 EDGE with GSM measurement personality
- E4406A-204 1xEV-DO measurement personality
- E4406A-B78 cdma2000 measurement personality
- E4406A-BAC cdmaOne measurement personality
- E4406A-BAE NADC, PDC measurement personality
- E4406A-BAF W-CDMA measurement personality
- E4406A-BAH GSM measurement personality
- E4406A-HN1 iDEN measurement personality
- E4406A-300 321.4 MHz IF output
- E4406A-B7C Baseband I/Q input, 5 Hz to 10 MHz
- E4406A-UK6 Commercial calibration certificate with test data
- E4406A-1CM Rackmount kit
- E4406A-1CN Handle kit
- E4406A-1CP Rackmount kit with handle kit
- E4406A-1CR Rack slide kit
- E4406A-OBV Service documentation, component level
- E4406A-OBW Service documentation, assembly level

- Frequency range: DC to as high as 6 GHz
- At least 36 MHz analysis bandwidth
- Baseband I&Q inputs available
- 24 digital demodulators with settleable center frequency, symbol rate, filter type and alpha/BT
- 25 standards based measurement setups include GSM (EDGE), cdma2000, W-CDMA, PHP, 1xEV-DO, TD-SCDMA, 802.11a/b/g (WLAN), digital video signal analysis and more
- Up to 1.2 GB of signal capture and playback memory
- PC-based analysis software also works with PSA/ESA spectrum analyzers, many Infiniium scopes, Agilent's Advanced Design System (ADS)



89640A-2002

89600 Vector Signal Analyzers

The Agilent 89600 family of vector signal analyzers measures the RF and modulation quality of wideband modulated signals. They offer FFT based spectrum analysis, wideband flexible demodulation, and scope-like measurements on RF signals.

Along with wide IF bandwidths (36 to 39 MHz), the 89600 VSAs offer traditional RF spectrum displays, baseband (I/Q) analysis, signal capture memory, RF and IF triggering, a wide variety of analog and digital demodulators, and an extensive set of time, frequency and modulation analysis tools. These capabilities make 89600 VSAs ideal for evaluating narrowband and broadband signals.

Analyze a wide variety of standard and non-standard signal formats. Twenty-five standard-signal presets cover GSM, GSM (EDGE), CDMAOne, cdma2000, W-CDMA, 802.11a, 802.11b, 1xEV-DO, TD-SCDMA and more. For emerging standards, the 89600 analyzers offer 24 digital demodulators with variable center frequency, symbol rate, filter type and alpha/BT. A user-adjustable adaptive equalizer is also provided.

Analysis Tools

Simplify the characterization of your signal with the 89600's frequency domain spectrum analysis tools. Speed-up high-resolution spur searching with fast-Fourier-transform-based (FFT) spectrum analysis. The 89600's wide selection of spans enables you to match the measurement span to your signal bandwidth, thus maximizing signal-to-noise ratio (SNR). Resolution bandwidths down to less than 1 Hz provide all the resolution needed for frequency domain investigations. The power spectral density (PSD) function is useful for estimating the noise floor level when calculating SNR. And, the spectrogram display provides for monitoring the wideband behavior of hopping signals over time.

Perform time domain analysis on your design using the 89600 Series "RF scope" tools. Evaluate pulse shape with the Main Time display, select specific portions of a burst for demodulation or other analysis with the Time Gating feature and use statistical tools like complementary cumulative distribution function (CCDF) and probability distribution function (PDF) to characterize the noise-like behavior of your modern communications signal.

Quickly evaluate and troubleshoot digitally modulated signals with the modulation domain analysis tools. For example you can examine symbol behavior with trellis/eye diagrams or use the constellation and vector diagrams for an overall indication of signal behavior and clues to the cause of a problem. Take advantage of the error vector magnitude (EVM), EVM spectrum and EVM time capabilities for a more sensitive examination of signal errors.

Operating System

If you are familiar with Microsoft® Windows® applications, you can quickly master an 89600 Series VSA. Just load the software on your PC and connect it via IEEE 1394 (FireWire) to the VSA's VXI hardware and you're running.

Features

- Up to 24 flexible digital demodulators with adjustable center frequency, symbol rate, filter type, and filter a/BT
- Twenty-five standards-based pre-sets speed analyzer set-up for standards-based signals including GSM, EDGE, W-CDMA, Bluetooth, and more
- A complete set of vector signal analysis and modulation analysis displays including constellation, eye diagram, EVM spectrum, EVM time, error screens, multiple trace displays, and a spectrogram display
- Up to 1.2 GB of signal capture and playback memory lets you re-analyze signals and store them for future comparisons
- Flexible marker capabilities include integrated band power, and offset (delta) markers
- Complete save and recall of your set-ups, trace data, and measurement screens
- Dynamic links to Agilent's Advanced Design Software, ESA and PSA spectrum analyzers and the Infiniium scopes
- A link to the Agilent ESG Series signal generators for download and playback of signals in the signal capture memory
- Familiar and intuitive Microsoft® Windows®

3G Modulation Analysis (option B7N)

Use the 3G modulation analysis option for the 89600 Series vector signal analyzers to evaluate and troubleshoot W-CDMA, cdma2000, TD-SCDMA, and 1xEV-DO test signals.

W-CDMA and CDMA2000

Supporting both forward and reverse links, this modulation analysis option offers a variety of measurements such as code domain power; code domain error; and time, spectrum, phase, and magnitude code error.

TD-SCDMA

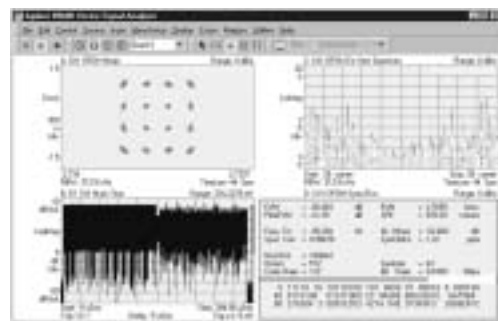
Troubleshoot and analyze your TD-SCDMA (TSM V3.0.0) signal modulation and RF performance. Single code domain layer or composite power and code domain displays are provided along with code domain power relative to total signal power. Depend on automatic measurements to show you rho, EVM, frequency error, I/Q offset and I/Q skew.

1xEV-DO

Measure and analyze 1xEV-DO modulated signals with the capabilities offered by the 3G modulation analysis option. Descramble, despread, and demodulate in the reverse link (mobile station or access terminal) and forward link (base station or access network). The analyzer automatically identifies all active channels regardless of the symbol rate or Walsh code length. Measurement results include: code domain power (composite or layer specific), code domain error (composite or layer specific), EVM, IQ offset, rho, overall 1 rho, and overall 2 rho.

WLAN Modulation Analysis (option B7R)

Agilent is an industry leader in baseband, RF and modulation quality measurements of WLAN (802.11a, b, g) signals.



89610A
89611A
89640A
89641A

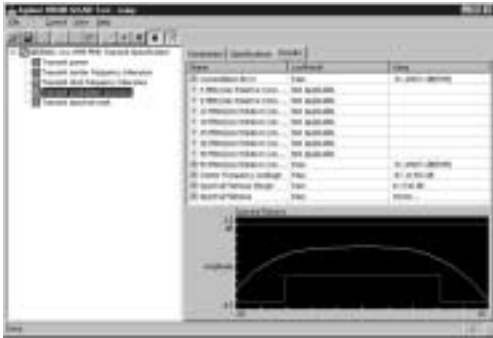
89610A
89611A
89640A
89641A

DSSS/CCK/PBCC Mode

The DSSS/CCK/PBCC mode automatically detects, despreads, descrambles and demodulates the payload in all four mandatory 802.11b formats (1, 2, 5.5, 11Mbps). It also handles the optional PBCC modes, the optional short preamble and the CCK preamble of the CCK-OFDM format. Measure EVM, frequency error, quadrature error, gain imbalance and more.

OFDM Mode

The OFDM mode lets you demodulate and analyze 802.11a, 802.11g, and HiperLAN2 compatible signals down to the bit level. A variety of displays include a compound constellation display that lets you view all modulation formats in the frame and a Common Pilot Error display to view the phase and magnitude behavior of the pilot sub-carriers for every symbol in the frame. A preamble test capability allows you to evaluate the settling time of the phase and magnitude in the preamble.



One Button 802.11 Test Suite

Speed the process of testing your 802.11 signal to its standard with the WLAN Test Suite (supplied as part of the WLAN option B7R). This applet automatically executes standards based testing of your signal. You specify which tests to perform, the center frequency, etc of the signal and the applet does the rest. The tests include: transmit power, center frequency and symbol clock frequency tolerance, modulation accuracy and spectral mask. Results are available as pass/fail and measured data and are available to download to a spreadsheet, report, or a network.

89610A Baseband Vector Signal Analyzer

Targeted at baseband measurements this is a DC-40MHz VSA with 39 MHz bandwidth. A second channel can be added giving I and Q baseband measurements and 78 MHz effective bandwidth for I+jQ measurements.

89611A IF Vector Signal Analyzer

Designed to team with tuners having 70 MHz IF center frequencies this is a 52 – 88 MHz VSA with 36 MHz analysis bandwidth. A second channel can be added for baseband I&Q analysis.

89640A RF Vector Signal Analyzer

The versatile 89640A is designed to measure the RF and modulation quality of signals up to 2.7 GHz. Baseband I and Q inputs are available.

89641A RF Vector Signal Analyzer

This flexible modular system is designed to measure signals up to 6.0 GHz. Baseband I and Q inputs are available.

89601A Vector Signal Analysis Software

The 89601A vector signal analysis software is a PC based package designed to measure the RF and modulation quality of most digitally modulated signals. Its large array of demodulators, filters, displays, and analysis tools make it ideally suited to evaluating and troubleshooting modulated signals in the R&D lab and can be directly linked to a wide range of Agilent spectrum analyzers, digital oscilloscopes and modular VXI systems. This software is provided as part of the 89610, 89611, 89640 and 89641 vector signal analyzers.

89604A Distortion Test Suite Software

The 89604A distortion test suite software accurately measures AM/AM and AM/PM distortion in MCPAs using complex modulated signals with bandwidths as high as 36 MHz. This wideband measurement technique helps assure that even subtle distortion mechanisms like memory effects and local heating are stimulated and measured. Use the complete graphic and data summary tables to characterize the performance of your MCPA.

Specifications

	89610A	89611A	89640A	89641A
Frequency Range	DC to 40 MHz	52 to 88 MHz (or frequency range of external tuner)	DC to 2700 MHz	DC to 6000 MHz
Maximum Analysis Bandwidth	39 MHz	36 MHz	36 MHz	36 MHz
Sensitivity	<-151 dBm/Hz	<-159 dBm/Hz	<-158 dBm/Hz	<-157 dBm/Hz
Displayed Average Noise Level at 1 GHz at Max Frequency			<-156 dBm/Hz	<-153 dBm/Hz
Dynamic Range (3rd IMD)	<-70 dBc ¹	<-70 dBc ¹	<-70 dBc ¹	<-70 dBc ¹
Amplitude Accuracy (20-30°C)	±0.8 dB	±0.8 dB	±2.0 dB	±2.0 dB
Signal Capture Memory		Up to 1.2 GB (384 MSa, complex)		
One Button, Standards-Based Pass/Fail Tests		802.11 (Opt)		
One Button Measurement Setups		W-CDMA, 1xEVDO, GSM, 802.11a/b/g, and more		
Flexible Demodulation		24 demodulators, 7 filters, equalizer (2-16 FSK, GFSK, MSK, GMSK, BPSK, QPSK, OQPSK, DQPSK, p/4 DQPSK, 8PSK, D8PSK, EDGE, 16-256 QAM, DVB 16-64, VSB 8-16)		
I&Q Inputs, Internal Source		Option N/A		

¹tones @ 6 dB below full scale (-31 dBm at input)

Key Literature & Web Link

- 89600 Demonstration Software CD literature number 5980-1989
- 89600 Brochure literature number 5980-0723
- 89600 Configuration guide literature number 5968-9350
- 89600 Datasheet literature number 5988-7811
- 89604A Product Overview literature number 5988-7812

Ordering Information

- 89610/89611/8964/89641
 - 144 MB/288 MB/1.2 GB signal capture memory option
 - Add a second IF/baseband channel option
 - Add a second RF channel option (89640/41 only)
 - Flexible vector modulation analysis option
 - 3G modulation analysis option
 - WLAN modulation analysis option
- 89601A Vector Signal Analysis Software
 - Flexible vector modulation analysis option
 - 3G modulation analysis option
 - WLAN modulation analysis option

- Frequency range DC to as high as 2.65 GHz
- Baseband I&Q inputs and programmable source available
- Up to 15 digital demodulators with settable center frequency, symbol rate, filter type and alpha/BT
- Up to 11 standards based measurement presets include NADC, GSM, PHP, CDMA, W-CDMA, PHP, digital video signal analysis and more
- Up to 1 MSA of signal capture and playback memory
- High speed, high resolution FFT-base spectrum analysis



89441A-GSM

Agilent Technologies' 89400 Vector Signal Analyzers integrate time-, frequency- and modulation-domain analysis to provide the most advanced measurements of complex and time-varying signals. Using state-of-the-art digitizing and signal processing technology, these analyzers offer complex signal analysis, such as digital modulation analysis and AM/FM/PM demodulation, vector spectrum analysis, and time-gated spectrum analysis. Simultaneous time- and frequency-domain measurements and displays improve productivity and enhance ease of use.

Complex and time-varying signals include burst, pulsed, transient, hopping, and analog- and digital-modulated signals. Signals such as these are common in RF communications, video broadcast satellite, radar, sonar and ultrasound imaging systems and must be characterized in the design, manufacture and monitoring of these systems. Vector signal analyzers are ideally suited to making the needed power, frequency, and modulation measurements on these complex signals.

The Agilent 89410A covers baseband frequencies from dc to 10 MHz with one or two full-bandwidth input channels. The Agilent 89441A covers baseband through RF frequencies of dc to 2.65 GHz with a single RF input and an (optional) dc to 10 MHz second baseband channel. The Agilent 89441V meets the needs of TV broadcasters and system designers by precisely analyzing digital modulation formats such as 8 VSB and 64/256 QAM to 2.65 GHz.

Features

- High-performance spectrum analysis
- Advanced, optimized time-gated spectrum analysis
- Vector modulation analysis (optional)
- Precision digital AM, FM, PM demodulation
- Flexible internal RF signal source (optional)
- Narrowband spectrum speed to 60 updates/s
- Simultaneous time and frequency measurement
- Up to 1 Msample time-capture
- High resolution, high accuracy, time domain

Specifications

	89410A	89441A	89441V
Frequency Range	DC to 10 MHz	DC to 2650 MHz	DC to 2650 MHz
Maximum Analysis Bandwidth	10 MHz	7 MHz	7 MHz
Sensitivity (dBm/Hz)	<-144 (10 MHz)	<-159 (2.65 GHz)	<-159 (2.65 GHz)
Dynamic Range (3rd IMD)	<-75 dBc	<-70 dBc	<-70 dBc
Signal Capture Memory	Up to 1 MSA		
One Button Pass/Fail Tests	NADC, PDC, PHS (89451A)	NADC, PDC, PHS (89451A)	NTSC, 8VSB, ATSC (IBASIC)
Presets	GSM/EDGE, DECT, CDMA, and more		
Flexible Demodulation	15 demods, 6 filters, equalizer	15 demods, 6 filters, equalizer	8 demods, 2 filters, equalizer
I&Q Inputs, Internal Source		Option	Option

Key Literature & Web Link

89410A datasheet, literature number 5965-5427
 89441A datasheet, literature number 5965-5425
 89441V datasheet, literature number 5966-0437
 89400 configuration guide, literature number 5964-3630

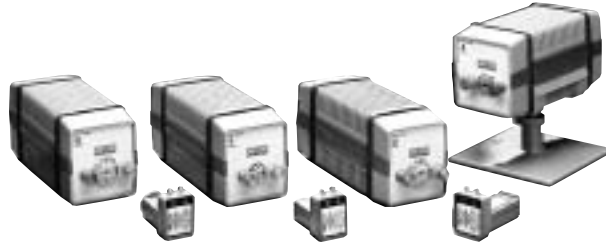
Ordering Information

89410A 10 MHz Vector Signal Analyzer
 89441A 2.65 GHz Vector Signal Analyzer
 89441V VSB/QAM Signal Analyzer

89410A
 89441A
 89441V

11974x
11970x

- Preselected mixers to eliminate signal identification
- State-of-the-art technology
- Easier automated measurements
- Low conversion loss
- Individually amplitude calibrated
- No bias or tuning adjustments
- High 100 mW safe input level



11970, 11974 Series Mixers

11974 Series Preselected Millimeter Mixers

Eliminate the need for signal identification at millimeter frequencies. The Agilent 11974 series mixers are preselected from 26.5 to 75 GHz for faster, easier testing of millimeter devices and systems. Preselection reduces mixer overload from broadband signals and reduces radiation of local oscillator harmonics back to the device under test. Equipment operators can quickly locate true signals, and software development for automated measurements is greatly simplified.

These mixers feature advanced barium-ferrite technology and come with a standalone power supply. They are particularly useful for broadband millimeter signal analysis, millimeter electromagnetic interference (EMI) measurements, and unattended monitoring of millimeter signals.

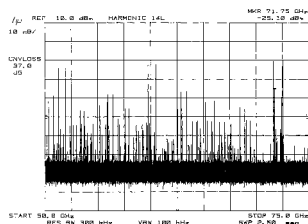
11974 series preselected mixers are available in four bands

Agilent Model	Frequency Range (GHz)	Sensitivity ¹ (displayed avg. noise level/10 Hz) (dBm)	Calibration Accuracy ¹ (dB)	Image Rejection ¹ (dB)	1 dB Gain Compression (dBm)
11974A	26.5 to 40	-111	<±2.3	-54	+6
11974Q	33 to 50	-106	<±2.3	-50	+0
11974U	40 to 60	-109	<±2.6	-50	+0
11974V	50 to 75	-100	<±4.5	-40	+3

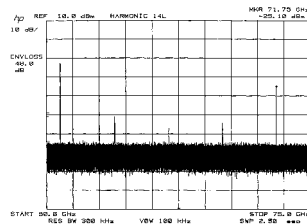
¹Specifications apply when connected to the 8566B or 70000 series spectrum analyzers.

Compatibility

Upgrade kits are available to assure the compatibility of 8566A/B spectrum analyzers and the 70907A external mixer interface module. Consult your Agilent sales representative to determine requirements. All 8560EC series spectrum analyzers and the 70907B external mixer interface modules are fully compatible with the 11974 series.



50 to 75 GHz Sweep Without Preselection



50 to 75 GHz Sweep Using 11974 Series Mixer

11970 Series Harmonic Mixers

The 11970 series waveguide mixers are general-purpose harmonic mixers. They employ a dual-diode design to achieve flat-frequency response and low conversion loss. These are achieved without external dc bias or tuning stubs. Manual operation and computer-controlled hardware operation are simplified because mixer bias and tuning adjustments are not required.

11970 series harmonic mixers are available in six bands (15 to 17 dBm LO)

Agilent Model	Frequency Range (GHz)	LO Harm Number	Conversion Loss (dB)	Noise Level (dB) 1 kHz RBW	Freq. ¹ Response (dB)	Gain Compression (dBm)
11970K	18 to 26.5	6+	24	-105	±1.9	-3
11970A	26.5 to 40	8+	26	-102	±1.9	-5
11970Q	33 to 50	10+	28	-101	±1.9	-7
11970U	40 to 60	10+	28	-101	±1.9	-7
11970V	50 to 75	14+	40	-92	±2.1	-3
11970W	75 to 110	18+	47	-85	±3.0	-1

¹Frequency response of the mixers is reduced by 1 dB for LO range of 14 to 18 dBm.

Compatibility

The 11970 series mixers extend the frequency range of the 8560EC series portable spectrum analyzers, the 8566B spectrum analyzer (used with the 11975A amplifier), and the 70000 modular measurement system (used with the 70907A/B external mixer interface modules).

11970 and 11974 Series Specifications

- IF Range: dc to 1.3 GHz
- LO Amplitude Range: +14 dB to +16 dB; +16 dB optimum
- Calibration Accuracy: ±2 dB for 11970 series with optimum LO amplitude
- Typical RF Input SWR: <2.2:1, <3.0:1 for 11974 series
- Bias Requirements: None
- Typical Odd-Order Harmonic Suppression: >20 dB (does not apply to 11974 series)
- Maximum CW RF Input Level: +20 dBm (100 mW), +25 dBm for 11974 series
- Maximum Peak Pulse Power: 24 dBm (250 mW) with <1 μs pulse (avg. power = +20 dBm)
- Bandwidth: 100 MHz minimum (11974 series only)
- Environmental: Meets MIL-T-28800, Type III, Class 3, Style C
- IF/LO Connectors: SMA (female)
- TUNE IN Connector: BNC
- LO Range: 3 to 6.1 GHz

Key Literature

- 11970 Series Technical Data, p/n 5968-1445E
- 11974 Series Technical Data, p/n 5952-2748

Ordering Information

- 11974A 26.5 to 40 GHz Preselected Mixer
- 11974Q 33 to 50 GHz Preselected Mixer
- 11974U 40 to 60 GHz Preselected Mixer
- 11974V 50 to 75 GHz Preselected Mixer
- 11974V-003 Delete Power Supply (11974 series only)
- 11970K 18 to 26.5 GHz Mixer
- 11970A 26.5 to 40 GHz Mixer
- 11970Q 33 to 50 GHz Mixer
- 11970U 40 to 60 GHz Mixer
- 11970V 50 to 75 GHz Mixer
- 11970W 75 to 110 GHz Mixer
- 11970
- 11970-009 Mixer Connection Set adds three 1-m low-loss SMA cables, wrench, Allen driver for any 11970 series mixer
- 11975A 2 to 8 GHz Amplifier
- 281A/B Coaxial to Waveguide Adapters
- R281A 26.5 to 40 GHz, 2.4 mm (f)
- R281B 26.5 to 40 GHz, 2.4 mm (m)
- Q281A 33 to 50 GHz, 2.4 mm (f)
- Q281B 33 to 50 GHz, 2.4 mm (m)

11867A and 11693A Limiters

Protect the input circuits of spectrum analyzers, counters, amplifiers and other instruments from high power levels with minimal effect on measurement performance. The 11867A RF limiter (dc to 1.8 GHz) reflects signals up to 10 W average power and 100 W peak power. Insertion loss is less than 0.75 dB. The 11693A microwave limiter (100 MHz to 12.4 GHz, usable to 18 GHz) guards against input signals over 1 mW up to 1 W average power and 10 W peak power.

11694A 75 Ω Matching Transformer

From 3 to 500 MHz, this transformer allows measurements in 75 Ω systems while retaining amplitude calibration with a 50 Ω spectrum analyzer input. VSWRs are less than 1.2; insertion loss is less than 0.75 dB.

8447A and 8447D Amplifiers

Specifications

	8447A Preamplifier	8447D Preamplifier
Frequency Range	0.1 to 400 MHz	100 kHz to 1.3 GHz
Typical 3 dB Bandwidth	50 kHz to 700 MHz	75 kHz to 1.7 GHz
Maximum Levelled Output Power	—	—
Output Power Leveling Range	—	—
Gain (mean, per channel)	20 dB ±1.0 dB at 10 MHz (20° to 30°C)	>25 dB (20° to 30°C)
Gain Flatness Across Full Frequency Range	±1.8 dB (0° to 55°C) ±0.7 dB (20° to 30°C) characteristic	±1.5 dB
Noise Figure	<7 dB	<8.5 dB
Output Power for 1 dB Gain Compression	>+6 dBm	>+7 dBm typical
Third-Order Intercept	—	—
Harmonic Distortion	−32 dB for 0 dBm output	−30 dB for 0 dBm output (typical)
Maximum Input for Minimum Internally Levelled Output	—	—
Output for <−60 dB Harmonic Distortion	−25 dBm (characteristic)	−30 dBm
VSWR	<1.7	<2.0 input <2.2 output 1 to 1300 MHz
Reverse Isolation	>30 dB	>40 dB
Maximum dc Voltage Output	±10 V	±10 V
Size	85.8 mm H x 130 mm W x 261 mm D (3.4 in x 5.1 in x 8.5 in)	85.8 mm H x 130 mm W x 216 mm D (3.4 in x 5.1 in x 8.5 in)
Weight	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)	Net, 1.56 kg (3.4 lb); Shipping, 2.3 kg (5.1 lb)
Power Requirements	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W	110 or 230 Vac + 10 %, 48 to 440 Hz, 15 W
Options Available	Option 001: Dual-channel amp, BNC (f) connectors	Option 001: Dual-channel amp, BNC (f) connectors Option 010: Single-channel amp, Type-N (f) connectors Option 011: Dual-channel amp, Type-N (f) connectors

Ordering Information

8447A Preamplifier
8447D Preamplifier

8449B Preamplifier

Specifications

Frequency Range	1.0 to 26.5 GHz		
Gain (mean, per channel)	≥26 dB (20° C to 30° C)		
Gain Flatness Across Full Freq. Range	1 to 26.5 GHz ±4.5 dB (0° C to 55° C); 2 to 22 GHz ±2.4 dB (20° C to 30° C)		
Noise Figure	Band	Typical	
	1.0 to 12.7 GHz	≤8.5 dB	7 dB
	12.7 to 22.0 GHz	12.5 dB	9 dB
	22.0 to 26.5 GHz	≤14.5 dB	12 dB
Output Power for 1 dB Gain Compression	≤+7 dBm (characteristic)		
Harmonic Distortion	−30 dB for 0 dBm output (characteristic)		
Output for <−60 dB Harmonic Distortion	−30 dBm (characteristic)		
VSWR	Input	1.0 to 2.0 GHz	2.0:1
		2.0 to 12.5 GHz	1.5:1
		12.5 to 26.5 GHz	2.0:1
	Output	1.0 to 26.5 GHz	2.0:1
Reverse Isolation	>75 dB		
Maximum dc Voltage	±20 V		

Displayed Average Noise Level, 0 dB atten. (characteristic)

8563EC (1 Hz RBW)	8566B (10 Hz RBW)
1.0 to 6.46 GHz, −165 dBm	1.0 to 2.5 GHz, −55 dBm
5.86 to 13.0 GHz, −163 dBm	2.0 to 5.8 GHz, −154 dBm
12.4 to 26.5 GHz, −160 dBm	5.8 to 12.5 GHz, −150 dBm
	12.5 to 18.6 GHz, −144 dBm
	18.6 to 22 GHz, −140 dBm

Size: 102 mm H x 213 mm W x 297 mm D (4.0 in x 8.4 in x 11.7 in)

Weight: Net, 4 kg (8.8 lb) nominal

Power: 100, 120, 220, or 240 V, ±10 %; 47 to 63 Hz

Ordering Information

8449B 1 to 26.5 GHz Preamplifier
8449B-907 Front Handle Kit
8449B-908 Rackmount Kit (half-rack width)

11867A
11693A
11694A
8447A
8447D
8449B

E740xA



E7400A Series EMC Analyzers

5

Whether your industry is information technology, automotive, communications, or medical electronics, you need to evaluate the EMI performance of your products during the development phase. With Agilent's E7400A Series EMC analyzers, you can evaluate performance quickly and easily.

Radiated Emissions

When combined with a broadband antenna, the E7400A Series analyzer provides the capabilities to check for radiated emissions coming from your DUT. This is best done in an area that is free from reflective objects such as an open area or EMI chamber.

Conducted Emissions

Test for noise or interference placed on power or data lines by coupling the E7400A series instrument to the power or data line through a line impedance stabilization network (LISN) device or absorbing clamp.

Diagnostics and Problem Isolation

If you have an emissions problem, you can use the E7400A with an 11940A or 11941A close field probe to isolate and diagnose the source of the problem.

The E7400A Series EMC analyzers have the following functionality and features to speed you through measurements:

- Detectors to perform peak, quasi-peak, and average measurements
- Complete measurement setups including span and EMI bandwidths
- Display two limit lines and margins
- Corrections for antennas, cables, and amplifiers
- Measure peak, quasi-peak, and average amplitudes of 2000 signals and store the results into the internal list
- Use the "Zone" feature to zoom in on a signal while viewing the broad spectrum
- Built-in 3.5 inch disk drive
- Large, crisp color display
- Built-in preamplifier with 20 dB nominal gain
- Sort, remeasure, mark, and delete signals in the internal list
- Standard GPIB and parallel ports
- Battery pack available
- Edit or customize and store limit lines and correction factors
- Optional built-in tracking generator to 3 GHz

Ordering Information

E7401A EMC analyzer 9 kHz to 1.5 GHz

E7402A EMC analyzer 9 kHz to 3.0 GHz

E7403A EMC analyzer 9 kHz to 6.7 GHz

E7404A EMC analyzer 9 kHz to 13.2 GHz

E7405A EMC analyzer 9 kHz to 26.5 GHz

Standard options included in an EMC analyzer:

- E740xA-AYQ** EMI detectors / FM demod
- E740xA-1DS** RF preamplifier (20 dB gain, 1 MHz to 3.0 GHz)
- E740xA-1DR** Narrow resolution bandwidths to 10 Hz
- E740xA-A4H** GPIB/parallel port (includes IntuiLink PC connectivity software)
- E740xA-B72** Memory extension to 10 MB
- E740xA-060** Low emissions shielding

Orderable Options

- E740xA-1AX** Replaces GPIB with RS-232 (includes RS-232 cable and IntuiLink PC connectivity software)
- E740xA-1CP** Rackmount and handle kit
- E740xA-UKB** Low frequency extension (100 Hz)
- E740xA-1D5** Adds high stability time base (includes 1 Hz and 3 Hz RBW)
- E740xA-1D6** Time gated sweep
- E740xA-1DN** Tracking generator
- E740xA-A4J** IF and sweep ports
- E740xA-A5D** 12 Vdc power cable
- E740xA-AXT** Transit case
- E740xA-AYT** Grey soft carrying case
- E740xA-AYU** Yellow soft carrying case
- E740xA-AYX** Fast time domain sweep
- E740xA-BAB** 3.5 mm RF input (E7405A only)
- E740xA-HYZ** External mixing (E7405A only)
- E740xA-UK6** Commercial calibration certificate
- E740xA-UK9** Front panel cover

Product Comparison

Product/Service	Frequency Range	Displayed Average Noise Level	3rd Order Dynamic Range	RBW
E7401A	9 kHz to 1.5 GHz	≤-150 dBm	+13.5 dBm TOI	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)
E7402A	100 Hz ¹ to 3.0 GHz	≤-150 dBm	+12.5 dBm TOI	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)
E7403A	100 Hz ¹ to 6.7 GHz	≤-150 dBm	+12.5 dBm TOI	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)
E7404A	100 Hz ¹ to 13.2 GHz	≤-150 dBm	+12.5 dBm TOI	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)
E7405A	100 Hz ¹ to 26.5 GHz	≤-150 dBm	+12.5 dBm TOI	1 Hz ² to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW)

¹With the Option UKB

²With the Option 1D5



84115EM Pre-Production Evaluation System

84105EM
84115EM

The 84115EM system has everything you need to perform radiated and conducted emissions measurements on your product. The 84115EM is based on the E7400A Series EMC analyzer, which includes EM average and quasi-peak detection and EMI bandwidths. The system includes the following:

Product Number	Description	Operating Range	Product Parameters	Configuration Details
84115EM	EMC preproduction evaluation system			
E7401A	EMC analyzer/receiver	9 kHz to 1.5 GHz	RBW: 1 Hz to 5 MHz (including 200 Hz, 9 kHz, 120 kHz, 1 MHz EMI BW) DANL: -150 dBm TOI: 12.5 dBm	Default option/Also available for purchase separately
E7402A		100 Hz to 3.0 GHz		Option/Available for purchase separately
E7403A		100 Hz to 6.7 GHz		
E7404A		100 Hz to 13.2 GHz		
E7405A		100 Hz to 26.5 GHz		
11945A	Close field probe set (includes 11940A & 11941A)	9 kHz to 1 GHz	Dielectric breakdown ± 1 kV	Default option/available for purchase separately
11955A	Biconical antenna	30 MHz to 300 MHz	Max continuous power 250 mW	Default option
11956A	Log periodic antenna	200 MHz to 2 GHz	Max continuous power 1 kW	Default option
11966P	BiConiLog broadband antenna	26 MHz to 2 GHz	Max continuous power 1 kW	Option
11966E	Double ridged waveguide horn antenna	1 GHz to 18 GHz	Max continuous power 300 W	Option
11966J	Horn antenna	18 GHz to 40 GHz	Max continuous power 50 W	Option
11968C	Antenna tripod	94 cm to 2.0 m	Max load 11.8 kg	Default option
E7415A	PC-based EMI software		Supports Windows 95, 98, NT 4.0, 2000, XP	Default option/Available for purchase separately
11909A	Amplifier	9 kHz to 1 GHz	Gain 32.5 dB ± 1.5 dB Noise Figure 1.8 dB	Option/Available for purchase separately
11947A	Transient limiter	9 kHz to 200 MHz	Insertion loss 10 dB	Default option/Available for purchase separately
11967D	LISN (NEMA)	9 kHz to 30 MHz	Max current 10A	Default option
11967D-001	LISN (SCHUKO)	9 kHz to 30 MHz	Max current 10A	Option
11967D-002	LISN (British)	9 kHz to 30 MHz	Max current 10A	Option

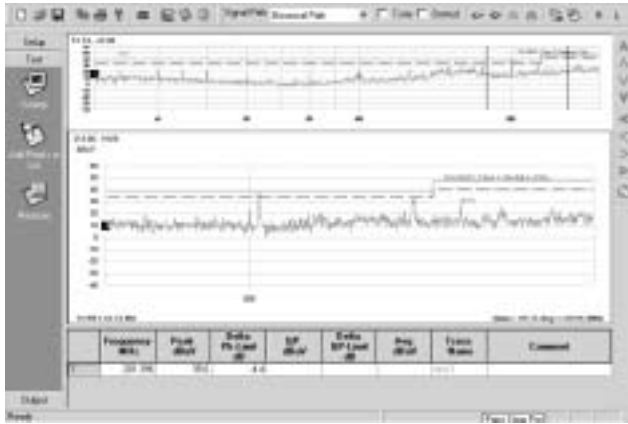
84105EM Design Development System

Identification, isolation, and resolution of problem emissions early in the design process is key to a successful product introduction. With the 84105EM design development system, you can easily isolate problems using the close field probes supplied with the system. The calibrated close field probes give very repeatable measurements ensuring that assessments of redesigns will produce meaningful results. The system is based on the E7401A (9 kHz to 1.5 GHz) and includes the 11945A close field probe set (9 kHz to 1.0 GHz). An optional preamplifier, 11909A, is available for additional sensitivity.

E7415A
11945A
11940A
11941A
Various
EMC
Accessories

PC Software for the E7400A Series

IntuiLink PC software provides easy transfer of EMC measurement trace data directly into MS Excel spreadsheets or screen images into MS Word documents for analysis, archiving, presentations, or printing. Transfer measurement results over GPIB, RS232, or LAN (using two PCs or an E2050A GPIB/LAN adapter). Save and restore analyzer states. Unattended operation with repetitive sequence of measurement transfers by date and time. IntuiLink is included standard with GPIB and RS232 options.



E7415A EMI Measurement Software

E7415A EMI Measurement Software

Choose the level of automation you need, from simple data capture from your EMC analyzer or receiver to fully automated EMI measurements. With the E7415A, you can select the measurement resolution over the span of interest or use the auto-select feature.

Zoom in on an area for a closer look simply by dragging a cursor. Point and click to mark individual signals and add them to a list or use the "Add Peaks to List" function to add all the signals above a limit or margin to a list with one click. Highlight signals in the list to measure peak, quasi-peak and average amplitude or tune and listen.

Generate a report by selecting from a wide range of entries. Your report may include a graph, limit lines, equipment table, transmitter factors etc.

The E7415A controls the E7400A Series EMC analyzers as well as the 8590EM Series EMC analyzer and 8546A/42E EMI receivers.

11940A and 11941A Close-Field Probes and 11945A Close-Field Probe Set

These handheld probes are designed to measure magnetic-field radiation from surface currents, slots, cables, and ICs for EMC diagnostic and troubleshooting measurements. Their unique design results in a high level of electric-field rejection. This significantly reduces errors, thus allowing calibrated and repeatable measurements.

The 11941A operates from 9 kHz to 30 MHz, the 11940A, from 30 MHz to 1 GHz. Five antenna factors appear on each probe for calculating absolute magnetic-field strength (dB μ A/m) from the dB μ V reading of a spectrum analyzer. Each probe is calibrated and comes with a 2-meter RG-223 coaxial cable, and SMA(f)-to-type-N(m) adapter, and an SMA (f)-to-BNC(m) adapter.

The 11945A close field probe set includes both the 11940A and 11941A probes for full coverage from 9 kHz to 1 GHz. Option E51 adds the 11909A preamplifier, with a 36-inch (914-mm) type-N cable, and a carrying bag for storage and protection of the entire set.

119XX Series Antennas

These antennas are individually calibrated and shipped with a calibration certificate showing actual performance data. The series includes the following products:

Model		Frequency Range
11955A	Biconical Antenna ¹	30 to 300 MHz
11956A	Log Periodic Antenna ¹	200 MHz to 2 GHz
11966E	Double-Ridged Waveguide Horn Antenna	1 to 18 GHz
11966J	Double-Ridged Waveguide Horn Antenna	18 to 40 GHz
11966L	Coax Cable, Type-N	10 m
11966P	Broadband Antenna	30 MHz to 2 GHz

¹Typical cal factor supplied

These antennas are available as part of the 84115EM system. For separate purchases, they may be ordered directly from ETS-Lindgren (www.ETS-Lindgren.com/VIPs). The E7400A Series EMC Analyzers, 84105EM, and 84115EM Systems will also work with most third party antennas, LISNs, and other EMC accessories.

11967D Line Impedance Stabilization Network

Used for commercial conducted measurements. Maximum current 10 amps. Includes options for SCHUKO, NEMA, and British power outlet connectors. Available as part of the 84115EM System.

11974A Transient Limiter

A Transient Limiter protects the EMC analyzer's input from damage caused by high-level transients. The 11974A is recommended for use with the Agilent 11967D or other LISN device and is a default option of the 84115EM system.

11909A Preamplifier

Improve receiver, sensitivity for more accurate radiated emissions measurements. This amplifier has 32 dB gain with a 1.8 dB noise figure. This amplifier is ideal for use with the 11940A and 11941A close field probes to detect low level signals from device-under-test. Frequency range is 9 kHz to 1 GHz.

8449B Microwave Preamplifier

This high-gain, low-noise preamplifier adds sensitivity for MIL-STD radiated measurements. Frequency range is 1 to 26.5 GHz.

Key Literature

E7400A Series EMC Analyzer Brochure, p/n 5968-2516E
ESA/EMC Configuration Guide, p/n 5968-3412E
E7400A Series Technical Specifications, p/n 5968-3662E
EMC Precompliance Systems and Accessories Catalog, p/n 5988-3290EN
EMC Precompliance Cookbook (AN 1328), p/n 5968-3661E

- Dedicated cable TV analyzer
- Portable and easy to use
- Non-interfering RF and video measurements
- Digital carrier power measurements
- Cable TV data management software



8591C

8591C Cable TV Analyzer

Industry's Only Cable TV Analyzer That Keeps Pace with Changing Regulations

The 8591C cable TV analyzer (1 MHz to 1.8 GHz) is the first economical, portable, one-box solution for making automatic, non-interfering cable TV RF and video measurements. The analyzer features a flexible hardware and software architecture that can be upgraded easily to protect your investment as new test requirements are introduced.

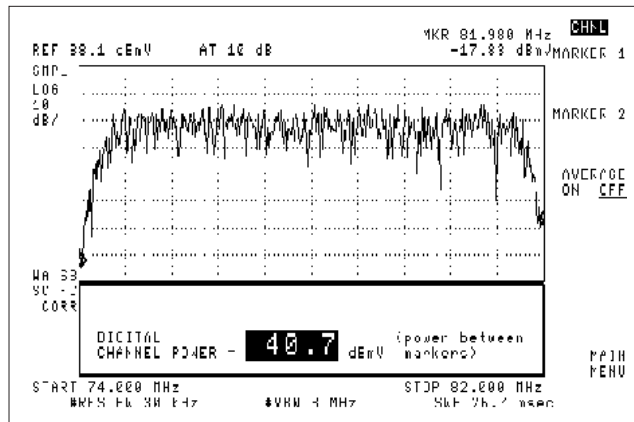
Included in the cable TV analyzer are the features you need for cable TV testing compatible with worldwide formats and standards, including all FCC proof-of-performance tests:

- Cable TV RF/video measurements personality to simplify channel and system cable TV measurements
- 75 Ω input matches analyzer to cable TV impedance
- Built-in, internally switched preamplifier for improved carrier-to-noise measurements
- Precision frequency reference to accurately measure carrier frequency
- Fast time-domain sweeps for displaying individual TV lines
- TV trigger for selecting TV lines by number
- RS-232 and parallel interfaces for PC and printer operation, respectively
- 85702A 128K RAM card for storing test data
- Rugged, yellow, soft carrying case

Options add even greater measurement capability to the analyzer. These include a 75 Ω tracking generator, narrow resolution bandwidths, and non-interfering RF and video measurements.

Non-Interfering Measurements

Option 107 for the 8591C adds the hardware needed to make non-interfering RF and video measurements. Non-interfering measurements let you perform required tests on multiple channels at multiple locations with no impact on customer programming. The video measurement capability allows you to perform required FCC color tests. Option 107 also enables simultaneous viewing of TV pictures and listening to program sound. The hardware demodulates NTSC-format television signals as well as versions of PAL and SECAM.



Digital Carrier Power Measurement on 8591C

Measurements for RF and Video Testing

The cable TV measurement personality card (included with the 8591C) customizes the analyzer for easy, non-interfering proof-of-performance measurements on NTSC-, PAL-, or SECAM-format signals. This software adds dedicated cable TV test functions and measurements that you can perform with the push of single keys. Measurements include the following functions and tests:

- Automatic tuning of cable TV and TV broadcast carriers
- Visual and aural carrier levels and frequencies
- Digital carrier power
- System channel survey
- Depth of modulation
- TV aural and FM broadcast carrier deviation
- Carrier-to-noise ratio (C/N)
- In-channel frequency response
- Hum/low frequency disturbances
- System frequency response
- Baseband TV line and field viewing
- TV aural and FM broadcast carrier demodulation
- Distortion (CSO/CTB)
- Crossmodulation
- Ingress and co-channel viewing

System monitor capability automates measurements, allowing the analyzer to test without assistance from the operator. It also allows you to design test plans and to turn test data into reports instantly. With Option 107 added to the cable TV analyzer, non-interfering measurements of carrier-to-noise, in-channel frequency response and distortions can be made, as well as video measurements:

- Differential gain
- Differential phase
- Chrominance-luminance delay inequality

Painless Reports and Data Archiving

Take the pain out of cable TV reports with option 030 cable TV data management software. Running on IBM compatible PCs, it downloads test data from your 8591C¹, into a PC database for making reports and archiving data. The software compares measurement results to your specifications and displays pass/fail messages for each test. Test data can also be exported to a word processor or spreadsheet for other analysis.

You can print the results of every test run at each specified location in the cable system. The printout will list all the channels tested, as well as additional required information such as the date of the testing, the name and qualifications of the person who ran the test, and the serial number of the equipment used. Add Option 032 to automatically generate reports in a format compliant with the FCC regulations. All RF and video tests (except leakage) currently required by the FCC are included.

¹ Option 030 accepts system mode-acquired data from the cable TV measurement personality for the NTSC format only.

8591C
85901A
85905A

5

8591C
85901A
85905A

Specification Summary

Specifications apply to the 8591C cable TV analyzer with preloaded Cable TV measurement personality.

General

Channel Selection: Analyzer tunes to specified channels

Input: 75 Ω, BNC

Frequency Range: 5 to 1002 MHz for channel mode;

54 to 896 MHz for system mode;

1 MHz to 1.8 GHz for spectrum analyzer mode

Amplitude Range: -15 to +70 dBm V for S/N >30 dB

Displayed Average Noise Level (1 kHz RBW, 0 dB atten.)

- Without Preamplifier: ≤-63 dBmV (1 to 1500 MHz)
- With Internal Preamplifier: ≤-83 dBmV (1 to 1000 MHz)
- With External Preamplifier: ≤-83 dBmV (1 to 1000 MHz)

Cable TV Measurements

Visual Carrier Frequency (visual carrier frequency is counted)

Precision Frequency Reference

- Resolution: 100 Hz
- Accuracy: $\pm(1.2 \times 10^{-7} \times \text{carrier freq.} + 110 \text{ Hz})$
- At 55.25 MHz (ch. 2): $\pm 117 \text{ Hz}$
- At 325.25 MHz (ch. 41): $\pm 149 \text{ Hz}$
- At 643.25 MHz (ch. 94): $\pm 187 \text{ Hz}$

Visual-to-Aural Carrier Frequency Difference [counted frequency

difference between visual (vision) and aural (sound) carriers]

- Difference Range: 4.1 to 4.9 MHz
- Resolution: 100 Hz
- Accuracy: $\pm 221 \text{ Hz}$ for precision frequency reference (std)

Visual Carrier Peak Level (measured to an absolute standard)

- Amplitude: -15 to +70 dBm V
- Resolution: 0.1 dB
- Absolute Accuracy: $\pm 2.0 \text{ dB}$ for S/N >30 dB
- Relative Accuracy: $\pm 1.0 \text{ dB}$ relative to adjacent channels in frequency; $\pm 1.5 \text{ dB}$ relative to all other channels

Visual-to-Aural Carrier Level Difference [measured difference between peak amplitudes of visual (vision) and aural (sound) carriers]

- Difference Range: 0 to 25 dB
- Resolution: 0.1 dB
- Accuracy: $\pm 0.75 \text{ dB}$ for S/N >30 dB

Digital Carrier Power

- Accuracy (characteristic): $\pm 0.75 \text{ dB}$
- Readout Resolution: 0.1 dB

Depth of Modulation, Characteristic (percent difference from horizontal sync tip to max. video level)

- AM Range: 50 to 93 %
- Resolution: 0.1 %
- Accuracy: $\pm 2.0 \%$ for C/N >40 dB

FM Deviation, Characteristic (peak reading of FM deviation)

- Range: $\pm 100 \text{ kHz}$
- Resolution: 100 Hz
- Accuracy: $\pm 1.5 \text{ kHz}$

Hum/Low Frequency Disturbance (measured for power-line frequency and low-frequency disturbance)

- AM range: 0.5 to 10 %
- Resolution: 0.1 %
- Accuracy: $\pm 0.7 \%$ for hum $\leq 5 \%$

Visual Carrier-to-Noise Ratio, C/N (calculated from visual-carrier peak level; min. noise level normalized to 4 MHz for NTSC format)

- Range (input level dependent): 63 dB max. for +25 dBmV input

C/N Resolution: 0.1 dB

C/N Accuracy (input level and measured C/N dependent): $\leq \pm 1 \text{ dB}$ for 50 dB C/N and +25 dBmV input with external preselector filter

Composite Second Order and Composite Triple Beat Distortion (CSO and CTB measured relative to visual-carrier peak)

- Range (input level dependent): 77 dB max. for 25 dBm V input
- Resolution: 0.1 dB
- Accuracy (input-level, measured-CSO/CTB dependent): $\leq \pm 1.5 \text{ dB}$ for 60 dB CSO/CTB and +25 dBm V input

Crossmodulation Characteristic (15.7 kHz horizontal-line related AM measured on unmodulated visual carrier)

- Range: 60 dB, usable to 65 dB
- Resolution: 0.1 dB
- Accuracy: $\pm 2.6 \text{ dB}$ for xmod <50 dB, C/N >40 dB

System Frequency Response (system amplitude variations measured relative to a reference trace stored during the setup)

- Frequency Response Setup: Reference-trace storage for 50 traces including analyzer states
- Frequency Response Test: Trace-flatness accuracy is $\pm 0.1 \text{ dB}$ per dB deviation from a flat line and $\pm 0.75 \text{ dB}$ maximum cumulative error

Option 107 Operation (for video and non-interfering measurements)

TV Receiver Input

- Frequency Range: 50 to 850 MHz
- Amplitude Range: 0 to 40 dBm V

Non-interfering Color Test (requires FCC composite or NTC-7 test signal for NTSC format)

- Differential Gain Accuracy: $\leq \pm 4 \%$
- Differential Phase Accuracy: $\leq \pm 3^\circ$
- Chrominance-luminance Delay Inequality Accuracy: $\leq \pm 45 \text{ ns}$, $\pm 32 \text{ ns}$ typical

Non-interfering Tests with Gate ON²

- C/N and CSO: Quiet line must be selected
- In-channel Frequency Response Accuracy: $< \pm 0.5 \text{ dB}$ within channel (requires sin x/x, Philips ghost canceling reference, or FCC/NTC-7 multiburst test signal for NTSC format)

Preamplifiers

85905A 75 Ω Preamplifier (external)

- Frequency Range: 45 to 1000 MHz
- Gain: 20 dB $\pm 1.0 \text{ dB}$
- Noise Figure: 7 dB maximum at midband

8591C 75 Ω Preamplifier (internal) (std)

- Frequency Range: 1 to 1000 MHz
- Gain: $\geq 24 \text{ dB}$
- Noise Figure: $\leq 10 \text{ dB}$

Ordering Information

8591C Cable TV Analyzer (includes NTSC format only)³

- 8591C-107⁴** TV Receiver/Video Tester (includes 75 Ω coupler and cables)
- 8591C-011** 75 Ω Tracking Generator
- 8591C-015** Change Yellow to Tan Soft Carrying Case
- 8591C-030** Cable TV Data Management Software with FCC Reports
- 8591C-040** Front-Panel Cover (used without soft carrying case)
- 8591C-041⁵** GPIB and Parallel⁶ Interfaces
- 8591C-119** Noise Figure Card
- 8591C-130** Narrow Resolution Bandwidths
- 8591C-180⁷** TV Picture Display
- 8591C-701** Delete TV Trigger, AM/FM Demodulator, Fast Time-Domain Sweeps
- 8591C-704** Delete Precision Frequency Reference
- 8591C-908** Rackmount without Handles
- 8591C-909** Rackmount with Handles
- 8591C-915** Component Level Info. and Service Guide
- 8591CU-R07** Retrofit Kit for Option 107

Recommended Accessories

- 85702A** 128 K RAM Card (Additional)
- 85901A** Portable AC Power Source
- 85905A** 75 Ω Preamplifier
- 24542U** RS-232 Nine-Pin Cable (analyzer to PC)
- 24542G** RS-232 Nine-Pin to 25-Pin Cable (analyzer to PC)
- C2950A** Parallel Cable (analyzer to printer)
- 10833A** GPIB Cable

¹ 20° C to 30° C, $\geq 20 \text{ dBm V}$ input.

² Gate ON synchronizes the measurement to the TV line selected.

³ Worldwide format options available.

⁴ Not compatible with Option 180.

⁵ Replaces standard RS-232 and parallel interfaces.

⁶ Print and plot control only.

⁷ Not compatible with Option 107.



Why Network Analysis?

Characterizing the behavior of linear electrical networks that will be stimulated by arbitrary signals and interfaced with a variety of other networks is a fundamental problem in both synthesis and test processes. For example, the engineer designing a multi-component network must predict with some certainty, from knowledge of the individual components, the final network performance. Similarly, a production manager must know allowable tolerances on the products manufactured and whether the final products meet the specified tolerances. Network analysis offers a solution to these problems through complete description of linear network behavior in the frequency domain. Additionally, some network analyzers offer the capability to transform measurement data, taken in the frequency domain, to the time domain, providing further insight into the behavior of linear networks.

Network analysis accomplishes the description of both active and passive networks by creating a data model of such component parameters as impedances and transfer functions. However, these parameters not only vary as a function of frequency but are also complex variables in that they have both magnitude and phase (see Figure 1). Swept network analyzers now measure magnitude and phase (the total complex quantity) as a function of frequency with less difficulty than conventional CW measurements. Impedance and transfer functions then can be displayed or conveniently on an internal display, or on peripherals such as a printer and/or a plotter.

Thus, network analysis satisfies the engineering need to characterize the behavior of linear networks quickly, accurately, and completely over broad frequency ranges. Agilent Technologies manufactures a full line of scalar network analyzers (magnitude only) and vector network analyzers (both magnitude and phase).

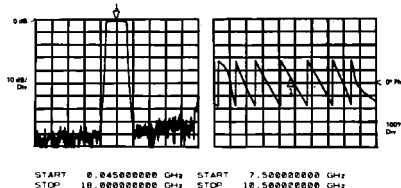


Figure 1: 45 MHz to 18 GHz measurement of magnitude and phase in a single sweep.

What is Network Analysis?

Network analysis is the process of creating a data model of the transfer and/or impedance characteristics of a linear network through stimulus-response testing over the frequency range of interest. All network analyzers in the Agilent product line operate according to this definition.

At frequencies above 1 MHz, lumped elements actually become “circuits” consisting of the basic elements plus parasitics like stray capacitance, lead inductance, and unknown absorptive losses. Since parasitics depend on the individual device and its construction, they are almost impossible to predict. Above 1 GHz component geometries are comparable to a signal wavelength, intensifying the variance in circuit behavior due to device construction.

Network analysis has classically been limited to the definition of linear networks. Since linearity constrains networks stimulated by a sine wave to produce a sine-wave output, sine-wave testing is an ideal method for characterizing magnitude and phase response as a function of frequency. While modern network analyzers use sine-wave power sweeps to characterize certain parameters of nonlinear behavior, such as gain compression and AM-to-PM conversion, this discussion will be limited to linear characterization of devices. For a more complete discussion of nonlinear

measurements, refer to the sections on spectrum analyzers, wave analyzers (signal analyzers) and vector modulation products in this catalog.

Network Analyzers

Agilent network analyzers are instruments that measure transfer and/or impedance functions of linear networks through sine-wave testing (see Figure 2). A network analyzer system accomplishes these measurements by configuring its various components around the device-under-test. The first requirement of the measurement system is a sine-wave signal source to stimulate the device-under-test. Since transfer and impedance functions are ratios of various voltages and currents, a means of separating the appropriate signals from the measurement ports of the device-under-test is required. Finally, the network analyzer itself must detect the separated signals, form the desired signal ratios and display the results.

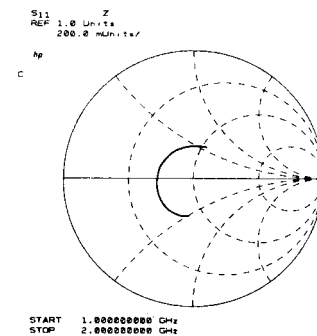


Figure 2: Input impedance of microcircuit amplifier is read directly with Smith Chart overlay for polar display.

Signal Sources and Signal Separation

In the general case, any sine-wave source meeting the network analyzer’s specifications can be used to stimulate the device-under-test. If the analyzer is capable of swept measurements, great economies in time can be achieved by stimulating the device-under-test with a sweep oscillator or synthesized sweeper. Many Agilent network analyzers contain internal, synthesized sources with excellent frequency resolution. Swept measurements allow quick and easy characterization of devices over broad frequency ranges.

At high frequencies the problem of signal separation usually involves traveling waves on transmission lines and becomes correspondingly more difficult. Agilent network analyzers employ both internal and external test sets applicable for separating the appropriate traveling waves in a variety of high-frequency measurements.

Broadband and Narrowband Detection

After the desired signals have been obtained from the test set, they must be detected by the network analyzer; Agilent network analyzers can use one of two detection methods. Broadband detection accepts the full-frequency spectrum of the input signal, while narrowband detection involves tuned receivers that convert CW or swept-RF signals to a constant-IF signal. There are certain advantages to each detection scheme.

Scalar analyzers usually employ broadband detection techniques. Broadband detection reduces instrument cost by eliminating the IF section required by narrowband analyzers but sacrifices noise and harmonic rejection. However, noise is not a factor in many applications. Finally, broadband systems can make measurements where the input and output signals are not of the same frequency, as in the measurement of the insertion loss of mixers and frequency doublers.

Vector network analyzers normally employ narrowband detection techniques. Narrowband detection makes a more sensitive low noise detection of the constant IF possible. This allows increased accuracy and dynamic range for frequency-selective measurements (as compared to broadband systems).

Vector network analyzers can vary with their employment of broadband, narrowband, or both types of detection. When both types of detection are available, the user selects the detection method, which allows optimization of the device measurements.

Signal Processing and Display

Once the RF has been detected, the network analyzer must process the detected signals and display the measured quantities (see Figure 3). All Agilent network analyzers are multi-channel receivers utilizing a reference channel and at least one test channel; absolute signal levels in the channels, relative signal level (ratios) between the channels, or relative phase difference between channels can be measured, depending on the analyzer.

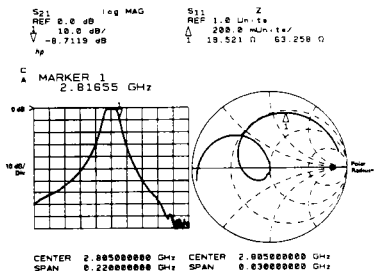


Figure 3: Simultaneous measurement of transmission response and passband reflection coefficient.

Relative ratio measurements are usually made in dB, which is the log ratio of an unknown signal (Test Channel) with a chosen reference signal (Reference Channel). This allows the full dynamic range of the instrumentation to be used in measuring variations of both high- and low-level circuit responses. For example, 0 dB implies the two signal levels have a ratio of unity, while ± 20 dB implies a 10:1 voltage ratio between two signals.

All network analyzer phase measurements are relative measurements with the reference channel signal considered to have zero phase. The analyzer then measures the phase difference of the test channel with respect to the reference channel.

Phase information complements amplitude data in the measurement of device parameters. Phase is more sensitive to network behavior and it is a required component of complex impedance and transfer functions.

Phase data is also required to measure delay distortion or group delay of networks. Delay distortion occurs when different frequency components of a complex waveform experience nonlinear phase shifts as they are transmitted through a network. Group delay (see Figure 4) is a measure of this distortion and is defined as:

$$T_{gd} = -\frac{d\theta}{d\omega}$$

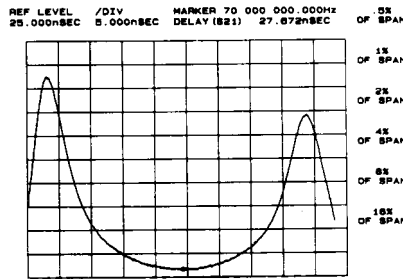


Figure 4: Direct measurement of group delay with digital readout at marker.

An alternative method for measuring phase distortion is deviation from linear phase or differential phase. Deviations from linear phase can be measured by introducing enough electrical length in the network analyzer's reference channel to linearize a device's phase shift. This is usually accomplished by using the electrical-delay feature of the network analyzer, which cancels the average electrical length of a device mathematically.

Scattering parameters, or S-parameters, were developed to characterize linear networks at high frequencies. S-parameters define the ratios of reflected and transmitted traveling waves measured at the network ports. A two-port device is modeled with S-parameters (see Figure 5). S_{11} is the complex reflection coefficient at port 1, and is

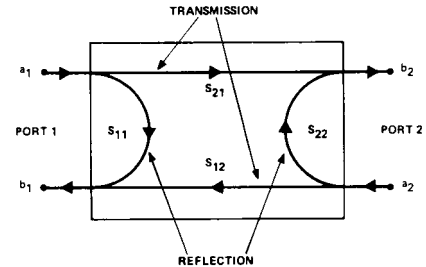


Figure 5: S-parameter model for a two-port linear network.

the ratio of b_1/a_1 , if $a_2 = 0$ (port 2 terminated in its characteristic impedance). S_{21} is the complex transmission coefficient from port 1 to port 2, b_2/a_1 , if $a_2 = 0$. The "a" and "b" signals represent the amplitude and phase of the incident and emerging or reflected traveling waves. By reversing the ports and terminating port 1 in its characteristic impedance, S_{22} and S_{12} can be similarly defined.

Additional Capabilities

Precision design work and manufacturing tolerances demand highly accurate measurements, but most errors in network measurements are complex quantities that vary as a function of frequency. By characterizing and virtually removing these systematic errors, measurement accuracies are improved by several orders of magnitude. Agilent network analyzers contain built-in, high-speed computational hardware that can perform the complex mathematics required for sophisticated error correction.

Computer-controlled network analyzers can be programmed to set up and make many measurements automatically. The measurement process is further accelerated by the computer's ability to store, transform, summarize, and output data in a variety of formats to a number of peripherals. These capabilities make the computer-controlled network analyzer ideal for both computer-aided design or automatic production testing. Several products have built-in automation features, including sequencing and GP Instrument BASIC.

- Excellent measurement accuracy
- Fast, precise, integrated synthesized sources
- Choice of integrated S-parameter or T/R test sets
- Advanced automation and flexible options to boost capabilities



Tackle the Most Demanding Active and Passive Devices

From precision design work to high-volume manufacturing, component test manufacturers demand fast, accurate measurements. Agilent offers a host of RF and microwave vector network analyzers that are ready to tackle the most challenging active and passive networks, devices, components and subsystems.

Squeeze more performance from your designs with the exceptional accuracy. Wide dynamic range and low trace noise make it easy to see the stopband and passband of even the highest-rejection filters.

On the production line, advanced productivity features such as automated pass/fail testing and segmented sweeps help accelerate test throughput. Built-in sequencing, programming and connectivity capabilities increase the flexibility of your test systems, and can decrease the cost of test.

Overview

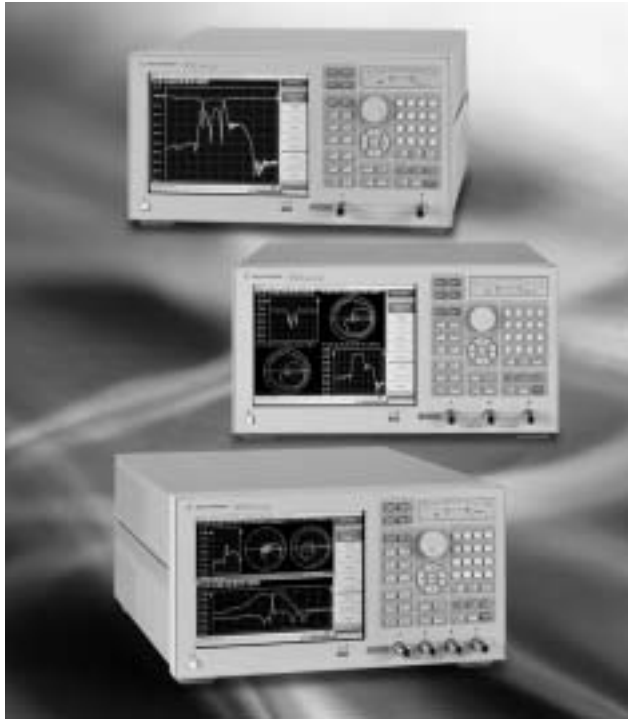
Selection Guide for Agilent Network Analyzers

	Frequency Range	Number of Ports	Balanced Measurements*	System Impedance	ECal Support	Measurement Speed (1 sweep, 201 points)
Vector E5100A	10 kHz to 300 MHz	2	No	50 ohm	No	8 ms (1-port cal, ramp-sweep) 64 ms (1-port cal, step-sweep)
Combination Network/spectrum/impedance 4395A & 4396B	10 Hz to 1.8 GHz	2	No	50 or 75 ohms	No	165 ms (response cal, gain, 30 kHz BW)
Vector 8712ES/ET; 8714ES/ET	300 kHz to 3 GHz	2	No	50 or 75 ohms	No	72 ms (1-port cal, 6.5 kHz BW) 119 ms (1-port cal, 4.0 kHz BW) 240 ms (2-port cal, 4.0 kHz BW, ES model only)
Vector 8753ES/ET	30 kHz to 6 GHz	2	No	50 or 75 ohms	Yes	70 ms (1-port cal) 139 ms (2-port cal, ES model only) (6 kHz BW)
Vector E5070B; E5071B	300 kHz to 8.5 GHz	2, 3, or 4	Yes	50 ohms	Yes	8 ms (2-port cal) (100 kHz BW)
Vector E8356/7/8A; E8801/2/3A; N3381/2/3A	300 kHz to 9 GHz	2 or 3	No	50 ohms	Yes	29 ms (2-port cal) (35 kHz BW)
Vector 8719ES/ET; 8720ES/ET; 8722ES/ET	50 MHz to 40 GHz	2	No	50 ohms	Yes	65 ms (1-port cal) 158 ms (2-port cal, ES model only) (6 kHz BW)
Vector E8362/3/4B; E8361A	10 MHz to 67 GHz	2	No	50 ohms	Yes	38 ms (2-port cal) (35 kHz BW)
Vector N5250A	10 MHz to 110 GHz	2	No	50 ohms		
Vector 8757D	10 MHz to 110 GHz	2	No	50 ohms	No	470 ms (2-port cal) (10 kHz BW)

* Table shows the capabilities of the stand-alone instrument, possible to add balanced capability with an external test set

E5070B
E5071B
E5091A

- 125 dB wide dynamic range
- 0.001 dBrms trace noise
- Fast multiport measurement of 9.6 us/point
- Integrated 2, 3, or 4 test ports
- Built-in balanced measurements
- Fixture embedding/de-embedding
- Port characteristic impedance conversion
- Time domain analysis with gating
- 4-port electronic calibration kit (ECal) support
- Built-in Microsoft® Visual Basic® for Applications (VBA)
- 10.4-inch color LCD with touch screen



5

E5070B/E5071B ENA Series RF Network Analyzers

The Agilent ENA Series Network Analyzers perform fast and accurate RF component measurements for both R&D evaluations and production testing. Both the E5070B (300 kHz to 3 GHz) and the E5071B (300 kHz to 8.5 GHz) models offer integrated 2, 3, or 4 test ports, enabling the measurement of various components from 2-port filters to multiport devices like duplexers and couplers. The ENA series offers built-in balanced measurements, matching circuit simulation and port characteristic impedance conversion, all of which deliver accurate measurement results for the most advanced RF components such as balanced SAW filters and differential amplifiers. These comprehensive test capabilities enable fast and accurate measurements and increase engineering efficiency.

Excellent Measurement Accuracy

The Agilent ENA series dramatically improves measurement accuracy and meets the test needs of today and the future. With the wide dynamic range of up to 125 dB, high rejection filters can easily be measured. The low trace noise of 0.001 dBrms at 3 kHz IFBW makes it easy to evaluate a filter's passband ripple accurately. The ENA's excellent measurement performance enables the design of high performance components with a short cycle time.

Advanced Architecture for Multiport Component Test

Built-in 2, 3, or 4 test ports provide simultaneous measurement of all signal paths for components with up to 4 ports. This advanced architecture minimizes the number of sweeps to complete a multiport S-parameter measurement and dramatically improves test throughput.

English URL www.agilent.com/find/products

The ENA series holds up to 16 measurement channels in a single instrument state. Independent frequency list, calibration data, measurement parameters, trace layout, triggering, and limit test are applied in each measurement channel, which acts as if it is an independent network analyzer. This multi-channel capability eliminates recall time for sequencing multiple instrument setup states. Up to 16 display windows representing each measurement channel may be observed simultaneously. Within each window, it is possible to display up to 16 traces. The layout of display windows and traces are easily selected from the various preset states.

Integrated Balanced Measurement and Embedding/De-Embedding

The ENA series provides balanced conversion, and delivers mixed-mode S-parameter measurements. This integrated measurement capability improves test efficiency of balanced components.

The matching circuit function (embedding) re-calculates measured data to simulate characteristics of components including matching circuits with arbitrary port characteristic impedance. The de-embedding function removes additional fixture characteristics from the measured data, enabling the measurement of a device's characteristics without the test fixture effects.

Reducing Calibration Time Using ECal

The ENA series provides full 2-, 3-, and 4-port calibration and improves measurement accuracy of multiport devices. The ENA supports various electronic calibration kits (ECal), including the N4431A 4-port electronic calibration kit. The ECal automatically performs the calibration procedure and minimizes operational errors. The ECal module can be controlled by the ENA series via USB interface without an external PC. The front USB port is available for the ECal module and it is easy to connect to a rack mounted ENA.

The ENA supports various useful functions for ECal. After ECal calibration, the calibration performance can be verified using the ECal Confidence Check function. The User-Characterization ECal function enables ECal calibration with various adapters attached, increasing your calibration flexibility.

Evolution of Test Automation, Built-In VBA

The ENA series accelerates test system development, expands customization capability and increases flexibility of test system integration. VBA is a powerful programming language that brings in a new era of test automation. A test program can be developed in the ENA Series by using the built-in VBA editor. This powerful programming tool helps you to accelerate test system development.

A custom user interface can be easily developed with the graphical programming features of the VBA. This allows the limit test results and instructions to be displayed and helps to avoid operational errors.

At times measurement parameters need to be calculated mathematically or processed statistically after data acquisition. The VBA is also useful for such post processing. Unique analysis functions are easily implemented using various VBA functions. This expands analysis capability of the test equipment and fully meets test needs.

Ease-of-Use

The ENA series employs conventional softkey-style operation, which enables users to quickly start using it without any intensive learning. The optional touch screen provides further enhancement for usability. The large 10.4-inch color display is very useful when looking at many traces for multiport measurements. For those who are familiar with a Windows® PC, the ENA series can also be controlled using Windows-style pull down menus. These ease-of-use features increase engineers' test efficiency.

Key Specifications

Test Frequency:

- 300 kHz to 3 GHz (E5070B)
- 300 kHz to 8.5 GHz (E5071B)

Max Port Output Power:

- With Opt E5070B/E5071B 213/313/413, -15 to 10 dBm
- With Opt E5070B/E5071B 214/314/414, -50 to 10 dBm

Number of Test Ports: 2, 3, or 4

Korean URL www.agilent.co.kr/find/products

IFBW: 10 Hz to 100 kHz (1, 1.5, 2, 3, 4, 5, 7 step)
Number of Points: 2 to 1601

System Dynamic Range:

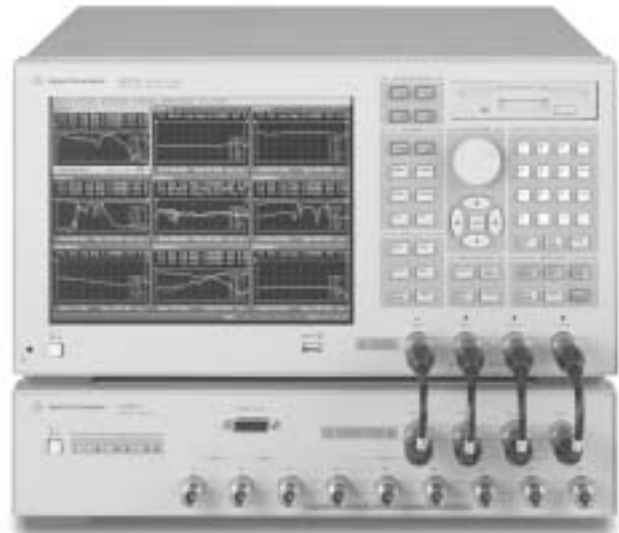
- 123 dB@10 Hz IFBW (3 MHz to 1.5 GHz)
- 125 dB@10 Hz IFBW (1.5 GHz to 4 GHz)
- 120 dB@10 Hz IFBW (4 GHz to 6 GHz)
- 116 dB@10 Hz IFBW (6 GHz to 7.5 GHz)
- 109 dB@10 Hz IFBW (7.5 GHz to 8.5 GHz)
(Response & isolation calibration)

Trace Noise (magnitude):

- 0.001 dBrms @3 kHz IFBW (3 MHz to 4.25 GHz)
- 0.003 dBrms @3 kHz IFBW (4.25 GHz to 7.5 GHz)
- 0.005 dBrms @3 kHz IFBW (7.5 GHz to 8.5 GHz)
(Response calibration)

Ordering Information

- E5070B** 300 kHz to 3 GHz RF Network Analyzer
E5071B 300 kHz to 8.5 GHz RF Network Analyzer
E507xB-010 Time Domain Analysis Capability
E507xB-213 2-port S-parameter Test set,
Standard Power Range (-15 to 10 dBm)
E507xB-214 2-port S-parameter Test Set,
Extended Power Range (-50 to 10 dBm)
E507xB-313 3-port S-parameter Test Set,
Standard Power Range (-15 to 10 dBm)
E507xB-314 3-port S-parameter Test Set,
Extended Power Range (-50 to 10 dBm)
E507xB-413 4-port S-parameter Test Set,
Standard Power Range (-15 to 10 dBm)
E507xB-414 4-port S-parameter Test Set,
Extended Power Range (-50 to 10 dBm)
E507xB-016 Touch Screen Color LCD
E507xB-1E5 High Stability Frequency Reference



E5070B
E5071B
E5091A

E5091A Multiport Test Set

5

The E5091A is a multiport test set used with the 4-port ENA Series network analyzer to expand the number of test ports up to 9. This is an ideal solution for testing antenna switch modules for mobile handsets, particularly those modules with balanced ports, although it can be used in a wide range of multiport measurement applications. The test set is available in 7- and 9-port configurations and is controlled as if it were a part of the analyzer rather than a separate test set.

With up to 16 channels, each of which can measure up to 16 measurement parameters, the ENA multiport test solution can measure all the measurement paths required for antenna switch module testing. The signal paths of each measurement channel can also be displayed to help identify complex connections to the device. These capabilities ensure a single connection, single-set-up measurement that reduces test time.

Key Literature

- ENA Series Product Brochure, literature number 5988-3765EN
 ENA Series Data Sheet, literature number 5988-3780EN
 ENA Series Configuration Guide, literature number 5988-4926EN
 Introduction to the Fixture Simulator Function of the ENA Series RF Network Analyzers, Product Note E5070/71-1, literature number 5988-4923EN
 Evolution of Test Automation Using the Built-In VBA with the ENA Series RF Network Analyzers, Product Note E5070/71-2, literature number 5988-6192EN
 On-wafer Multiport Calibration using the ENA Series RF Network Analyzer with the Cascade Microtech Probing System, Product Note E5070/71-3, literature number 5988-5886EN

Ordering Information

- E5091A** Multiport Test Set
E5091A-007 7-port Test Set Configuration
E5091A-009 9-port Test Set Configuration

Network Analyzers

210

PNA Series RF and MW Network Analyzers

E8356/7/8A
E8801/2/3A
N3381/2/3A
E8362/3/4B
E8361A

- Frequency coverage from 300 kHz – 67 GHz
- Exceptional performance
- USB controlled electronic calibration (ECal)
- Windows 2000 operating system



RF PNA Series



MW PNA Series

PNA Series

Rapid and continuous changes in RF, microwave, and millimeter-wave technology present a growing challenge for designers and manufacturers. The Agilent PNA Series is a measurement platform that meets the challenge; with the right combination of fast sweep speeds, wide dynamic range, low trace noise, and flexible connectivity. Test your high-performance components with a fast, accurate network analyzer that meets your measurement needs now and well into the future.

Microwave PNA Series

The Microwave PNA Series brings superior performance to microwave frequencies in 20, 40, 50, and 67 GHz models. With exceptional stability ($<0.06\text{dB}/^{\circ}\text{C}$) and four receivers for TRL/LRM calibration, the Microwave PNA Series is ideal for your high-performance microwave components.

In addition, the microwave models offer the option of frequency-offset measurements, enabling you to characterize mixers and amplifiers. The mixer measurement algorithm enables accurate characterization (including absolute group delay) of various mixer types, with an easy-to-use interface, and includes Agilent's exclusive vector error-corrected calibration technique.

RF PNA Series

The RF PNA series, with 3, 6, and 9 GHz models, provides TRL/LRM calibration for accurate characterization of in-fixture and on-wafer devices. Also, the 3-port models are ready to tackle components such as circulators, duplexers, splitters, couplers and base station combiner/divider units (CDUs) with their fast, simultaneous measurements of all three paths.

Advanced Connectivity

The entire PNA series achieves new levels of connectivity. There are many methods of communication to and from the instrument, using a variety of built-in I/O interfaces. Windows® 2000 lets you take advantage of many features you take for granted on your personal computer, helping you attain a new level of integration for your device-measurement purposes.

For local storage, use the analyzer's internal hard disk drive or connect a compatible CD drive. In addition, using drive mapping and the LAN interface, you can save data directly to remote PCs or file servers. This arrangement makes it very easy to develop statistical-process-controlled manufacturing environments.

The PNA series allows a number of ways to connect and control other test equipment such as power meters or signal sources. You can choose to connect them via the available USB, GPIB, LAN, serial, or parallel interfaces. When utilizing any one of your Windows-supported automation tools, you can control the test equipment directly from the analyzer.

The LAN interface also makes it easy to perform remote troubleshooting. You can view measurement results and control the analyzer from anywhere on the network, whether you are on another floor, in another building, or even at a different site. Additionally, you can download firmware and help-file updates from our web site: www.agilent.com/find/pna

Automation

For manufacturing environments, test automation is essential for high throughput. For R&D, automated tests can save considerable time that might be spent on repetitive and tedious measurements. The PNA series lets you automate your test processes using several powerful automation approaches. You can create programs using familiar SCPI commands via the GPIB or LAN interfaces, or use COM commands over LAN for fast analyzer access.

Flexibility

The PNA series combines powerful features with the benefits of Windows to provide maximum measurement flexibility:

- Configure up to 32 independent measurement channels to eliminate the need for multiple instrument state recalls
- 16,001 points per channel
- Display up to 16 windows
- Display up to 4 active traces in each window
- Select 10 coupled or fully-independent markers per trace

Throughput

Decreasing test time is often critical for success in manufacturing environments. The PNA series has many attributes that help you accomplish your throughput goals. The outstanding performance of the analyzers starts with exceptionally fast sweeps that do not sacrifice performance.

Features such as segmented sweep and limit lines for pass/fail testing allow you to most efficiently test your device. For devices that once required two to four instrument setups for complete characterization, the PNA series' ability to have up to thirty-two-measurement channel, each with its own stimulus and response parameters, can also improve your test throughput. When using Agilent's electronic calibration (ECal) modules, you can dramatically reduce the time it takes to perform calibrations. Simply connect the module to your test ports and let the analyzer control and measure all the standards necessary for full two-port calibration. These modules are controlled directly from the analyzer via a USB connection.

Key Specifications

RF PNA Series

Model	E8356/7/8A	E8801/2/3A	N3381/2/3A
Frequency Range	300 kHz to 3/6/9 GHz	300 kHz to 3/6/9 GHz	300 kHz to 3/6/9 GHz
Number of Ports	2	2	3
Measurement Receivers ¹	4	3	4
Configurable Test Set	■	▲	▲
Receiver Attenuators	■	▲	▲
Extended Power Range	■	▲	▲
High Stability Timebase	■	▲	▲
Bias-Tees	■	—	—
Time Domain	▲	▲	▲
ECal Support	Yes	Yes	Yes
Dynamic Range (at test port)			Port 1/Port 2, 3
300 kHz to 1 MHz	125 dB	125 dB	125/123 dB
1 MHz to 3 GHz	128 dB	128 dB	128/126 dB
3 to 6 GHz	118 dB	118 dB	118/116 dB
6 to 9 GHz	113 dB	113 dB	113/113 dB
Dynamic Range (receiver access)			Port 1/Port 2, 3
300 kHz to 1 MHz	140 dB	140 dB	140/138 dB
1 MHz to 3 GHz	143 dB	143 dB	143/141 dB
3 to 6 GHz	133 dB	133 dB	133/131 dB
6 to 9 GHz	128 dB	128 dB	128/128 dB
Trace Noise (1 kHz IF BW)			
300 kHz to 9 GHz	<0.002 dB <0.010 deg rms	<0.002 dB <0.010 deg rms	<0.002 dB <0.010 deg rms
Maximum Output Power			Port 1/Port 2, 3
300 kHz to 6 GHz	+10 dBm	+10 dBm	+10/+8 dBm
6 to 9 GHz	+5 dBm	+5 dBm	+5/+5 dBm

■ Standard ▲ Optional — Not available

MW PNA Series

Model	E8362/3/4/B	E8361A
Frequency Range	10 MHz to 20/40/50 GHz	10 MHz to 67 GHz
Number of Ports	2	2
Measurement Receivers	4	4
Configurable Test Set	▲	▲
Receiver Attenuators	▲	▲
Extended Power Range	▲	▲
High Stability Timebase	■	■
Bias-Tees	▲	▲
Frequency-Offset Mode	▲	▲
Reference Channel Switch	▲	▲
Frequency Converter Measurement Application	▲	▲
Time Domain	▲	▲
ECal Support	Yes	Yes
Dynamic Range (at test port) ²		
10 to 45 MHz	78 dB	70 dB
45 MHz to 2 GHz	94 to 119 dB	89 to 114 dB
2 to 20 GHz	122 dB	118 dB
20 to 40 GHz	110 dB	106 dB
40 to 50 GHz	104 dB	98 dB
50 to 60 GHz	—	97 dB
60 to 70 GHz	—	93 dB
Dynamic Range (receiver access) ²		
10 to 45 MHz	130 dB	104 dB
45 MHz to 2 GHz	132 dB	101 to 125 dB
2 to 20 GHz	136 dB	127 dB
20 to 40 GHz	119 dB	114 dB
40 to 50 GHz	111 dB	105 dB
50 to 60 GHz	—	102 dB
60 to 70 GHz	—	96 dB
Trace Noise (1 kHz IF BW) ²		
10 MHz to 50 GHz	<0.006 dB <0.1 deg rms	<0.006 dB <0.1 deg rms
Maximum Output Power ²		
10 to 45 MHz	+2 dBm	-10 dBm
45 MHz to 10 GHz	+5 dBm	0 dBm
10 to 20 GHz	+3 dBm	+1 dBm
20 to 40 GHz	-4 dBm	-2 dBm
40 to 45 GHz	-5 dBm	-4 dBm
45 to 50 GHz	-10 dBm	-5 dBm
50 to 60 GHz	—	-6 dBm
60 to 70 GHz	—	-10 dBm

■ Standard ▲ Optional — Not available

Measurement Speed (35 kHz IF bandwidth)

Model	Frequency	Points	Cycle Time (ms) ³	µs/Point	Updates/Second
All	1.8 GHz to 2 GHz	101	9	89	111
All	1.8 GHz to 2 GHz	1601	56	26	18
All	300 kHz to 9 GHz	201	57	284	18
E8361A/2/3/4B	10 MHz to 20/40/50/67 GHz	201	126/185/210/244	627/920/1045/1214	8/6/5/4
E8361A	10 MHz to 67 GHz	16,001	645	40	1.5

Data transfer Speed, 32-bit Binary (ms)⁴

	201 points	16,001 points
COM ⁵	2	6
SCPI ⁵	3	30
DCOM ⁵	3	121
SCPI over GPIB ⁵	9	435

¹TRL calibration not available on 3-port.

²Typical performance below 45 MHz and above 67 GHz.

³Typical performance includes retrace and band-switching times with response calibration. Two-port calibration approximately doubles cycle time.

⁴Typical performance.

⁵Program executed in PNA.

⁶Program executed on an external PC.

E8356/7/8A
E8801/2/3A
N3381/2/3A
E8362/3/4B
E8361A

E8356/7/8A
E8801/2/3A
N3381/2/3A
E8362/3/4B
E8361A

Accessories

Not required in this page
To be listed on Analyzer Accessories Section of the T&M Catalog

Key Literature & Web Link

PNA Series Brochure, p/n 5968-8472E
RF PNA Series Technical Specifications, p/n 5980-1236E
MW PNA Series Technical Specifications, p/n 5988-7988EN
RF PNA Series Configuration Guide, p/n 5980-1253E
MW PNA Series Configuration Guide, p/n 5988-7989EN

For more information, visit our web site:
www.agilent.com/find/pna

Ordering Information

PNA Series RF Network Analyzers

E8356/7/8A 2-port, 4 receiver, 300 kHz – 3/6/9 GHz
E8801/2/3A 2-port, 3 receiver, 300 kHz – 3/6/9 GHz
N3381/2/3A 3-port, 4 receiver, 300 kHz – 3/6/9 GHz

Options

To add options to a product, use the following ordering scheme
Model: Model# (ex: E8358A)
Model Options: Model#-opt# (ex: E8356A-015)

	Description	E8356/7/8A Availability	E8801/2/3A Availability	N3381/2/3A Availability
Test Set				
Model#-015	Configurable test set	X		
Model#-014	Configurable test set		X	X
Power Configuration				
Model#-1E1	Extended power range	Standard	X	X
Timebase Stability				
Model#-1E5	Add high stability timebase	Standard	X	X
Measurement Features				
Model#-010	Time domain capability	X	X	X
Accessories				
Model#-1CM	Rackmount kit with handles	X	X	X
Model#-1CP	Rackmount kit without handles	X	X	X
N4688A	USB CD R/W drive	X	X	X
N4689A	USB Hub	X	X	X
Calibration Documentation				
Model#-UK6	Commercial calibration certificate with test data	X	X	X

Warranty and Service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60).

Standard warranty is 36 months.

R-51B Return-to-Agilent warranty and service plan

Calibration²

For 3 years, order 36 months of the appropriate calibration plan shown below.

For 5 years, specify 60 months.

R-50C-001 Standard calibration

R-50C-002 Standards compliant calibration

¹The PNA Series is shipped with an embedded Help System. A printed version of this is available as an option.

²Options not available in all countries.

Ordering Guide For PNA Series Network Analyzers

This guide is intended to assist you in the ordering process. Additional information and products (such as calibration kits and cables) are described throughout this document.

PNA Series Microwave Network Analyzers

E8362B 10 MHz to 20 GHz

E8363B 10 MHz to 40 GHz

E8364B 10 MHz to 50 GHz

E8361A 10 MHz to 67 GHz

Options

To add options to a product, order the corresponding item number.

	Description	For E8362B Item Number	For E8363B Item Number	For E8364B Item Number	For E8361A Item Number	Additional Information
Test Set						
Option 014	Configurable test set	E8362B-014	E8363B-014	E8364B-014	E8361A-014	
Power Configuration						
Option UNL	Extended power range and bias-tees	E8362B-UNL	E8364B-UNL	E8364B-UNL	E8361A-UNL	
Option 016	Add receiver attenuators	E8362A-016	E8364A-016	E8364A-016	E8361A-016	
CPU RAM						
Option 022	Extended memory	E8362A-022	E8364A-022	E8364A-022	E8361A-022	
Non-Linear Measurements						
Option 080	Frequency offset	E8362A-080	E8364A-080	E8364A-080	E8361A-080	Requires 014 Requires 014, 080 Requires 014, 080, and 081(E8361A only requires 014, 080) includes GPIB to USB interface (82357A)
Option 081	Reference receiver switch	E8362A-081	E8364A-081	E8364A-081	E8361A-081	
Option 083	Frequency-converter measurement application	E8362A-083	E8364A-083	E8364A-083	E8361A-083	
Measurement Features						
Option 010	Time-domain capability	E8362A-010	E8363A-010	E8364A-010	E8361A-010	
Accessories						
Option 1CM	Rackmount kit without handles	E8362A-1CM	E8363A-1CM	E8364A-1CM	E8361A-1CM	
Option 1CP	Rackmount kit with handles	E8362A-1CP	E8363A-1CP	E8364A-1CP	E8361A-1CP	
N4688A	USB CD R/W drive	N4688A	N4688A	N4688A	N4688A	
N4689A	USB Hub	N4689A	N4689A	N4689A	N4689A	
Calibration Documentation						
Option 1A7	ISO 17025 compliant calibration	E8362B-1A7	E8363B-1A7	E8364B-1A7	E8361A-1A7	
Option UK6	Commercial calibration certificate with test data	E8362A-UK6	E8363A-UK6	E8364A-UK6	E8361A-UK6	

Note: Item numbers may not correspond to product model number. For example, to order the time-domain option on the E8362B, the correct item number to order is E8362A-010.

Warranty and Service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B Return-to-Agilent warranty and service plan

Calibration²

For 3 years, order 36 months of the appropriate calibration plan shown below.

For 5 years, specify 60 months.

R-50C-001 Standard calibration

R-50C-002 Standards compliant calibration

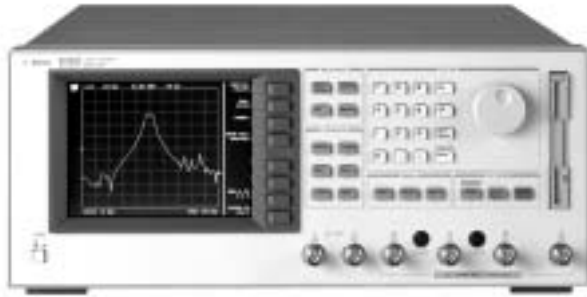
¹ Options not available in all countries.

² Printed version of on-line help has translations up to firmware revision 1.0.

E8356/7/8A
E8801/2/3A
N3381/2/3A
E8362/3/4B
E8361A

E5100A

- 10 kHz to 300 MHz
- 0.04 ms/point measurement speed
- Fine resolution IFBW
- List sweep function
- Stable measurements
- High-speed evaluation using the waveform analysis commands
- Evaporation Monitoring Function (Option)
- Phase Tracking Function (Option)
- Supports active probes (Option)
- GP Instrument BASIC for easy automation



E5100A

5

E5100A Network Analyzers

The E5100A network analyzer is a 10 kHz to 300 MHz network analyzer best fitted for production lines of electronic component manufacturers, especially resonator and filter manufacturers, who require extra-high throughput.

The E5100A improves production line productivity with its fast measurement speed (fastest sweep speed is 0.04 ms/point), fast waveform analysis commands, and speedier processor. It provides faster measurements with lower fluctuations because of its low-noise performance and fine selection IFBW.

High-Quality and High-Speed Tests

The E5100A is a versatile network analyzer with many functions and options to fit your needs with a minimum investment. During final tests, both precision and high speed are required for better yield and better productivity. The E5100A makes high-quality and high-speed tests with its fine IFBW selection and low-noise circuitry. Its convenient analysis and processing functions improve the productivity of the final test processes.

Low-Cost 180 MHz Version

The E5100A 180 MHz version (E5100A-218/318/618) is the economical solution for lower frequency applications. The frequency range is 10 kHz to 180 MHz. The E5100A 180 MHz version provides the same measurement performance as the 300 MHz version with lower price.

	E5100A 300 MHz Version	E5100A 180 MHz Version
Frequency Range	10 kHz to 300 MHz	10 kHz to 180 MHz
System Dynamic Range at Test Port	120 dB	120 dB
# of Ports	2 to 4 (optional)	2 to 3 (optional)
Power Range	-9 to +11 dBm (Standard) -48 to +22 dBm (Optional)	-9 to +11 dBm (Standard) -48 to +22 dBm (Optional)
Phase Tracking DLD Function	E5100A-023	E5100A-823
Evaporation Monitor Function	E5100A-022	Not available

Specifications

Source Characteristics

Frequency Range: 10 kHz to 300 MHz, 10 kHz to 180 MHz (E5100A with Option E5100A-218/318/618)
Output Power Range (at SINGLE): -48 to +22 dBm (option), -9 to +11 dBm (standard)
Resolution: 0.1 dB

Receiver Characteristics

Frequency Range: 10 kHz to 300 MHz, 10 kHz to 180 MHz (E5100A with Option E5100A-218/318/618)
IFBW: 10 Hz to 30 kHz (1, 1.5, 2, 3, 4, 5, 8 steps)
Input Impedance (nominal): 50 Ω (std.), 50 Ω / 1 M Ω , 30 pF (option)
Dynamic Range: >120 dB (IFBW = 1 kHz)
Dynamic Accuracy: ± 0.05 dB, ± 0.3 deg
Measurement Speed: 0.04 ms/point (IFBW = 30 kHz, ramp-sweep)

General Characteristics

Measurement Parameters: Gain (Amplitude Ratio), Phase, Group-Delay, Amplitude, Gain-Phase, Gain-Delay Impedance, Admittance
Display: 6.5 inch TFT Color LCD
Programming: IBASIC
Mass Storage: FDD and internal non-volatile memory
Parallel I/O Port: TTL, 16-bit output, 8-bit input/output (standard)
Power Requirement: 90 to 132 V or 198 to 264 V, 47 to 63 Hz, 400 VA max.
Size: 177 mm H x 425 mm W x 425 mm D (7.08 in x 17 in x 17 in)
Weight: 12 kg (26.4 lb) (typical)

Key Literature

E5100A Network Analyzer Product Overview, p/n 5968-1873E
 E5100A Technical Specifications, p/n 5966-2888E

E5100A Accessories

41901A SMD PI-Network Test Fixture

The 41901A SMD PI-network test fixture produces the capability to measure surface-mount crystal resonator using the E5100A. Attachment kit (option) is required for measurement. The frequency range of the 41901A is 1 MHz to 300 MHz.



Ordering Information

E5100A Network Analyzer

- E5100A-600 300 MHz X'tal Resonator Test w/PI-network
- E5100A-618 180 MHz X'tal Resonator Test w/PI-network
- E5100A-001 One RF OUT Port
- E5100A-002 Two RF OUT Ports, Built in Power Splitter
- E5100A-003 Two RF OUT ports, Switched Single Output
- E5100A-801 Power Extended One RF OUT Port
- E5100A-802 Power Extended Two RF OUT Ports, Built-in Power Splitter

- E5100A-803 Power Extended Two RF OUT Ports, Switched Single Output
- E5100A-200 300 MHz, 2 Receivers, Ports R and A
- E5100A-218 180 MHz, 2 Receivers, Ports R and A
- E5100A-300 300 MHz, 3 Receivers, Ports R, A and B
- E5100A-318 180 MHz, 3 Receivers, Ports R, A and B
- E5100A-400 300 MHz, 4 Receivers Input Connector on Port A
- E5100A-702 Type-BNC 50 Ω Input Connector Ports A and B
- E5100A-703 Type-BNC 50 Ω /1 M Ω Selectable Input on Port A
- E5100A-704 Type-BNC 50 Ω /1 M Ω Selectable Input on Port A and B
- E5100A-705 Type-N 50 Ω Input Connector on Port A
- E5100A-706 Type-N 50 Ω Input Connectors, Ports A and B
- E5100A-707 Type-N 50 Ω /1 M Ω Selectable Input on Port A
- E5100A-708 Type-N 50 Ω /1 M Ω Selectable Inputs, Port A and B
- Note: E5100A-701/703/705/707 is for E5100A-100/118/200/218 only. E5100A-702/704/706/708 is for E5100A-300/318/400 only. E5100A-703/704/707/708 cannot be ordered with E5100A-003 or 803.
- E5100A-022 Evaporation Monitoring Function (300 MHz Opt only)
- E5100A-023 Phase Tracking Function (300 MHz Opt only)
- E5100A-823 Phase Tracking Function (180 MHz Opt only)
- Note: E5100A-022 is for E5100A-200/300/400 only. E5100A-023 is for E5100A-200/300/400 only. E5100A-823 is for E5100A-218/318 only.
- E5100A-005 Parallel I/O Mode A
- E5100A-006 Parallel I/O Mode B
- E5100A-007 Opto-isolated Parallel I/O
- E5100A-1D5 High Stability Frequency Reference
- E5100A-UKR Delete Instrument BASIC
- E5100A-1F0 PC Style Keyboard -U.S. Version
- E5100A-1CM Rackmount Kit
- E5100A-1CN Handle Kit
- E5100A-1CP Rackmount and Handle Kit
- E5100A-ABA English localization
- E5100A-ABJ Japanese localization

Accessories

- 41800A Active Probe
- 41802A 1 M Ω Input Adapter
- 41900A PI-Network Test Fixture
 - 41900A-001 Adapter Kit for Load Capacitor
- 41901A SMD PI-Network Test Fixture
 - 41901A-010 to 41901A-061 Attachment Kit
- 11850C 50 Ω Three-Way Power Splitter
- 87512A Transmission/Reflection Test Kit

E5100A

5

4395A

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ± 0.05 dB/ $\pm 0.3^\circ$ dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- -145 dBm/Hz sensitivity for spectrum analysis
- Built-in IBASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



4395A with 87511A

4395A Network/Spectrum/Impedance Analyzer

The 4395A provides excellent vector network, spectrum and optional impedance measurements for audio, baseband, HF, VHF, and IF applications. When combined with a test set, the 4395A provides reflection measurements, such as return loss, and SWR, and S parameters. Gain, phase, group delay, distortion, spurious, CN ratio, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4395A operates from 10 Hz to 500 MHz with 1 mHz resolution and its integrated synthesized source provides -50 to $+15$ dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ± 0.05 dB and $\pm 0.3^\circ$ so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4395A operates from 10 Hz to 500 MHz with resolution bandwidths (RBWs) spanning 1 Hz to 1 MHz in a 1-3-10 steps. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ± 0.8 dB level accuracy (@ 50 MHz, -20 dBm). Noise sidebands fall below -110 dBc/Hz @ 100 kHz offset from carriers, while sensitivity is -145 dBm/Hz at 10 MHz.

Extremely Fast Spectrum Measurement

The 4395A features Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed for all RBW settings. For example, with 100 Hz RBW and 100 kHz span, the 4395A has a sweep time of 300 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the efficiency of narrowband spectrum measurement.

Time-Gated Spectrum Analysis

With Option 4395A-1D6, the 4395A offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 6μ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4395A by adding Option 4395A-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 500 MHz, impedance parameters $|Z|$, θ , C, L, Q, D, and more, are directly measured and displayed on the TFT color display. The basic impedance measurement accuracy is 3%. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test fixture. A wide variety of fixtures can be used with this test kit, including the surface-mount-device (SMD) fixtures. The Option 4395A-001 DC source is useful in applying DC voltage to the device up to 40 V.

4395A Specifications Summary

Network Measurement

Frequency Characteristics

- Range: 10 Hz to 500 MHz
- Resolution: 1 mHz
- Accuracy: $< \pm 5.5$ ppm (Option 4395A-1D5: $< \pm 0.13$ ppm)

Output Characteristics

- Power Range: -50 to $+15$ dBm
- Resolution: 0.1 dB
- Level Accuracy: ± 1.0 dB @ 0 dBm, 50 MHz

Receiver Characteristics

- Frequency Range: 10 Hz to 500 MHz
- Noise Level (referenced to full scale input level, $23 \pm 5^\circ$ C):
 - -85 dB (typical) @ $10 \text{ Hz} \leq f < 100 \text{ Hz}$, IFBW = 2 Hz
 - -85 dB @ $100 \text{ Hz} \leq f < 100 \text{ kHz}$, IFBW = 10 Hz
 - $(-115 + f/100 \text{ MHz})$ dB @ $100 \text{ kHz} \leq f$, IFBW = 10 Hz
- IF Bandwidth (Hz): 2, 10, 30, 100, 300, 1 k, 3 k, 10 k, 30 k

Dynamic Accuracy

Input Level (relative to full scale input level -10 dB)	Dynamic Accuracy Frequency ≥100 Hz
Magnitude Dynamic Accuracy	
0 dB ≥ input level ≥ -10 dB	±0.4 dB
-10 dB > input level ≥ -60 dB	±0.05 dB
-60 dB > input level ≥ -80 dB	±0.3 dB
-80 dB > input level ≥ -100dB	±3 dB
Phase Dynamic Accuracy	
0 dB ≥ input level ≥ -10 dB	±3°
-10 dB > input level ≥ -60 dB	±0.3°
-60 dB > input level ≥ -80 dB	±1.8°
-80 dB > input level ≥ -100 dB	±18°

@ R port input level=full scale input level -10 dB, IFBW=10 Hz, 23 ± 5 °C

Spectrum Measurement

Frequency Characteristics

- Frequency Range: 10 Hz to 500 MHz

Frequency Reference

- Accuracy: <±5.5 ppm (Option 4395A-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)

- Range: 1 Hz to 1 MHz, 1-3-10 step @ span >0
3 k, 5 k, 10 k, 20 k, 40 k, 100 k, 200 k, 400 k, 800 k, 1.5 M, 3 M,
5 MHz @ span = 0

- Selectivity (60 dB/3 dB): <3 @ span >0

Noise Sidebands

- Offset
1 kHz -97 dBc/Hz
10 kHz -97 dBc/Hz
100 kHz -110 dBc/Hz
1 MHz -110 dBc/Hz

Displayed Average Noise Level

- Frequency
1 kHz ≤ f <100 kHz -120 dBm/Hz
100 kHz ≤ f <10 MHz -133 dBm/Hz
10 MHz ≤ f (-145 + f/100 MHz) dBm/Hz

Spurious Response

- Second Harmonic Distortion: -70 dBc @ -16 dB full scale
- Third-Order Intermodulation Distortion: -70 dBc @ -16 dB full scale
- Other Spurious: -70 dBc @ -16 dBc full scale
- Scale Fidelity: ±0.05 dB @ 0 to -30 dB from full scale input level -10 dB

Impedance Measurement (Option 4395A-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy

Frequency Range: 100 kHz to 500 MHz

Measurement Port: 7 mm connector on the 43961A Test Kit

Source Level at Measurement Port: -56 to +9 dBm @ 50 Ω

Calibration: OPEN/SHORT/LOAD calibration,

OPEN/SHORT/LOAD compensation on test fixtures, port extension

Accuracy (Supplemental Performance Characteristics):

±3% basic accuracy @ 23 ± 5 °C, after OPEN/SHORT/LOAD calibration

General Characteristics

Full Scale Input Level

Attenuator setting (dB)	Full Scale Input Level	
	Network	Spectrum
0	-10 dBm	-20 dBm
10	0 dBm	-10 dBm
20	+10 dBm	0 dBm
30	+20 dBm	+10 dBm
40	+30 dBm	+20 dBm
50	+30 dBm	+30 dBm

Option 4395A-001 DC Voltage/Current Source

- Voltage Range: -40 V to +40 V
- Current Range: -20 mA to -100 mA, 20 mA to 100 mA

Operating Temperature/Humidity

- Disk Drive Non-Operating Condition: 0 °C to 40 °C, 15% to 95% RH
- Disk Drive Operating Condition: 10 °C to 40 °C, 15% to 80% RH

Storage Temperature/Humidity: -20 °C to 60 °C, 15% to 95% RH

Power Requirement: 100/120/220/240 V ±10%, 47 Hz to 66 Hz, 300 VA max.

Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Weight: 21 kg (46.2 lb) (typical)

Key Literature

4395A/96B Awareness Brochure, p/n 5965-9374E

4395A Network/Spectrum/Impedance Analyzer, Technical Specifications, p/n 5965-9340E

Dramatic Speed Improvement for Narrow RBW Sweeps by Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E

Network, Spectrum, and Impedance Evaluation of Electronic Circuits and Components, p/n 5967-5942E

How to Measure Noise Accurately Using the Combination Analyzers, p/n 5966-2292E

ADSL Copper Loop Measurements, p/n 5968-1196E

Switching Power Supply Evaluation, p/n 5968-7274E

Ordering Information

4395A Network/Spectrum/Impedance Analyzer

4395A-001 Add DC Source

4395A-010 Add Impedance Measurement Function (Requires 43961A)

4395A-1D5 Add High Stability Frequency Reference

4395A-1D6 Add Time-Gated Spectrum Analysis

4395A-1D7 50 Ω to 75 Ω Minimum Loss Pads

4395A-810 Add Keyboard

4395A-A6J ANSI Z540 compliant

87511A 50 Ω S-Parameter Test Sets

87511B 75 Ω S-Parameter Test Sets

87512A 50 Ω Transmission/Reflection Test Kits

87512B 75 Ω Transmission/Reflection Test Kits

43961A RF Impedance Test Kit (add test fixture listed below)

16191A Side Electrode SMD Test Fixture

16192A Parallel Electrode SMD Test Fixture

16194A High Temperature Component Test Fixture

16196A/B/C Parallel Electrode SMD Test Fixture

16197A Bottom Electrode SMD Test Fixture

16092A Spring Clip Test Fixture

4396B

- Full-vector network and spectrum measurement and analysis
- Wide dynamic range network measurement with fast sweep speeds
- ± 0.05 dB/ $\pm 0.3^\circ$ dynamic magnitude/phase accuracy
- Extremely fast narrowband spectrum measurement
- Impedance analysis option and test kit available
- ± 1.0 dB level accuracy for spectrum analysis
- -150 dBm/Hz sensitivity for spectrum analysis
- Built-in IBASIC for easy test automation
- Time-gated spectrum analysis option
- Color TFT display and built-in disk drive/RAM disk



4396B with 85046A

4396B RF Network/Spectrum Impedance Analyzer

The 4396B provides excellent RF vector network, spectrum, and optional impedance measurements for lab and production applications. When combined with a test set, the 4396B provides reflection measurements, such as return loss, and SWR, and S-parameters. Gain, phase, group delay, distortion, spurious, CN, and noise measurements often required for evaluating components and circuits can be measured using one instrument. As a vector network analyzer, the 4396B operates from 100 kHz to 1.8 GHz with 1 mHz resolution and its integrated synthesized source provides -60 to $+20$ dBm of output power with 0.1 dB resolution. The dynamic magnitude and phase accuracy are ± 0.05 dB and $\pm 0.3^\circ$ so that it can accurately measure gain and group delay flatness, which are becoming more important in modern electronics systems.

As a spectrum analyzer, the 4396B operates from 2 Hz to 1.8 GHz with resolution bandwidths (RBWs) spanning 1 Hz to 3 MHz in a 1-3-10 sequence. A fully-synthesized local oscillator allows stable and accurate frequency analysis. Direct A/D conversion (no LOG amplifier is used) results in ± 1.0 dB overall level accuracy. Noise sidebands fall below -105 dBc/Hz offset 10 kHz from carriers below 1 GHz, while sensitivity is -150 dBm/Hz at 10 MHz and -147 dBm/Hz at 1 GHz. In addition, with two independent display channels available, you can simultaneously view network and spectrum (or transmission and reflection) characteristics of the device under test in split-screen format. For example, an amplifier's frequency response (network measurement) and distortion (spectrum measurement) can be shown at the same time.

Extremely Fast Spectrum Measurement

The 4396B features a stepped Fast Fourier Transform (FFT) digital-signal-processing (DSP) technique for 20 to 100 times faster narrowband spectrum measurement than swept-tuned spectrum analyzers. The stepped FFT is performed when the resolution bandwidth (RBW) is set at 3 kHz or below. For example, with a 30 Hz RBW and 10 kHz span, the 4396B has a sweep time of 400 ms, while swept-tuned spectrum analyzers take a few tens of seconds. The stepped FFT can greatly improve the speeds of narrowband spectrum measurement such as frequency tuning of a VCO or CN measurements.

Time-Gated Spectrum Analysis

With Option 4396B-1D6, the 4396B offers time-gated spectrum analysis capability to capture and measure repetitive burst signals in video, disk drives, communication equipment, and more. The minimum gate length is 2 μ sec so that even narrow-burst signals can be analyzed.

Impedance Measurement Function and RF Impedance Test Kit

A full-featured impedance measurement function (useful for quick-check general-purpose impedance applications) can be added to the 4396B by adding Option 4396B-010 and the 43961A RF impedance test kit. Covering from 100 kHz to 1.8 GHz, impedance parameters $|Z|$, θ , C, L, Q, D, and more, are directly measured and displayed. The basic impedance accuracy (typical value) is 3%. The 43961A RF impedance test kit is designed for the 4396B and is required to utilize the features of Option 4396B-010. A 7 mm connector is mounted on this kit for easy connection to an appropriate impedance test figure. A wide variety of Agilent test fixtures can be used with the test kit, including the surface-mount-device (SMD) fixtures.

4396B Specifications Summary

Network Measurement

Frequency Characteristics

- Range: 100 kHz to 1.8 GHz
- Resolution: 1 mHz
- Accuracy: $< \pm 5.5$ ppm (Option 4396B-1D5: $< \pm 0.13$ ppm)

Output Characteristics

- Power Range: -60 to $+20$ dBm
- Resolution: 0.1 dB
- Level Accuracy: $< \pm 0.5$ dB

Receiver Characteristics

- Frequency Range: 100 kHz to 1.8 GHz
- Noise Level (10 Hz IFBW, ≥ 10 MHz, f = frequency in GHz):
 - $< (-125 + 3 \times f)$ dBm (A, B inputs);
 - $< (-100 + 3 \times f)$ dBm (R input)
- Full Scale Input Level: -5 dBm (A, B), $+20$ dBm (R)
- IF Bandwidth (Hz): 10, 30, 100, 300, 1 k, 3 k, 10 k, 40 k

Dynamic Accuracy

Input level (relative to full scale input level)	
Magnitude Dynamic Accuracy	
0 dB	<±0.3 dB
-10 to -70 dB	<±0.05 dB
-80 dB	<±0.1 dB
-90 dB	<±0.3 dB
-100 dB	<±1.0 dB
-110 dB	<±0.8 dB typical
-120 dB	<±2.5 dB typical
Phase Dynamic Accuracy	
0 dB	<±3°
-10 dB	<±0.6°
-20 to -70 dB	<±0.3°
-80 dB	<±0.7°
-90 dB	<±2°
-100 dB	<±7°
-110 dB	<±8° typical
-120 dB	<±25° typical

@ 23 ±5 °C, IFBW 10 Hz, R input = -35 dBm

Measurement Throughput Summary (IFBW 40 kHz, ms)

Measurement (with THRU Cal)	Number of points			
	51	201	401	801
(1) Magnitude	62	138	239	443
(2) Magnitude and phase	84	227	417	798

Spectrum Measurement

Frequency Characteristics

- Frequency Range: 2 Hz to 1.8 GHz

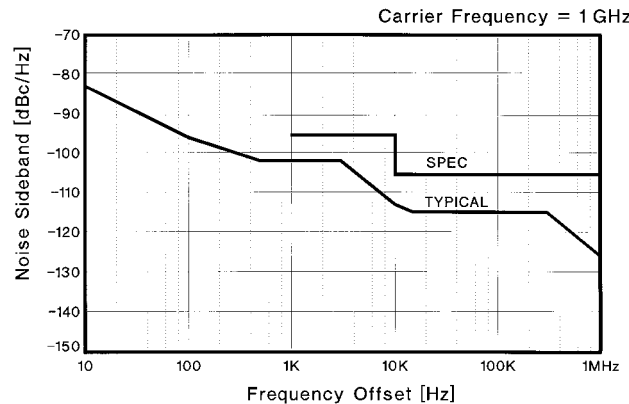
Frequency Reference

- Accuracy: <±5.5 ppm (Option 4396B-1D5: <±0.13 ppm)

Resolution Bandwidth (RBW)

- Range: 1 Hz to 3 MHz, 1-3-10 step
- Selectivity (60 dB/3 dB): RBW ≥10 kHz: <10; RBW ≤3 kHz: <3

Noise Sidebands



Noise sidebands normalized to 1 Hz RBW versus offset from carrier (typical)

Displayed Average Noise Level

(@ frequency ≥10 MHz, ref. level ≤-40 dBm, att. = 0 dBm): <(-150 + 3f (GHz)) dBm/Hz

Spurious Response

- Second Harmonic Distortion (@ ≥10 MHz, -35 dBm mixer input): <-70 dBc
- Third-Order Intermodulation Distortion (@ ≥10 MHz, -30 dBm, separation >20 kHz): <-75 dBc

Other Spurious (@ -30 dBm mixer input, offset ≥1 kHz): <-70 dBc

Scale Fidelity: ±0.05 dB @ 0 to -30 dB from ref. level

Impedance Measurement (Option 4396B-010, 43961A)

Measurement Parameters: |Z|, θz, |Y|, θy, R, X, G, B, Cp, Cs,

Lp, Ls, Rp, Rs, D, Q, |Γ|, θγ, Γx, Γy

Frequency Range: 100 kHz to 1.8 GHz

Measurement Port: 7 mm connector on the 43961A Test Kit

Source Level at RF out: -60 to +20 dBm (6 dB lower at 43961A port)

DC Bias: ±40 V (20 mA maximum). A 2 kΩ ±5% internal resistor is used for dc bias current limitation. An external dc bias source is required.

Connector: BNC (f) on 43961A.

Calibration: OPEN (0 S)/SHORT (0 Ω)/LOAD (50 Ω) calibration, OPEN/SHORT/LOAD compensation on test fixtures, port extension compensation

Accuracy (Supplemental Performance Characteristics): 3% basic accuracy at 23 °C ±5 °C, after OPEN/SHORT/LOAD calibration

General Characteristics

Operating Temperature/Humidity: 0 °C to 40 °C, 15% <RH <95%

Storage Temperature: -20 °C to 60 °C

Power Requirement: 90 V to 132 V, 198 V to 264 V, 47 Hz to 63 Hz, 300 VA max.

Weight: 21.5 kg (47.3 lb) typical

Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Key Literature

4395A/96B Awareness Brochure, p/n 5965-9374E

4396B 1.8 GHz Network/Spectrum Analyzer Technical Data,

p/n 5965-6311E

Combining Network and Spectrum Analyzers and IBASIC to improve

device characterization and test time, p/n 5965-7656E

Configuring the 4396B for O/E Testing, p/n 5965-7657E

How to Characterize CATV Amplifiers Effectively, p/n 5965-9434E

Dramatic Speed Improvement for Narrow RBW Sweeps by

Audio/Video/IF/RF/Spectrum Analyzers, p/n 5966-4099E

Network, Spectrum, and Impedance Evaluation of Electronic Circuits

and Components, p/n 5967-5942E

How to Measure Noise Accurately Using the Combination Analyzers,

p/n 5966-2292E

Ordering Information

4396B Network/Spectrum/Impedance Analyzer

4396B-010 Add Impedance Measurement Function

(Requires 43961A)

4396B-1D5 Add High Stability Frequency Reference

4396B-1D6 Add Time-Gated Spectrum Analysis

4396B-1D7 50 ohm to 75 ohm Minimum Loss Pads

4396B-810 Add Keyboard

4396B-A6J ANSI Z540 compliant

85046A 50 Ω S-Parameter Test Sets

85046B 75 Ω S-Parameter Test Sets

87512A 50 Ω Transmission/Reflection Test Kits

87512B 75 Ω Transmission/Reflection Test Kits

43961A RF Impedance Test Kit (add test fixtures listed below)

16191A Side Electrode SMD fixture (dc to 2 GHz)

16192A Parallel Electrode SMD fixture (dc to 2 GHz)

16194A High Temperature Component Test Fixture

16196A/B/C Parallel Electrode SMD Test Fixture

16197A Bottom Electrode SMD Test Fixture

16092A Spring-Clip Fixture (dc to 500 MHz)

43961A
87511A
87511B
87512A
87512B
41800A



43961A

43961A RF Impedance Test Kit

The 43961A RF impedance test kit provides the capability to measure impedance parameters of 1-port devices with the 4395A with Option 4395A-010 (100 kHz to 500 MHz) or the 4396B with Option 4396B-010 (100 kHz to 1.8 GHz). The test port of the 43961A is a 7 mm connector and can be used with the 16196A/B/C, 16197A, or 7 mm type test fixtures. The 43961A includes open/short/load calibration standards, and the test fixtures such as 16197A are optional.

Frequency Range: 100 kHz to 1.8 GHz (100 kHz to 500 MHz with 4395A)
Measurement Parameters: $|Z|$, $|Y|$, θ , R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q, $|\Gamma|$



87511A

87511A/B S-Parameter Test Sets

The 87511A/B S-parameter test sets provide the capability to measure S-parameters of 2-port devices from 100 kHz to 500 MHz with a network analyzer. The test ports of the 87511A are 50 Ω connectors (Option 87511A-008: 7 mm or Option 87511A-001: type N(f)), and the test ports of the 87511B are 75 Ω type N(f) connectors. Calibration kits are not included.

Frequency Range: 100 kHz to 500 MHz
Test Port Impedance: 87511A, 50 Ω ; 87511B, 75 Ω

	87511A	87511B
Directivity		
100 kHz to 300 kHz	30 dB	30 dB
300 kHz to 200 MHz	40 dB	33 dB
200 MHz to 500 MHz	35 dB	33 dB
Nominal Insertion Loss		
RF IN to port 1, 2	13 dB	19 dB
RF IN to R, A, B	19 dB	31 dB

Size: 90 mm H x 432 mm W x 495 mm D (3.6 in x 17.28 in x 19.8 in)
Weight: 5.7 kg (12.54 lb) (typical)

English URL www.agilent.com/find/products



87512A

87512A/B Transmission/Reflection Test Kits

87512A/B transmission/reflection test kits provide the capability to measure the reflection and transmission characteristics of 50 Ω or 75 Ω devices up to 2 GHz with an Agilent network analyzer. The test port of the 87512A is a 50 Ω type N(f) connector, and the test port of the 87512B is a 75 Ω type N(f) connector. The 87512A/B include precision short/load termination for calibration.

Frequency Range: DC to 2 GHz
Test Port Impedance: 87512A, 50 Ω ; 87512B, 75 Ω
Equivalent Directivity: 40 dB (typical)
Insertion Loss: 10 dB \pm 1 dB



41800A

41800A Active Probe

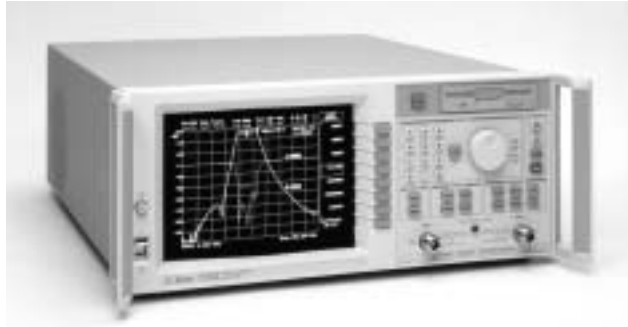
The 41800A active probe provides high input impedance from 5 Hz to 500 MHz. The 41800A is a valuable tool when used with a network and spectrum analyzer for circuit signal analysis.

Specifications

Bandwidth: 5 Hz to 500 MHz
Output Connector: 50 Ω type N male
Input R,C (typical): 100 k Ω , 3 pF (probe alone); 1 M Ω , 1 pF (with 10:1, 100:1 divider)
Frequency Response relative to 50 MHz: \pm 1 dB @ 50 Hz to 200 MHz
Average Noise Level: 10 nV/ $\sqrt{\text{Hz}}$ @ \geq 300 kHz
Second Harmonic Distortion: $<$ -50 dBc @ 20 dBm (250 MHz) input (typical)
Third-Order Intermodulation Distortion: $<$ -70 dBc @ -26 dBm two signal input (typical)
1 dB Gain Compression: $>$ +3 dBm input @ 500 MHz

Korean URL www.agilent.co.kr/find/products

- 300 kHz to 1.3 GHz (8712ET/ES) or 3 GHz (8714ET/ES)
- S-parameter measurements (ES models)
- Up to 100 dB dynamic range
- Narrowband and broadband detection
- Real-time sweep speeds
- 50 Ω or 75 Ω system impedance
- 1 Hz resolution synthesized source
- Standard LAN interface
- Standard GP Instrument BASIC (IBASIC)
- Optional fault-location and SRL measurements
- Standard multiport test sets available



8712E RF Network Analyzer Series

8712E RF Network Analyzer Series

Designed for Manufacturing

The 8712E Series of economical RF network analyzers provides speed, accuracy, and automation features in compact, integrated instruments for high-volume RF component manufacturing. These analyzers help reduce tune and test times, increase throughput, and lower your overall cost per component. A choice of transmission/reflection analyzers (ET models) or S-parameter analyzers (ES models) allows you to choose the optimum level of performance versus price to meet your measurement needs.

Standard Family Features

The 8712ET and 8714ET feature built-in transmission/reflection test sets with a full range of magnitude and phase measurements. These analyzers also employ advanced vector-error correction techniques to enhance measurement accuracy.

The 8712ES and 8714ES feature S-parameter test sets with full two-port vector-error correction, providing the highest level of measurement accuracy.

All these analyzers provide fast, complete swept-frequency and swept-power characterization of RF components. In addition:

- 300 kHz to 1.3 or 3 GHz models are available in both 50 Ω or 75 Ω options
- A synthesized source provides fast, stable, high-resolution (1 Hz) stimulus for accurate measurements on a variety of RF components
- Power sweeps enable testing of amplifier gain compression and AM-PM conversion
- A 60 dB step attenuator (standard on ES models, optional on ET models) provides a wide range of output power levels for testing active devices
- Real-time sweep speeds with better than 10 updates per second facilitate high device throughput and increase tuning efficiency
- A built-in 3.5-inch DOS-format disk drive provides unlimited data storage
- Serial, parallel, LAN and GPIB interfaces make it easy to print or plot data to all printers and plotters

Flexible, sensitive receivers offer a choice between narrowband and broadband detection. Broadband detection allows scalar characterization of frequency-translating devices, while narrowband detection provides up to 100 dB of dynamic range for vector measurements of high-rejection devices.

The instruments are equipped with a large, 9-inch monochrome display for clear view of measurement data, softkey functions, IBASIC programs, and markers. Display pass/fail indicators and trace data in color by connecting any VGA-compatible monitor. Two independent measurement channels let you display transmission and reflection data simultaneously. Each channel can have independent measurement parameters such as frequency range, IF bandwidth, number of points, and display formats. Display formats include SWR, linear and log magnitude, phase and group delay, Smith chart, polar, real and imaginary, dBW, dBm, dB μ W, dBV, dBmV, and dB μ V.

Manufacturing Features

A network connection provides an efficient and reliable way to communicate with your test systems. The standard TCP/IP-compliant Ethernet LAN interface makes connecting to a factory-wide network easy. Use a variety of standard protocols, such as ftp, http, bootp, telnet, sockets, and network file system (NFS) to simultaneously distribute new test programs, test parameters, limit lines, and custom interfaces to all of the instruments on your production lines. With LAN capability, data can be directly imported into your PC applications, such as Microsoft Word, and Excel, or sent to a networked printer. You can also remotely troubleshoot test station problems from anywhere on the network by using any standard web browser.

With Instrument BASIC programming language (IBASIC), you can easily create custom test applications and user interfaces that include:

- Special softkey labels, graphical setup diagrams, and tailored user prompts
- Bar-code-reading capability for efficient tracking and documentation of individual device performance
- Control other test instruments via the LAN, GPIB, serial, or parallel interfaces
- For simpler applications, even those without programming expertise can use IBASIC as a keystroke recorder, to easily automate manual measurements

Many manufacturing tests can be accomplished by merely recalling the appropriate instrument state, eliminating the need to change measurement parameters manually. Hundreds of instrument states can be programmed for a variety of uses. With Agilent's "fast-recall" feature, one of seven instrument states can be quickly recalled with a single softkey, or with a foot switch for hands-free switching during aligning or assembly operations.

Instrument states can include user-defined limit lines that let you easily and consistently compare measured data to test limits, providing automated pass/fail testing. The pass/fail results are displayed clearly on the instrument screen or external monitor to minimize operator errors or misinterpretation. Automated pass/fail testing eliminates the guesswork from your test processes and helps ensure that your components are aligned and tested to the same specifications at all test stations.

Speed up component test times by using the power of built-in data markers. Use the eight markers per channel to display data in absolute or relative terms. Or, perform automatic, real-time calculations of device characteristics such as maximum/minimum, center frequency, mean and standard deviation, peak-to-peak excursion, gain, slope and flatness, and filter 3-dB bandwidth, loss, and Q.

Comprehensive, Fast Cable Test

Option 100 adds fault-location and structural-return-loss (SRL) measurement capability for characterizing 50 Ω or 75 Ω cables that are still on a spool in a warehouse, or already installed on a cellular tower.

Agilent's fault-location option is easy to use and has many advantages over traditional time-domain reflectometry (TDR) techniques. You can also use the option to easily characterize the loss and velocity factors of your cables, and to accurately check the effect of cable damage by measuring SRL. Option 101 combines Option 100 with a rugged transport case to protect your instrument in the field during transport and operation.

8712ET
8712ES
8714ET
8714ES

8712ET
8712ES
8714ET
8714ES
87050E
87075C



8712E RF Network Analyzer Series

87050E and 87075C Multiport Test Sets

The 87050E (50 ohm) and the 87075C (75 ohm) multiport test sets are designed to work with the 8712E series of RF vector network analyzers to provide complete multiport measurement systems. The 87050E has specified performance from 3 MHz to 2.2 GHz, with typical performance to 3 GHz. The 50 ohm test set is offered in 4, 8 and 12-port options. The 87075C has a frequency range of 3 MHz to 1.3 GHz and is offered in 6- and 12-port options.

These systems dramatically increase measurement throughput by minimizing RF connections. Connect your device one time to measure all signal paths and ports. Reduce operator fatigue, mis-connection rates, and the wear on cables, fixtures, and connectors as well. In addition, the 8712E series of network analyzers provides many productivity features that speed tune and test times, increase throughput, and simplify automation.

An 87050E or an 87075C coupled with an 8712E series network analyzer is the only low-cost, multiport test system with fully specified performance at the actual test ports, whether you measure in a fixture or at the end of test cables. Specified performances means you get the same measurement results on any test station, reduce measurement uncertainty to tighten your product specifications, and increase customer confidence in your products.

Innovative New Calibration Techniques Save Time and Increase Accuracy

Test Set Cal is an advanced calibration technique that eliminates the redundant connection of standards during a system calibration. Calibrating a multiport test set using two-port error correction and a traditional network analyzer requires a unique instrument state for each measurement path, forcing many redundant connections of calibration standards. As the number of ports increases, so does the number of connections required to calibrate all possible measurement paths. Full calibration of the 87050E and 87075C multiport test systems is quick and simple when performing a Test Set Cal:

- Connect short, open, and load standards only once to each measurement port
- Minimize the number of through standards required during calibration

In between Test Set Cals, the system can quickly recalibrate itself by using SelfCal. SelfCal is an internally automated calibration technique that uses solid-state switches to measure calibration standards located inside the test set. The network analyzer's firmware automatically controls the SelfCal process at an interval you define. SelfCal re-calibrates your multiport system to the same measurement accuracy achieved immediately after performing a Test Set Cal, thus reducing the effects of test-system drift and improving overall measurement accuracy between Test Set Cals. Using Test Set Cal and SelfCal, you can:

- Easily reduce your overall calibration times by a factor of twenty or more
- Increase the amount of time a test station can be used for measuring devices – typically, by three days per month

Detectors and Bridges

External detectors (50 Ω and 75 Ω) are available for remote device measurements.

86200B 50 Ω Scalar Detector

An external scalar detector for measuring 50 Ω devices.

86201B 75 Ω Scalar Detector

An external scalar detector for measuring 75 Ω devices.

Upgrade Kits

The following upgrade kits add optional measurement capability to existing 8712E series RF network analyzers.

To order, add a “U” to the end of the model number of the instrument to be upgraded, and specify one or more of these options:

Option 1E1 50 Ω Step Attenuator

Provides the necessary components to retrofit an 8712ET or 8714ET with a 60 dB step attenuator (for 50 ohm models only). Does not include installation. Requires recalibration.

Option UNE 75 Ω Step Attenuator

Provides the necessary components to retrofit an 8712ET or 8714ET with a 60 dB step attenuator (for 75 ohm models only). Does not include installation. Requires recalibration.

Option 099 Firmware Upgrade

Upgrade to the latest version of firmware. Does not include installation.

Option 100 Fault Location/SRL

Provides cable-measurement software. Does not include transport case. Does not include installation.

Option 101 Transport and Operating Case and Fault Location/SRL

Combines transport and operation case with Option 100. Does not include installation.

Transit Cases

Agilent offers a complete line of sturdy transit cases in Valise and Tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2656 (standard) or model 9211-7481 (tote) fit the 8712ET/ES and 8714ET/ES.

Key Literature

- 8712ET/ES and 8714ET/ES Brochure, p/n 5967-6316E
- 8712ET/ES and 8714ET/ES Technical Specifications, p/n 5967-6314E
- 8712ET/ES and 8714ET/ES Configuration Guide, p/n 5967-6315E
- 87050E Brochure, p/n 5968-4763E
- 87050E Technical Specifications, p/n 5968-4764E
- 87050E Configuration Guide, p/n 5968-4765E
- 87075C Brochure, p/n 5968-4766E
- 87075C Technical Specifications, p/n 5968-4767E
- 87075C Configuration Guide, p/n 5968-4768E

For more information, visit our web site:
<http://www.agilent.com/find/8712>

8712ET
 8712ES
 8714ET
 8714ES

5

	8712ET 8712ES		8714ET 8714ES	
Impedance	50 ohm	75 ohm (Option 1EC)	50 ohm	75 ohm (Option 1EC)
Minimum Frequency	300 kHz	300 kHz	300 kHz	300 kHz
Maximum Frequency	1.3 GHz	1.3 GHz	3.0 GHz	3.0 GHz
Frequency Resolution	1 Hz	1 Hz	1 Hz	1 Hz
Max. Source Power ET (<1 GHz/>1 GHz) with Option 1E1 ES (<1 GHz/>1 GHz)	16 dBm/13 dBm 15 dBm/12 dBm 13 dBm/10 dBm	13 dBm/10dBm 12 dBm/9 dBm 10 dBm/7dBm	11 dBm/10 dBm 10 dBm/9 dBm 9 dBm/7dBm	8 dBm/7 dBm 7 dBm/6 dBm 6 dBm/4 dBm
Min. Source Power ET with Option 1E1 ES	0 dBm -60 dBm -60 dBm	-3 dBm -60 dBm -60 dBm	-5 dBm -60 dBm -60 dBm	-8 dBm -60 dBm -60 dBm
Power Resolution	0.01 dBm	0.01 dBm	0.01 dBm	0.01 dBm
Power Flatness ET with Option 1E1 ES	±1.0 dB ±2.0 dB ±2.0 dB	±1.5 dB ±3.0 dB ±3.0 dB	±1.0 dB ±2.0 dB ±2.0 dB	±1.5 dB ±3.0 dB ±3.0 dB
Power Sweep Range	13 dB	13 dB	15 dB	15 dB
System Dynamic Range ET (narrowband/broadband) with Option 1E1 ES (narrowband/broadband)	>115 dB/>62 dB >115 dB/>60 dB >104 dB/>46 dB	>113 dB/>56 dB >110 dB/>53 dB >99 dB/>39 dB	>114 dB/>59 dB >112 dB/>57dB >101 dB/>43 dB	>110 dB/>53 dB >107 dB/>50 dB >96 dB/>36 dB
Test Port Connector	Type-N (f)	Type-N (f)	Type-N (f)	Type-N (f)

Data applies at 25°C ± 5°C. See product literature for more complete specifications and for total measurement uncertainty after error correction.

Size: 179 mm H x 425 mm W x 514 mm D (7.0 in x 16.75 in x 20.25 in)

Weight: 20.5 kg (45 lb) net; 27 kg (59 lb) shipping

Ordering Information

Note: A complete system consists of a network analyzer, calibration kit, and cables. Calibration kits and cables can be found in the Accessories section beginning on page 238.

8712ET Network Analyzer
8712ES Network Analyzer
8714ET Network Analyzer
8714ES Network Analyzer

The following options apply to all three network analyzers:

- Option 050** 50 Ω Impedance
- Option 1EC** 75 Ω Impedance
- Option 1E1** 60 dB Attenuator (ET models only)
- Option 1CL** DIN Keyboard
- Option 1CM** Rackmount Kit
- Option 100** Fault Location/SRL
- Option 101** Transport and Operating Case plus Fault Location/SRL
- Option AFN** 50 Ω Economy Cable
- Option AFP** 75 Ω Economy Cable
- Option B20** 50 Ω Precision Cable
- Option B21** 75 Ω Precision Cable

87050E Multiport Test Sets

- 87050E-004** 4 ports
- 87050E-008** 8 ports
- 87050E-012** 12 ports

87075C Multiport Test Sets

- 87075C-006** 6 ports
- 87075C-012** 12 ports

Upgrades for ET and ES models (Add "U" to model number)

- Option 1E1** 50 Ω Step Attenuator (ET only)
- Option UNE** 75 Ω step attenuator (ET only)
- Option 100** FL/SRL Upgrade Kit
- Option 101** Transport Operating Case plus FL/SRL Upgrade Kit

Upgrades for C models

- 86226C** Firmware Upgrade Kit
- 86227C** LAN Upgrade Kit

Accessories

- 86200B** 50 Ω Scalar Detector
- 86201B** 75 Ω Scalar Detector

Transit Cases

- 9211-2656** Standard Transit Case
- 9211-7481** Tote-Style Transit Case

- 30 kHz to 3 or 6 GHz frequency range
- Integrated T/R or S-parameter test set
- Up to 110 dB dynamic range
- Large LCD display with VGA output for external monitors
- Display up to four parameters at the same time
- Save/recall instrument states and data to built-in floppy-disk drive
- Optional time-domain and swept-harmonic measurements



Powerful measurement solutions

The 8753ET and 8753ES RF network analyzers offer an unbeatable combination of speed, performance, and ease of use to meet your measurement needs, whether in the R&D laboratory or on the production floor. With an integrated test set covering to 3 or 6 GHz, up to 110 dB of dynamic range, and both frequency and power sweeps, the 8753ET and 8753ES give you a powerful solution for characterizing the linear and nonlinear behavior of active and passive networks, devices, components, and subsystems.

Family Features

Selecting the transmission/reflection analyzers (ET model) or S-parameter analyzers (ES model) allows you to choose the optimum level of performance versus cost for your application. The network analyzers feature two independent measurement channels that can measure and display up to four parameters simultaneously. You can choose to display any combination of reflection and transmission parameters, with magnitude, phase, group-delay, Smith-chart, polar, SWR, or time-domain formats. Easy-to-use softkeys let you access measurement functions quickly, and you can view results in overlay or split-screen format on the crisp, LCD color display using up to four graticules. A VGA-compatible output has been added to drive larger external monitors for enhanced viewing.

Test sequencing allows rapid, repeated execution of complex measurements with a single keystroke. In test-sequence mode, you make a measurement once from the front panel, and the analyzer stores the keystrokes so that the measurement can be repeated without any additional programming. You can also use a test sequence to control external devices through the parallel or GPIB port.

For measurements of mixers, tuners, and other frequency-translating devices, the frequency-offset mode allows the network analyzer source to be tuned independently from the receiver. Measurements of conversion loss, phase, group-delay, and mixer-tracking can easily be done, with either fixed or swept-IF testing.¹

Power-meter calibration provides leveled absolute power to devices that are sensitive to absolute input or output levels. The 8753ET/ES automatically controls an 436A, 437B, 438A, E4418B or E4419B power meter to set the power anywhere in the test setup with power-meter accuracy, or to calibrate the network analyzer receivers for accurate absolute-power measurements.

Other productivity features include a built-in floppy-disk drive supporting LIF, DOS, JPEG, and comma separated variable (CSV) formats, non-volatile memory, serial and parallel interfaces, a DIN keyboard interface, and a real-time clock for time-stamping of print-

outs and files. Limit testing, arbitrary frequency testing, and marker-tracking functions are included. You can reduce measurement time by using swept-list mode to choose specific frequencies to test, and to set independent IF bandwidths and power levels in each frequency range. Segmented calibration and interpolated error correction allow you to apply vector-accuracy enhancement over a subset of the analyzer's calibrated frequency range. The 8753ET/ES code compatibility with the 8753D/E enables you to leverage your existing software.

With Option 010, you can view reflection or transmission responses in the time domain. The analyzer computes the inverse FFT of the frequency-domain data to display the reflection or transmission coefficient versus time. Two time-domain analysis modes enable you to view the step or impulse response of your device. Time gating can be used to remove unwanted responses such as connector mismatch, and the gated results can be displayed in either the time or frequency domains.

Combine an S-parameter network analyzer with the time domain capability to provide a simple, deterministic method for tuning cavity-resonator bandpass filters. Comparing the filter's reflection response in time-domain with the response of a properly tuned filter reveals which resonators or coupling adjustments need to be tuned. With time-domain filter tuning, you can easily train new personnel for this complex task and greatly simplify fine-tuning and troubleshooting procedures.

For more advanced characterization of devices, Option 002 adds harmonic-measurement capability. Swept second and third-harmonic levels of an amplifier can be displayed absolutely or in dBc relative to the fundamental. With the press of a button, you can measure harmonics down to -40 dBc.

A high-stability frequency reference, Option ID5, improves the frequency accuracy of measurements of high-Q devices such as SAW and crystal resonators or dielectric-resonance filters.

ET Models

The 8753ET features a built-in 50-ohm transmission/reflection (T/R) test set providing a full range of magnitude and phase measurements. Frequency coverage is from 300 kHz to 3 or 6 GHz. The T/R capability provides a very high level of accuracy and convenience in making forward measurements of the device under test. Enhanced response calibration corrects for the effects of source match in a transmission measurement. Option 004 extends the standard -20 to +5 dBm source power range to -85 to +10 dBm.

ES Models

The 8753ES features a built-in 50-ohm or 75-ohm S-parameter test set providing a full range of magnitude and phase measurements. Full two-port error correction capability provides the highest level of accuracy and the S-parameter test set provides the convenience of making both forward and reverse sweep measurements without reversing the device under test. For configuration flexibility, Option 011 deletes the built-in test set so that you can select your own. The 8753ES-011 works with the 85046A/B and 85047A S-parameter test sets, and other specialized test sets for specific applications. Option 014 provides a configurable test set for maximum flexibility. For convenient, accurate measurements in noncoaxial environments, TRL*/LRM** calibration is available. Highly accurate measurements of non-insertable devices can also be achieved using the built-in adapter-removal calibration technique.

Agilent-qualified Channel Partners provide measurement hardware and software solutions that combine with Agilent's network analyzer products to offer a complete solution for your testing needs. For additional information, please refer to page 34.

¹Phase measurements require reference mixer.

²TRL* and LRM** are three-sampler implementations of the through-reflect-line and line-reflect-match calibration techniques.

8753ET
8753ES

5

8753ET
8753ES

Specifications Summary

Test Sets

8753ET provides an integrated transmission/reflection test set with complete forward measurements in 50 ohm. 8753ES provides an integrated S-parameter test set with complete forward and reverse measurements in 50-ohm (standard) or 75-ohm (Option 075). External test sets supported with the 8753ES-011.

Upgrade Kits for the 8753ET and 8753ES

Upgrade kits retrofit the latest operating system or add optional measurement capability to existing network analyzers. To order, add a "U" to the end of the model number of the instrument to be upgraded, and specify the desired option(s):

Option 002 Harmonic-Measurements Upgrade

This upgrade kit adds harmonic-measurement capability (Option 002) to an 8753ET or 8753ES network analyzer. This kit includes installation at an Agilent service center.

Option 004 Step Attenuator Upgrade

This upgrade kit adds a step attenuator to the 8753ET network analyzer. This enables the output power range to operate from -85 to +10 dBm instead of the standard -20 to +5 dBm. This kit includes installation at an Agilent Service Center.

Option 006 6 GHz Upgrade for Standard Units

This kit extends the operating frequency range of the standard 8753ET or 8753ES from 3 GHz to 6 GHz. Includes installation at an Agilent service center. Not compatible with 8753ES-075 or -011.

Option 611 6 GHz Upgrade for Option 011 Units

This kit extends the operating frequency range of the 8753ES-011 from 3 GHz to 6 GHz. Includes installation at an Agilent service center.

Option 010 Time-Domain Upgrade

This upgrade kit adds time-domain-analysis capability (Option 010) to an existing 8753ET or 8753ES network analyzer. This kit is user-installable.

Option 099 Firmware Upgrade Kit

This kit provides the latest version of firmware for the 8753ET or 8753ES network analyzer. The kit is user-installable. This kit may be optionally downloaded from Agilent's web site: www.agilent.com/find/firmware

Option 1D5 High-Stability Frequency Reference Upgrade

This option adds a high-stability frequency reference (Option 1D5) to an 8753ET or 8753ES network analyzer. Includes installation at an Agilent service center.

Key Literature

8753ET/ES Network Analyzer Brochure, p/n 5968-5159E
8753ET/ES Network Analyzer Technical Specifications, p/n 5968-5160E
8753ET/ES Network Analyzer Configuration Guide, p/n 5968-5158E

For more information, visit our web site: www.agilent.com/find/8753

5

	8753ET	8753ES	8753ES Option 011
Impedance	50 ohm (standard)	50 ohm (standard) 75 ohm (Option 075)	Depends on test set
Minimum Frequency	300 kHz	30 kHz	300 kHz (30 kHz with Option 006)
Maximum Frequency	3 GHz (6 GHz with Option 006)	3 GHz (6 GHz with Option 006)	3 GHz (6 GHz with Option 006)
Frequency Resolution	1 Hz	1 Hz	1 Hz
Max. Source Power	5 dBm (10 dBm with Option 004)	10 dBm (8 dBm with Option 075 or Option 014)	20 dBm (18 dBm between 3 to 6 GHz with Option 006)
Min. Source Power	-20 dBm (-85 dBm with Option 004)	-85 dBm	-5 dBm
Power Resolution	0.01 dB	0.01 dB	0.01 dB
Power Flatness	<±0.5 dB	±1 dB	±1 dB
Power Sweep Range	25 dB	25 dB	25 dB
System Dynamic Range (>300kHz)	100 dB to 110 dB	100 dB to 110 dB	Depends on test set
Test Port Connector	Type-N (f)	7 mm (75 ohm Type-N (f) with Option 075)	Depends on test set

Data applies at 25°C ± 5°C. See product literature for more complete specifications and for total measurement uncertainty after error correction.

Size: 222 mm H x 425 mm W x 457 mm D (8.75 in x 16.75 in x 18 in)

Weight: 21 kg (46 lb) net; 35 kg (77 lb) shipping

External S-Parameter Test Sets

The S-parameter test sets provide the capability to measure reflection and transmission characteristics (including S-parameters) of two-port devices in either direction with a single connection. The test sets are controlled from the analyzer and include programmable step attenuators. These test sets are used with the 8753A/B/C or the 8753D/E/ES-011 only.

85046A/B S-Parameter Test Sets

The 85046A/B test sets provide the capability to simultaneously measure the transmission and reflection characteristics of 50-ohm and 75-ohm devices, respectively.

Specifications Summary

	85046A	85046B
Impedance	50 Ω	75 Ω
Frequency Range	300 kHz to 3 GHz	300 kHz to 2 GHz
Directivity	35 dB to 1.3 GHz 30 dB to 3.0 GHz	35 dB to 1.3 GHz 30 dB to 2.0 GHz
Typical Tracking		
Transmission Magnitude, Phase ^{1,2,3}		
0.3 MHz to 2.0 MHz	± 1.5 dB, $\pm 20^\circ$	± 1.5 dB, $\pm 20^\circ$
2.0 MHz to Fmax	± 1.5 dB, $\pm 10^\circ$	± 1.5 dB, $\pm 10^\circ$
Reflection Magnitude, Phase ^{1,2,3}		
0.3 MHz to 2.0 MHz	± 1.5 dB, $\pm 25^\circ$	± 1.5 dB, $\pm 25^\circ$
2.0 MHz to Fmax	± 1.5 dB, $\pm 10^\circ$	± 1.5 dB, $\pm 10^\circ$
Effective Source Match³ (test ports)		
0.3 MHz to 2.0 MHz	14 dB	14 dB
2.0 MHz to 1.3 GHz	20 dB	17 dB
2.0 MHz to Fmax	16 dB	16 dB
RF Connectors		
Test Ports	Precision 7 mm	75 Ω Type-N (female)
All Others	50 Ω Type-N (female)	50 Ω Type-N (female)

¹Degrees, specified as deviation from linear phase.

²Fmax is the upper frequency limit of the associated test set.

³Can be improved through accuracy enhancement.

Includes: Four 190-mm (7.5 in) cables with Type-N (male) connectors for connection to the 8753. One 8753 test set interconnect cable.

Physical Characteristics

Size: 90 mm H x 426 mm W x 508 mm D (3.5 in x 16.75 in x 20 in)

Weight: Net, 6.8 kg (15 lb); shipping, 9.1 kg (20 lb)

85047A S-Parameter Test Set

The 85047A test set includes a frequency doubler that can be switched in to measure 3 MHz to 6 GHz in a single sweep or switched out to measure 300 kHz to 3 GHz in a single sweep. The 8753B/C controls the frequency doubler. (The 8753D/E/ES-006 and 011 with built-in 6 GHz source does not use the frequency doubler, but are still compatible with the 85047A.) Option 006 (6 GHz receiver) is required to activate the 85047A.

Specifications Summary

Impedance: 50 Ω

Frequency Ranges

- 300 kHz to 3 GHz and 3 MHz to 6 GHz (8753B/C);
- 300 kHz to 6 GHz (8753D/E/ES Options 006 and 011)

Directivity

- 300 kHz to 1.3 GHz: 35 dB;
- 1.3 GHz to 3 GHz: 30 dB
- 3 GHz to 6 GHz: 25 dB

Typical Tracking

Transmission Magnitude, Phase

- 300 kHz to 3 GHz: ± 1.5 dB, $\pm 10^\circ$;
- 3 GHz to 6 GHz: +0.5, -2.5 dB, $\pm 20^\circ$

Reflection Magnitude, Phase

- 300 kHz to 3 GHz: ± 1.5 dB, $\pm 10^\circ$;
- 3 GHz to 6 GHz: ± 1.5 dB, $\pm 20^\circ$

Effective Source Match

- 300 kHz to 1.3 GHz: 20 dB;
- 1.3 GHz to 3 GHz: 16 dB
- 3 GHz to 6 GHz: 14 dB

RF Connectors

Test Ports: Precision 7 mm

All Others: 50 Ω Type-N (female)

Includes: Four 190 mm (7.5 in) cables with Type-N (male) connectors for connection to the 8753, one 8753 test set interconnect cable.

Physical Characteristics

Size: 90 mm H x 426 mm W x 508 mm D (3.5 in x 16.75 in x 20 in)

Weight: Net, 10 kg (22 lb); shipping, 15 kg (33 lb)

External Test Set Switching

Option 009 replaces the standard solid-state RF test port switch with a mechanical RF switch. 8753 system specifications for standard and Option 009 test sets are identical. Nominal insertion loss of the solid-state switch is less than 2 dB (at 3 GHz) or 3 dB (at 6 GHz), relative to a mechanical switch.

Special Test Sets

Special test sets are available to configure the 8753ES for specific applications. Some examples are listed below. Contact Agilent for details about these products or for information about additional special options for 8753 network analyzers.

Option H16 Low Noise Floor

Adds the ability to reverse the port 2 coupler to increase the forward dynamic range by about 13 dB.

Option H39 Three-Port Test Set

Adds a third test port and switching to provide all transmission and reflection measurements for three-port devices.

Option H68 Extended Frequency Range above 6 GHz

Allows characterization of components up to 6.8 GHz.

Option H85 High Power Test Set

Adds access to signal paths to allow the addition of an external amplifier, high power attenuators or isolators for handling up to 20 Watts of power at the test ports. Standard solid-state transfer switch is replaced by mechanical switch and internal attenuators are added.

8753ET/ES
85046A/B
85047A

Transit Cases

Agilent offers a complete line of sturdy transit cases in valise and tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2651 (standard) or model 9211-7522 (tote) fit the 8753ET/ES.

Key Literature

8753ET/ES Network Analyzer Brochure, p/n 5968-5159E
8753ET/ES Network Analyzer Technical Specifications, p/n 5968-5160E
8753ET/ES Network Analyzer Configuration Guide, p/n 5968-5158E

For more information, visit our web site: www.agilent.com/find/8753

Ordering Information

Note: A complete system consists of a network analyzer, calibration kit, and cables. Calibration kits and cables can be found in the Accessories section beginning on page 238.

8753ET Network Analyzer, 300 kHz to 3 GHz

- 8753ET-002 Harmonic Measurement Capability
- 8753ET-003 36 Hz Frequency
- 8753ET-004 Built-in Step Attenuator (Extended power range)
- 8753ET-005 Standard power range
- 8753ET-006 6 GHz Frequency Extension
- 8753ET-010 Time-Domain Capability
- 8753ET-1D5 High-Stability Frequency Reference

8753ES Network Analyzer, 30 kHz to 3 GHz

- 8753ES-002 Harmonic Measurement Capability
- 8753ES-003 36 Hz Frequency
- 8753ES-006 6 GHz Frequency Extension
- 8753ES-010 Time-Domain Capability
- 8753ES-011 Delete Built-in Test Set
- 8753ES-014 Configurable Test Set
- 8753ES-075 75 Ω Impedance
- 8753ES-1D5 High-Stability Frequency Reference

85047A 50 Ω S-Parameter Test Set, 6 GHz

- 85047A-009 Mechanical Test Port Switch
- 85047A-913 Rackmount Kit (5062-4069)

85046A 50 Ω S-Parameter Test Set, 3 GHz

- 85046A-001 Solid State Switch
- 85046A-009 Mechanical Test Port Switch
- 85046A-913 Rackmount Kit (5062-4069)

85046B 75 Ω S-Parameter Test Set, 300 kHz, 2 GHz

- 85046B-001 Solid State Switch
- 85046B-009 Mechanical Test Port Switch
- 85046B-913 Rackmount Kit (5062-4069)

Options may be added to an 8753E family analyzer after initial purchase by ordering one of the following upgrade kits. To order an upgrade kit, specify the instrument's model number followed by a "U" to indicate upgrade, along with the option(s) you want to retrofit.

8753ET Upgrade Kits

- 8753ET-002 Harmonic Measurements Upgrade
- 8753ET-004 Step Attenuator Upgrade
- 8753ET-006 6 GHz Upgrade for Standard Units
- 8753ET-010 Time-Domain Upgrade
- 8753ET-099 Firmware Upgrade Kit
- 8753ET-1D5 High-Stability Frequency Reference Upgrade

8753ES Upgrade Kits

- 8753ES-002 Harmonic Measurements Upgrade
- 8753ES-006 6 GHz Upgrade for Standard Units
- 8753ES-010 Time-Domain Upgrade
- 8753ES-099 Firmware Upgrade Kit
- 8753ES-1D5 High-Stability Frequency Reference Upgrade
- 8753ES-611 6 GHz Upgrade for Option 011 Units

Transit Cases

- 9211-2651 Standard Transit Case
- 9211-7522 Tote-Style Transit Case

For more information on compatible printers, visit our web site: www.agilent.com/find/pcg

- 50 MHz to 13.5, 20, or 40 GHz frequency coverage
- Choice of transmission/reflection or S-parameter test sets
- Fast measurement speeds and data-transfer rates
- Display up to four parameters at the same time
- Up to 105 dB dynamic range
- Optional time domain, frequency offset, and high power measurements



8720E Family of Network Analyzers

8720E Family Microwave Network Analyzers

The 8720E family features six vector network analyzers to meet your measurement needs. The 8719ET, 8720ET, and 8722ET models offer economical transmission/reflection test sets, while the 8719ES, 8720ES, and 8722ES models offer S-parameter test sets and a wide selection of configurations for your applications. The ET models provide transmission and reflection measurements in the forward direction at an affordable price. The ES models provide both forward and reverse measurements and full two-port calibration for the best measurement accuracy.

Both ET and ES models combine a fast, synthesized source with an integrated test set covering frequencies from 50 MHz to 13.5, 20, or 40 GHz. Compact, economical, and easy to use, the 8720E family provides accurate and fast testing of microwave linear and nonlinear devices. These instruments are excellent tools for improving your designs in R&D or maximizing your measurement throughput in manufacturing.

ET Models

The 8719ET, 8720ET, and 8722ET feature a built-in transmission/reflection test set for a full range of magnitude and phase measurements in the forward direction. Built-in vector accuracy enhancement techniques include one-port, response, and enhanced response calibrations. Enhanced response calibration improves the accuracy of transmission measurements by correcting for source match effects, which a regular response calibration cannot do. The optional 55-dB step attenuator provides a wider range of output power levels for testing active devices.

ES Models

The 8719ES, 8720ES, and 8722ES feature solid-state switching S-parameter test sets with full two-port error correction. The ES models contain a 55-dB step attenuator as a standard feature for wide output power range. Enhanced response calibration provides improved accuracy for transmission measurements by correcting for source match without the speed penalty of a full two-port calibration. Adapter-removal calibration provides greater accuracy for measurements of non-insertable devices, such as devices with the same sex connectors on both ports or different connector types on ports 1 and 2. Electronic calibration (ECal) provides fast and simple calibration with a single connection, using the 85097B ECal VNA Interface Kit with the appropriate N4690 microwave ECal module. This requires the 85097B-100 cable.

Agilent-qualified Channel Partners provide measurement hardware and software solutions that combine with Agilent's network analyzer products to offer a complete solution for your testing needs. For additional information, please refer to page 34.

Affordable Analyzers with Outstanding Performance

The 8720 analyzers have a fast source that is fully synthesized, in either swept or stepped modes, with stability and accuracy within 10 ppm (typical). Frequency resolution is 1 Hz standard for accurate measurements of narrowband or long-delay devices. The tuned receivers with variable bandwidth IF filters provide up to 105 dB of dynamic range.

Two independent channels can measure and display up to four S-parameters simultaneously. Reflection and transmission measurements can be displayed in a variety of formats, including magnitude, phase, group delay, SWR, and Smith charts. The analyzer's display can be shown on a larger external monitor using the VGA-compatible display output.

Built-in vector accuracy enhancement provides excellent error-corrected accuracy in common coaxial connectors. A user kit supports user-defined standards, and allows calibration in waveguide (including effects of dispersion).

Time Domain for Fault Location and Filter Tuning

Time domain capability (Option 010) computes and displays the response versus time or distance (instead of frequency) of the device under test. Use time domain to locate and quantify individual faults or mismatches in your device, fixture, or cable. Apply the gating feature to remove the effects of unwanted reflections (separated in time), then view the device's true response versus frequency.

Combine an S-parameter network analyzer with time domain capability to provide a simple, deterministic method for tuning cavity-resonator bandpass filters. Comparing the filter's reflection response in time-domain with the response of a properly tuned filter reveals which resonators or coupling adjustments need to be tuned. With time-domain filter tuning, you can easily train new personnel for this complex task and greatly simplify fine-tuning and troubleshooting procedures.

Powerful Features for Active Devices

The 8720E family has plenty of power for testing amplifiers. Option 007 (ES models only) provides 5 dB more output power by replacing the solid-state transfer switch with a mechanical switch (although Option 007 does not provide continuous updating of all four S-parameters). For sensitive small-signal devices, the built-in step attenuator can reduce power to -65 or -70 dBm (Option 004 adds the step attenuator on ET models). Absolute power levels can be set accurately anywhere in the system, using the power meter calibration feature. Power-sweep capability and 0.01 dB power resolution make it easy to test the gain-compression characteristics of active components. The power level during retrace is controllable for safe testing of AGC amplifiers.

In-Fixture and On-Wafer Device Characterization (ES models only)

Use TRL[®]/LRM[®] calibration to minimize fixture errors for measuring non-coaxial devices such as microstrip. For even better accuracy, Option 400 adds a fourth sampler and full TRL/LRM calibration. Electronic port extensions and gating are also available to enhance accuracy.

Productivity Features

Swept-list mode reduces measurement time by allowing you to choose the frequencies you want to test, and to set independent IF bandwidths and power levels in each frequency range. Fast two-port tuning mode speeds up 12-term error correction by allowing the user to specify the number of forward sweeps to take before updating the reverse sweep.

Automate repeated measurements with test sequencing. Create test sequences with keystroke recording, then repeat the measurements with a single keystroke. No programming expertise is needed. You can also use test sequencing to control external devices such as part handlers through the parallel port.

Additional productivity features include limit testing for consistent pass/fail results, up to 5 markers per channel, serial and parallel interfaces for connecting to printers, 2 MB of internal non-volatile memory for storing up to 31 test configurations, JPEG, CSV (comma separated variable), and S2P-compatible data files for exchanging data with CAD programs such as EEsos's Touchstone, Libra, and Advanced Design System.

Programming code compatibility with the previous 8720D series of network analyzers allows you to protect and leverage your investment in test software.

8719ET
8720ET
8722ET
8719ES
8720ES
8722ES

8719ET
8720ET
8722ET
8719ES
8720ES
8722ES

Flexible Configuration for Applications

Option 004 adds a 55 dB step attenuator to expand the output power range. (ET models only; step attenuator is included in all ES models)

Option 007 replaces the standard solid-state transfer switch with a mechanical switch to provide 5 dB more power at the test port, and 5 dB more dynamic range. The mechanical transfer switch does not provide continuous updating of all four S-parameters for full two-port calibration. (ES models only)

Option 010 adds time-domain capability, which allows fault location and gating of fixture responses. (ET and ES models)

Option 012 provides direct sampler access, enabling the user to eliminate coupler loss and increase sensitivity by 16 dB. Option 012 allows filter rejection measurements to greater than -120 dB and allows insertion of attenuation between coupler and sampler. By using separate transmit and receive antennae, Option 012 can improve signal-to-noise in free-space measurements. (ES models only)

Option 085 is a high-power S-parameter test set modification allowing device test up to +43 dBm (20 Watts) input and output. It deletes the bias tees, replaces the solid-state switch with a mechanical switch, and adds internal attenuators. It also includes the direct sampler access provided by Option 012. (ES models only)

Option 089 offers a frequency offset mode for simple mixer conversion loss measurements without the need for a reference mixer. (ES models only)

Option 1D5 adds a high-stability frequency reference to improve measurement accuracy of narrowband or high-Q devices. (ET and ES models)

Option 400 adds a fourth sampler to the receiver and improves TRL calibration accuracy for in-fixture and on-wafer applications. Not compatible with Option 007 or 085. (ES models only)

Upgrade Kits for the 8720E Family

Options may be added to an 8720E family analyzer after initial purchase by ordering the instrument's model number followed by a "U" to indicate an upgrade, along with the option(s) you want to retrofit. See "Ordering Information" for available upgrade options.

Upgrading the 8720D Family

Customers with 8719D, 8720D, or 8722D analyzers can upgrade their analyzers to include the firmware features of the ES models with one of the following upgrades.

8719DU, 8720DU, or 8722DU-099 Firmware Upgrade

Customers who have analyzers with firmware revision above 7.0 can order the latest firmware with this upgrade. The firmware can also be downloaded from Agilent's web site: www.agilent.com/find/firmware

8719DU, 8720DU, or 8722DU-000 Performance Upgrade

Customers who have analyzers with firmware revisions below 7.0 can install the updated CPU board to provide significant measurement and data-transfer speed improvements and the latest firmware features.

Key Literature

8720E Family Microwave Network Analyzers Brochure, p/n 5968-5161E

8720E Family Microwave Network Analyzers Technical Specifications,

p/n 5968-5163E

8720E Family Microwave Network Analyzers Configuration Guide,

p/n 5968-5162E

For more information, visit our web site: www.agilent.com/find/8720

5

Specifications Summary

	8719ET 8719ES	8720ET 8720ES	8722ET 8722ES
Minimum Frequency	50 MHz	50 MHz	50 MHz
Maximum Frequency	13.5 GHz	20 GHz	40 GHz
Frequency Resolution	1 Hz	1 Hz	1 Hz
Frequency Accuracy	10 ppm	10 ppm	10 ppm
Max. Source Power:			
ET models	+10 dBm	+10 dBm	0 dBm, <20 GHz; -5 dBm, 20 to 40 GHz
ES models (std)	+5 dBm	+5 dBm	-5 dBm, <20 GHz; -10 dBm, 20 to 40 GHz
ES models with Option 007	+10 dBm	+10 dBm	0 dBm, <20 GHz; -5 dBm, 20 to 40 GHz
Min. Source Power:			
ET models (std)	-10 dBm	-10 dBm	-15 dBm
ET models with Option 004	-65 dBm	-65 dBm	-70 dBm
ES models (std)	-70 dBm	-70 dBm	-75 dBm
ES models with Option 007	-65 dBm	-65 dBm	-70 dBm
Power Resolution	0.01 dB	0.01 dB	0.01 dB
Power Flatness	±2 dB	±2 dB	±3 dB
Power Sweep Range	20 dB	20 dB	15 dB to 20 GHz; 10 dB, 20 – 40 GHz
System Dynamic Range (>2 GHz)			
ET	104 dB	104 dB	84 to 97 dB
ES	100 dB	100 dB	80 to 93 dB
ES with Option 007	105 dB	105 dB	85 to 98 dB
Test Port Connector	3.5 mm (m)	3.5 mm (m)	2.4 mm (m)

Data applies at 23°C ± 3°C. See product literature for more complete specifications and for total measurement uncertainty after error correction.

Size: 222 mm H x 425 mm W x 457 mm D (8.75 in x 16.750 in x 18.00 in)

Weight: Net, 22.7 to 27.7 kg (50 to 60 lb); shipping, 31.8 to 36.7 kg (70 to 81 lb)

Ordering Information

Note: A complete system consists of a network analyzer, calibration kit, and cables. Calibration kits and cables can be found in the Accessories section beginning on page 238.

8719ET Network Analyzer, 50 MHz to 13.5 GHz

8720ET Network Analyzer, 50 MHz to 20 GHz

8722ET Network Analyzer, 50 MHz to 40 GHz

The following options apply to all three network analyzers:

Option 004 Step Attenuator (Extended power range)

Option 005 Standard Power Range

Option 010 Time Domain Capability

Option 1D5 High-Stability Frequency Reference

Option 1CM Rackmount Kit

Option 1CP Rackmount and Handle Kit

8719ES Network Analyzer, 50 MHz to 13.5 GHz

8720ES Network Analyzer, 50 MHz to 20 GHz

8722ES Network Analyzer, 50 MHz to 40 GHz

The following options apply to all three network analyzers:

Option 007 Mechanical Transfer Switch

Option 010 Time Domain Capability

Option 012 Direct Sampler Access

Option 050 Standard Test Set

Option 085 High-Power Test Set

Option 089 Frequency Offset Mode

Option 1D5 High-Stability Frequency Reference

Option 701 Three-Sampler Test Set

Option 400 Four-Sampler Test Set

Option 1CM Rackmount Kit

Option 1CP Rackmount and Handle Kit

Upgrades and Retrofit Kits

To add options to an 8720E family analyzer after initial purchase, order the analyzer's model number followed by a "U" with one of the following upgrade options. All upgrade/retrofit kits include installation at an Agilent service center or the factory.

The following upgrade options are available for the 8719ET, 8720ET, and 8722ET.

Option 099 Firmware Upgrade

Option 004 Add Step Attenuator

Option 010 Add Time Domain Capability

Option 1D5 Add High-Stability Frequency Reference

The following upgrade options are available for the 8719ES, 8720ES, and 8722ES.

Option 099 Firmware Upgrade

Option 007 Add Mechanical Transfer Switch

Option 010 Add Time Domain Capability

Option 012 Add Direct Sampler Access

Option 085 Add High-Power Test Capability

Option 089 Add Frequency Offset Mode

Option 1D5 Add High-Stability Frequency Reference

Option 489 Add Frequency Offset for Opt 400 Analyzers

Option 589 Add Frequency Offset for Opt 085 Analyzers

Option 400 Add Four-Sampler Test Set

The following upgrades are only available for the specified models. For 8719ET only:

Option 020 Upgrades 8719ET to 8720ET

Option 040 Upgrades 8719ET to 8722ET

For 8720ET only:

Option 040 Upgrades 8720ET to 8722ET

For 8719ES only:

Option 020 Upgrades 8719ES to 8720ES

Option 040 Upgrades 8719ES to 8722ES

For 8720ES only:

Option 040 Upgrades 8720ES to 8722ES

The following kits offer upgrades for older 8720 family network analyzers. Installation is not included.

8719DU, 8720DU, or 8722DU Option 099 Firmware Upgrade

8719DU, 8720DU, or 8722DU Option 000 Performance Upgrade

Transit Cases

Agilent offers a complete line of sturdy transit cases in valise and tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2651 (standard) or model 9211-7522 (tote) fit the 8719ET/ES, 8720ET/ES, and 8722ET/ES.

9211-2651 Standard Case

9211-7522 Tote-style Case

8719ET

8720ET

8722ET

8719ES

8720ES

8722ES

8757D

- 75 dB dynamic range
- Optional power calibrator
- 40 dB directivity bridges
- 40 GHz in coax, 110 GHz in waveguide
- Buffered plotter/printer output
- External disk and internal register save/recall
- Built-in limit testing
- Color display



8757D-001 & -002

5

8757D Scalar Network Analyzers

Measure insertion loss, gain, return loss, SWR, and power quickly and accurately with the 8757D scalar network analyzer. With high-performance detectors and directional bridges, and a companion source and digital plotter, the 8757D is the basis of a complete measurement system with superb performance.

The 8757D features three detector inputs and two independent display channels, allowing simultaneous ratioed or non-ratioed measurement of your device's transmission and reflection characteristics, 75 dB dynamic range (+20 to -55 dBm) for measuring high-rejection devices, and a choice between ac (square wave modulated) or dc detection techniques. The internal plotter/printer buffer allows you to send your measurement data directly to a plotter and then proceed to the next measurement, typically in less than five seconds. The 8757D includes a user-friendly interface, and menu-driven, direct-access softkeys, which simplify its operation.

It offers limit testing, external disk save/recall, and a color display. Limit testing reduces test time by letting the analyzer make quick and objective pass/fail decisions. External disk save/recall allows your measurement state to be preconfigured by an engineer or skilled specialist and then automatically recalled by production technicians. The result is reduced set-up time and greater test integrity at each production station. The precision color display simplifies the separation of measurement information while providing a pleasant display for the technician.

Increase Absolute Power Measurement Accuracy

For near power meter measurement accuracy, configure a system that includes the 8757D Option 002 and the 85037 series precision detectors. Option 002 on the 8757D adds an internal power calibrator used to characterize the 85037 series detectors' accuracy versus power. In addition, each 85037 series precision detector incorporates a dual-diode detector to improve power measurement accuracy when harmonics are present, plus internal frequency correction factors, read by the 8757D, for more accurate power versus frequency measurements. The result is a system optimized for swept absolute power measurements.

Feature	8757D
Display	Color
Display channels	4
Detector inputs	3 standard 4 with Option 001
Dynamic range	75 dB
AC/DC detection mode	Yes
Measurement points:	
Selectable values	101, 201, 401, 801, 1601
Channels displayed	3 or 4 2 1
Max. points per channel	401 801 1601
Plotter/printer buffer	Yes
Noise figure display capability*	Yes
External disk save/recall	Yes
Internal save/recall registers	9
Limit testing (channels 1 and 2)	Yes
Adaptive normalization	Yes
Cursor search functions	Max., Min., bandwidth, n dB
SWR display mode	Yes
Non-standard sweep mode	Yes
Auxiliary voltage display mode	Yes
Optional power calibrator	Yes
Compatible with 85037 series precision detectors	Yes

*Product Note 8970 B/S-4, Agilent Literature 5959-8742

Size: 178 mm H x 425 mm W x 445 mm D (7 in x 16.75 in x 17.5 in)
Weight: 22 kg (48 lb) net; 28 kg (61.5 lb) shipping

Transit Cases

Agilent offers a complete line of sturdy transit cases in Valise and Tote styles. The cases protect your instrument from shock, vibration, moisture, impact, and contamination, providing a secure enclosure for shipping. Model 9211-2650 (standard) or model 9211-7521 (tote) fit the 8757D/E.

85037 Series Precision Detectors (ac/dc)

The 85037 series precision detectors are designed specifically for operation with the 8757D scalar network analyzer and may be used in either ac or dc detection modes. These dual diode detectors contain internal frequency correction factors in an internal EE PROM (read automatically by the 8757D) for improved measurement accuracy versus frequency. When used in conjunction with the 8757D's internal power calibrator (Option 002), these detectors provide the maximum absolute power measurement accuracy. The 85037 series detector is not compatible with the 8757E.

Absolute Power Measurement Uncertainty Examples

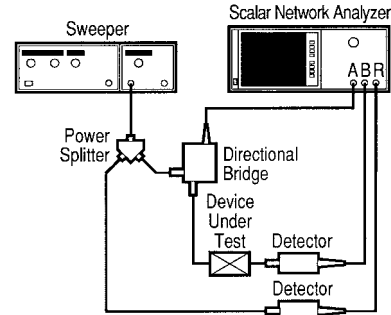
Assumptions:

- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Measured power = 0 dBm

Uncertainty Component	85037B Detector	85025E Detector
Absolute power accuracy at 50 MHz (±dB)	0.11	0.40
Frequency response (±dB)	0.18	0.50
Mismatch (±dB)	0.18	0.10
Uncertainty Total (±dB)	0.47	1.00

Reflection Measurement Accuracy

Uncertainties due to calibration error and the frequency response of the source, detectors, and bridges are removed via open/short averaging. The remaining uncertainties are primarily the sum of directivity uncertainty, effective source match uncertainty and dynamic power accuracy. See Technical Data Sheet for further information.



Basic scalar coaxial system configured for ratio reflection and transmission measurements.

85037A
85037B
85025A
85025B
85025D
85025E

Precision Detector Summary, 85037 Series For use with the 8757D in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 MHz)	Dynamic Accuracy ¹	Absolute Accuracy ²	
85037A ¹	10 MHz to 18 GHz	Type-N (m) 7 mm ²	ac mode	0.01 to 0.04 GHz	10 dB	±0.35 dB	20 dBm	±0.25 dB	±0.25 dB	
			+20 to -55 dBm	0.04 to 18.0 GHz	20 dB	±0.18 dB	10 dBm	±0.11 dB	±0.11 dB	
			dc mode							
			+20 to -50 dBm							
85037B ¹	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode	0.01 to 0.04 GHz	10 dB	±0.35 dB	20 dBm	±0.25 dB	±0.25 dB	
			+20 to -55 dBm	0.04 to 18.0 GHz	20 dB	±0.18 dB	10 dBm	±0.11 dB	±0.11 dB	
			dc mode	18 to 26.5 GHz	18 dB	±0.22 dB	-30 dBm	±0.11 dB	±0.11 dB	
			+20 to -50 dBm							

85025 and 85026 Series Detectors (ac/dc)

The 85025 and 85026 series detectors are designed specifically for operation with the 8757 scalar network analyzer. The 85025/26 detectors detect either a modulated (ac) or an unmodulated (dc) microwave signal.

85025C Detector Adapters

The 85025C adapter matches the scalar analyzer display to most standard crystal, silicon and gallium arsenide detectors. This enables the user to operate up to 110 GHz with the 8757. The 85025C detector adapter is designed for use with the 8757 only, and can operate in either ac or dc detection modes.

Coaxial Detector Summary, 85025 Series For use with the 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Frequency	Return Loss	Frequency Response	Power (at 50 Mhz)	Dynamic Accuracy ¹	Absolute Accuracy ⁵
85025A ³	10 MHz to 18 GHz	Type-N (m) 7 mm ²	ac mode	0.01 to 0.04 GHz	10 dB	±0.8 dB	16 dBm	±0.8 dB	±0.8 dB
			+16 to -55 dBm	0.04 to 4 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	4 to 18 GHz	17 dB	±0.5 dB	-35 dBm	±0.4 dB	±0.4 dB
			+16 to -50 dBm						
85025B ³	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode	0.01 to 0.04 GHz	10 dB	±0.8 dB	16 dBm	±0.8 dB	±0.8 dB
			+16 to -55 dBm	0.04 to 4 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	4 to 18 GHz	17 dB	±0.5 dB	-35 dBm	±0.4 dB	±0.4 dB
			+16 to -50 dBm	18 to 26.5 GHz	12 dB	±2.0 dB	-50 dBm	±1.3 dB	±1.3 dB
85025D ³	10 MHz to 50 GHz	2.4 mm (m)	ac mode	0.01 to 0.1 GHz	10 dB	±0.8 dB	16 dBm	±1.0 dB	±1.0 dB
			+16 to -55 dBm	0.1 to 20 GHz	20 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	20 to 26.5 GHz	20 dB	±1.0 dB	-35 dBm	±0.4 dB	±0.4 dB
			+16 to -50 dBm	26.5 to 40 GHz	15 dB	±2.5 dB	-50 dBm	±1.3 dB	±1.3 dB
85025E ³	10 MHz to 26.5 GHz	3.5 mm (m)	ac mode	0.01 to 0.1 GHz	10 dB	±0.8 dB	16 dBm	±1.0 dB	±1.0 dB
			+16 to -55 dBm	0.1 to 18 GHz	25 dB	±0.5 dB	6 dBm	±0.4 dB	±0.4 dB
			dc mode	18 to 25 GHz	25 dB	±0.5 dB	-35 dBm	±0.4 dB	±0.4 dB
			+16 to -50 dBm	25 to 26.5 GHz	23 dB	±1.4 dB	-50 dBm	±1.3 dB	±1.3 dB

¹The 85037A/B specifications are applicable when used with the 8757D scalar network analyzer. The absolute power accuracy and dynamic power accuracy specifications apply after a calibration via the 8757D Option 002's internal power calibrator.

²Option 001 changes to a 7-mm connector.

³The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.

⁴Dynamic accuracy refers to measurement accuracy as power varies (in dB) from a 0 dBm reference, 25° ± 5° C, 50 MHz.

⁵DC mode, 25° ± 5° C.

Waveguide Detectors and Detector Adapters Summary For use with the HP 8757 only in either ac or dc detection modes

Model	Frequency Range	Connector Type	Dynamic Range	Return Loss	Frequency Response	Dynamic Accuracy
R85026A ¹	26.5 to 40 GHz	WR-28	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±1.5 dB	±(0.3 dB + 0.03 dB/dB)
Q85026A ¹	33 to 50 GHz	WR-22	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
U85026A	40 to 60 GHz	WR-19	+10 to -50 dBm (ac mode) +10 to -45 dBm (dc mode)	12 dB	±2.0 dB	±(0.3 dB + 0.03 dB/dB)
85025C Option K57 ³	50 to 75 GHz	WR-15	+10 to -45 dBm (typical)	9.5 dB (typical)	—	—
85025C Option K71 ³	75 to 110 GHz	WR-10	+10 to -45 dBm (typical)	9.5 dB (typical)	—	—
85025C ¹	²	SMA (m)	²	²	²	²

¹The 85025 and 85026 series detectors and the 85025C detector adapter require 8757A firmware revision 2.0 or higher. To upgrade previous revisions, order the 11614A firmware enhancement.

²Depends upon the particular detector being used.

³Must be used with the 85025C detector adapter.

85027 Series Directional Bridges (ac/dc)

The 85027 series directional bridges are designed to operate with either the 8757 in ac or dc detection modes. These bridges offer high directivity, excellent test port match, and a measurement range of up to 50 GHz in coax.

8757D Option 002 Power Calibrator

The 8757D's internal power calibrator provides a 50 MHz reference standard for characterizing the absolute power accuracy and dynamic power accuracy of the 85037 series precision detectors.

- Frequency: 50 MHz ± 0.2 MHz
- Accuracy at 0 dBm: ±0.05 dB
- Linearity: (over any 10 dB range)
 - ±0.08 dB (+20 to +10 dBm)
 - ±0.04 (+10 to -30 dBm)
 - ±0.06 (-30 to -50 dBm)

Directional Bridge Summary For use with the HP 8757 in ac or dc detection mode

Model	Frequency Range	Nominal Impedance	Connector – Input	Connector – Test Port	Frequency	Directivity (dB)	Frequency	Test Port Match (SWR)
85027A	10 MHz to 18 GHz	50 Ω	Type-N (f)	7 mm	0.01 to 18 GHz	40 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027B	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (f)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78
85027C	10 MHz to 18 GHz	50 Ω	Type-N (f)	Type-N (f)	0.01 to 12.4 GHz 12.4 to 18 GHz	36 dB 34 dB	0.01 to 8.4 GHz 8.4 to 12.4 GHz 12.4 to 18 GHz	<1.15 <1.25 <1.43
85027D	10 MHz to 50 GHz	50 Ω	2.4 mm (f)	2.4 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz 26.5 to 40 GHz 40 to 50 GHz	36 dB 32 dB 30 dB 25 dB	0.01 to 16 GHz 16 to 30 GHz 30 to 40 GHz 40 to 50 GHz	<1.18 <1.27 <1.57 typically <2.00
85027E	10 MHz to 26.5 GHz	50 Ω	3.5 mm (f)	3.5 mm (m)	0.01 to 20 GHz 20 to 26.5 GHz	40 dB 36 dB	0.01 to 8.4 GHz 8.4 to 20 GHz 20 to 26.5 GHz	<1.15 <1.43 <1.78

System Accuracy

Transmission Loss or Gain Measurement Accuracy

Transmission loss or gain measurements are made relative to a 0 dB reference point established at calibration. Transmission measurement uncertainty = dynamic power accuracy + mismatch uncertainty.

Dynamic power accuracy is the measurement uncertainty due to the change in power level between calibration and the measurement. Mismatch uncertainty is the uncertainty due to reflections in the measurement setup. The frequency response errors of the source, detectors, bridge and power splitter are removed via calibration.

Transmission Measurement Uncertainty Examples

Assumptions:

- Measurement frequency = 10 GHz
- DUT input/output SWR = 1.5
- Change in power after calibration <30 dB (+0 to -30 dBm range)

Uncertainty Component	85037B Precision Detector	85025E Detector
Dynamic accuracy (±dB)	0.11	0.40
Mismatch (±dB)	0.45	0.33
Uncertainty Total (±dB)	0.56	0.73



11679A



85022A



11667A



11667C

11679A
11679B
85022A
8757D
11636A
11636B
11852B
11667A
11667B
11667C

11679A/B Extension Cables

Function

These cables extend the distance between the scalar network analyzer and the detector or bridge to a maximum of 200 feet without degradation of performance.

11679A: 7.6 m (25 ft) extension cable

11679B: 61 m (200 ft) extension cable

85022A System Cable Kit

The 85022A contains all the BNC and GPIB cables to connect an Agilent sweep oscillator (8360 series, 83750, or 83751 synthesized sweepers), an HP computer and a printer to the 8757. This kit contains three one-meter GPIB cables (10833A), three two-foot BNC (m-m) cables (11170B) and one four-foot BNC (m-m) cable (11170C).

BNC Impedance: 50 Ω

Weight: Net, 0.5 kg (1.2 lb); shipping, 1.2 kg (2.9 lb)

11636A/B Power Dividers

The 11636A/B power dividers/combiners are recommended when making wideband comparison measurements without ratioing.

11613B Calibrator

The 11613B is a dedicated transfer standard for calibration of the 8757D/E scalar network analyzers. The 11613B provides a standard, a 27.778 kHz source and a series of precision attenuators. The calibrator includes software that verifies (and adjusts if necessary) the internal calibration parameters stored in the nonvolatile memory of the analyzer.

An HP Series 200 or 300 computer is required for operation. The computer must have BASIC 2.0 or greater and 512 K bytes of RAM. For use with the 8756A Scalar Analyzer, the computer also requires the HP 98622A 16-bit GPIO card.

11852B 50 Ω /75 Ω Minimum-Loss Pad

The 11852B is a low SWR minimum-loss pad required between 75 Ω devices and 50 Ω sources and detectors.

11667A/B/C Power Splitters

The 11667A/B/C power splitters are recommended when making wideband ratio measurements using the 8757 scalar network analyzer. These two-resistor type splitters provide excellent output SWR at the auxiliary arm when used for source leveling or ratio measurement applications. The tracking between output arms over a frequency range from dc to 50 GHz allows wideband measurements to be made with a minimum of uncertainty.

Frequency Range

11667A: DC to 18 GHz

11667B: DC to 26.5 GHz

11667C: DC to 50 GHz

Impedance: 50 Ω nominal

Insertion Loss

11667A/B: 6 dB nominal

11667C: 8.5 dB nominal

Max. Input Power: +27 dBm

Connectors

11667A: N-female on all ports

11667B: 3.5-mm female on all ports

11667C: 2.4-mm female on all ports

8757D Upgrade Kits

Increase your analyzer's measurement capability and performance with an 8757 upgrade kit.

The 86383C upgrade kit allows you to add the fourth detector input to your 8757D (86383C-001) and/or the internal power calibrator (86383C-002). Installation is not included with this kit.

Key Literature

8757D Scalar Network Analyzer Brochure, p/n 5091-2469E

8757D Scalar Network Analyzer Technical Data, p/n 5091-2471E

8757D Scalar Network Analyzer Configuration Guide, p/n 5967-6177E

8757
System
8757XC

The 8757 scalar network analyzer is ordered with multiple line items to give you maximum flexibility in specifying a system that meets your needs. Consult your local Agilent Technologies sales office if you would like assistance.

Ordering Information

Analyzer

- 8757D Scalar Network Analyzer
 - 8757D-001 Fourth Detector Input
 - 8757D-002 Internal Power Calibrator
 - 8757D-W30 Two-Year Extended Service
 - 8757D-1BN MIL-STD-45662A Calibration Certificate
 - 8757D-1BP MIL-STD-45662A Calibration with Test Data
 - 8757D-UK6 Commercial Calibration Certificate w/data

Sweepers

Choose the E8247C/57C synthesized sweepers for applications from 10 MHz to 40 GHz, or the 8360 series synthesized sweepers for measurements up to 50 GHz in coax or 110 GHz in waveguide.

Precision Detectors

- 85037A 0.01 to 18 GHz, Type-N(m)
 - 85037A-001 7-mm Connector
- 85037B 0.01 to 26.5 GHz, 3.5 mm(m)

Directional Bridges

- 85027A 0.01 to 18 GHz, 7 mm, 50 Ω
- 85027B 0.01 to 26.5 GHz, 3.5 mm (f), 50 Ω
- 85027C 0.01 to 18 GHz, Type-N (f), 50 Ω
- 85027D 0.01 to 50 GHz, 2.4 mm (m), 50 Ω
- 85027E 0.01 to 26.5 GHz, 3.5 mm (m), 50 Ω

Detectors

- 85025A 0.01 to 18 GHz, Type-N (m)
 - 85025A-001 7-mm Connector
- 85025B 0.01 to 26.5 GHz, 3.5 mm (m)
- 85025D 0.01 to 50 GHz, 2.4 mm (m)
- 85025E 0.01 to 26.5 GHz, 3.5 mm (m)
- R85026A 26.5 to 40 GHz, WR-28 Waveguide
- Q85026A 33 to 50 GHz, WR-22 Waveguide
- U85026A 40 to 60 GHz, WR-19 Waveguide
- 85025C Detector Adapter

System Cable Kit

- 85022A System Cable Kit

Optional Accessories

(For ratio and/or modulation measurements)

- 11636A Power Divider dc to 18 GHz
- 11636B Power Divider dc to 26.5 GHz
- 11667A Power Splitter dc to 18 GHz
 - 11667A-001 N-male on Input Port; N-female on Output Ports
 - 11667A-002 N-female on Input Port; 7 mm on Output Ports
- 11667B Power Splitter dc to 26.5 GHz
- 11667C Power Splitter dc to 50 GHz
- 11679A Detector Extension Cable, 7.6 m (25 ft)
- 11679B Detector Extension Cable, 61 m (200 ft)
- 11852B 50 to 75 Ω Minimum Loss Pad

Upgrade Kits

- 86383C Upgrade Kit for 8757D
 - 86383C-001 Adds Fourth Detector Input
 - 86383C-002 Adds Internal Power Calibrator

Transit Cases

- 9211-2650 Standard Transit Case
- 9211-7521 Tote-Style Transit Case

For information on compatible printers, visit our web site:
<http://www.agilent.com/find/pcg>

- RF voltage and phase measurements
- 100 kHz to 1 GHz high-impedance probe inputs
- 300 kHz to 2 GHz 50 Ω inputs

- 8720D
- Opt K22
- Z5621A
- Opt H36
- 87050B
- Opt H37
- 8753ES
- Opt H85



Let Agilent Design and Build You a Custom Test Set

If your application requires a special configuration, ask us about our special options, which offer nonstandard specifications.



A Special Twenty-Two Port Test Set

Special 8720D option K22

The 8720D K22 is a multifunction box with four ports in the forward path and four ports in the reverse path. Two ports allow the user to connect the 8720D/ES directly to the 8720D K22 for a full 12 port matrix. The additional forward and reverse ports can be connected to additional test equipment for custom configurations.



Duplexer Test Set

Special 87050B option H37

The 87050B option H37 is a duplexer test set designed for use with a standard 8753D/E/ES network analyzer. The duplexer test set uses solid-state switching for port connections. The test set has seven ports located on the front panel. Two of these ports are APC-7 and mate with port 1 and port 2 of the network analyzer. The other five ports, labeled ANT, TX1, TX2, RX1, and RX2 are 50 ohm Type-N connectors and connect to the device under test.

High-Power Test Set

Special 8753ES option H85

The 8753ES option H85 provides a built in high power test set. High power measurements can be made up to 20 watts (+43 dBm) each test port. Frequency range of H85 is 50 MHz to 3 GHz or 6 GHz, with standard option 006. Test port connectors are NMD 3.5 mm male. Option H85 uses a mechanical transfer switch.

For more information, contact the Agilent Call Center in your region.

Duplexer Test Set Adapter

Special Z5621A option H36

This test set adapter provides three ports to allow direct testing of duplexers. The test set adapter contains a solid-state switch. The connectors are 50 ohm Type-N. The transmitter-to-antenna and receiver-to-antenna paths can be measured; the transmitter-to-receiver path cannot be measured.

Calibration Kits

Error-correction procedures require that the systematic errors in the measurement system be characterized by measuring known devices (standards) on the system over the frequency range of interest. Agilent Technologies offers two types of calibration kits: mechanical and electronic. For further information about these products, please refer to the following web site <http://www.agilent.com/find/accessories> or <http://www.agilent.com/find/ecal>



5

Mechanical Calibration Kits

All network analyzer, coaxial mechanical calibration kits contain standards to characterize systematic errors. Many mechanical calibration kits also contains adapters for test ports and a torque wrench for proper connection. Mechanical calibration kits are divided into three categories: economy, standard, and precision. Economy kits include a fixed load. Standard kits include a sliding load or a series of offset shorts. Precision kits contain TRL devices.



Electronic Calibration (Ecal) Modules

Electronic calibration (Ecal) is a precision, single-connection, one- or two-port calibration technique that uses fully traceable and verifiable electronic calibration modules. Ecal provides repeatable, accurate measurements while bringing convenience and simplicity to your daily calibration routine. Ecal replaces the traditional calibration technique, which uses mechanical standards. With mechanical standards, you are required to make numerous connections to the test ports for a single calibration. These traditional calibrations require intensive operator interaction, which is prone to errors.

Ecal modules consist of a connector-specific calibration standard. Modules are available with 3.5 mm, 7 mm, Type-N, Type-F, 2.92 mm, 2.4 mm, 1.85 mm and 7-16 connectors. Options exist for modules with one male and one female connector (MOF), two male (00M) or two female (00F) connectors. Ecal modules are controlled via the 85097B VNA interface kit. The PNA Series and ENA series of network analyzers can control RF Ecal modules directly via a USB port, and do not require the 85097B kit.

For more information refer to either the Ecal Reference Guide or the Ecal Product Overview.

PC Interface Module with Control Software

The 85097B consists of a VNA interface module, and power supply. The interface module is the interface between the parallel port on your VNA, the Ecal module, and the external power supply. The 85097B interfaces with the 8753E/ET/ES, the 8719D/ET/ES, the 8720D/ET/ES and the 8722D/ET/ES network analyzers.

Mechanical Verification Kits

Measuring known devices, other than the calibration standards, is a straightforward way of verifying that the network analyzer system is operating properly. Agilent offers verification kits that include precision airlines, mismatch airlines, and precision fixed attenuators. Traceable measurement data, on disk, is shipped with each kit. Verification kits may be recertified by Agilent Technologies. This recertification includes a new measurement of all standards and new data with uncertainties.

Coaxial Mechanical Calibration Kits

Legend: O = open S = short L = load SL = sliding load TRL = TRL adapter

Device Connector Type	Frequency Upper Limit ¹	Included	Available Options	Model
Type-F (75 ohm)	3 GHz	O, S, L (m) and (f), adapters	00M, 00F	85039B
Type-N (75 ohm)	3 GHz	O, S, L (m)		85036E
Type-N (75 ohm)	3 GHz	O, S, L (m) and (f), adapters		85036B
Type-N (50 ohm)	6 GHz	O, S, L (m)		85032E
Type-N (50 ohm)	9 GHz	O, S, L (m) and (f)	100, 200, 300, 500	85032F
Type-N (50 ohm)	18 GHz	O, S, L, SL (m) and (f), adapters		85054B
Type-N (50 ohm)	18 GHz	O, S, L (m) and (f), adapters		85054D
7-16	7.5 GHz	O, S, L (m) and (f), adapters		85038A
7 mm	6 GHz	O, S, L		85031B
7 mm	18 GHz	O, S, L		85050D
7 mm	18 GHz	O, S, L, SL		85050B
7 mm	18 GHz	O, S, L, TRL		85050C
3.5 mm	9 GHz	O, S, L (m) and (f)	100, 200, 300, 400, 500	85033E
3.5 mm	26.5 GHz	O, S, L (m) and (f), adapters		85052D
3.5 mm	26.5 GHz	O, S, L, SL (m) and (f), adapters		85052B
3.5 mm	26.5 GHz	O, S, L (m) and (f), TRL adapters		85052C
2.92 mm	50 GHz	O, S, L, SL (m) and (f), adapters	001*	85056K
2.4 mm	50 GHz	O, S, L (m) and (f), adapters		85056D
2.4 mm	50 GHz	O, S, L, SL (m) and (f), adapters		85056A
1.85 mm	67 GHz	Offset, S, L (m) and (f), adapters		85058B
1.85 mm	67 GHz	O, S, L (m) and (f), adapters		85058E
1 mm	110 GHz	O, S, L (m) and (f), adapters		85059A

¹All coaxial calibration kits are specified from DC to their upper frequency limit.

Waveguide Mechanical Calibration Kits

Device Connector Type	Frequency Range (GHz)	Type	Model
WR-90	8.2 to 12.4	Precision	X11644A
WR-62	12.4 to 18	Precision	P11644A
WR-42	18 to 26.5	Precision	K11644A
WR-28	26.5 to 40	Precision	R11644A
WR-22	33 to 50	Precision	Q11644A
WR-19	40 to 60	Precision	U11644A
WR-15	50 to 75	Precision	V11644A
WR-10	75 to 110	Precision	W11644A

Electronic Calibration Modules (ECal)

Device Connector Type	Frequency Range	Available Options	Model
Type-F (75 ohm) ¹	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	85099C
Type-N (75 ohm) ¹	300 kHz to 3 GHz	00A, 00F, 00M, MOF, UK6	85096C
Type-N (50 ohm) ¹	300 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	85092C
Type-N (50 ohm)	10 MHz to 18 GHz	00A, 00F, 00M, MOF, UK6	N4690A
7-16 ¹	300 kHz to 7.5 GHz	00A, 00F, 00M, MOF, UK6	85098C
7 mm ¹	300 kHz to 9 GHz		85091C
7 mm	10 MHz to 18 GHz		N4696A
3.5 mm ¹	30 kHz to 9 GHz	00A, 00F, 00M, MOF, UK6	85093C
3.5 mm	10 MHz to 26.5 GHz	00A, 00F, 00M, MOF, UK6	N4691A
PC Interface kit ²	N/A	N/A	85097B
2.92 mm	10 MHz to 40 GHz	00A, 00F, 00M, MOF	N4692A
2.4 mm	10 MHz to 50 GHz	00A, 00F, 00M, MOF	N4693A
1.85 mm	10 MHz to 67 GHz	00A, 00F, 00M, MOF	N4694A
3.5 mm, Type-N 50 ohm (4-port)	300 kHz to 9 GHz	010, 020, UK6	N4431A

¹Modules have both USB and parallel connectors. A USB cable is supplied with the module.

²The VNA Interface Unit is connected to the ECal module(s) via another parallel cable. The VNA Interface kit is not needed with the PNA Series (E8356A, E8357A, E8358A) network analyzers. These analyzers control the modules directly.

Mechanical Verification Kits

Device Connector Type	Frequency Range (GHz)	Type	Available Options	Compatible Network Analyzers	Model
Type-N	30 kHz to 18	Precision		8719, 8720, 8510, PNA	85055A
7 mm	DC to 6	Precision	001**	8753	85029B
7 mm	0.045 to 18	Precision		8719, 8720, 8510, PNA	85051B
3.5 mm	30 kHz to 26.5	Precision		8719, 8720, 8510, PNA	85053B
2.4 mm	0.045 to 50	Precision		8722, 8510, PNA	85057B
1.85 mm	0.010 to 67 Hz	Precision		8510, PNA	85058V
WR-28	26.5 to 40	Precision		8510, 85106	R11645A
WR-22	33 to 50	Precision		8510, 85106	Q11645A
WR-19	40 to 60	Precision		8510, PNA	U11645A
WR-15	50 to 75	Precision		8510, 85106	V11645A
WR-10	75 to 110	Precision		8510, 85106	W11645A

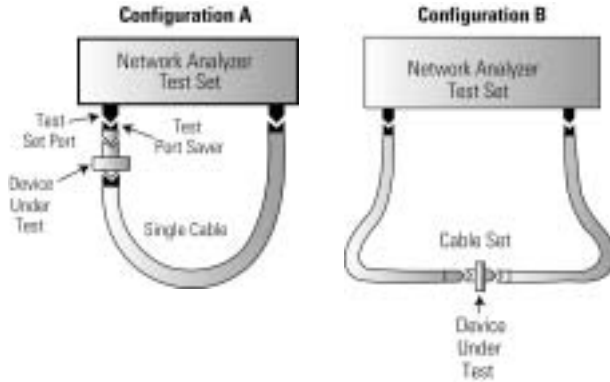
Options apply to mechanical calibration, ECal, and verification kits

- Option 001*: Adds 2.4 mm sliding load and 2.4 mm gauges
- Option 001**: Adds data for 8702 lightwave component analyzer
- Option 00A Adds male to male and female to female adapters
- Option MOF Ecal module with one male and one female connector
- Option OOF Ecal module with two female connectors
- Option OOM Ecal module with two male connectors
- Option 100 Adds female to female adapter
- Option 200 Adds male to male adapter
- Option 300 Adds male to female adapter
- Option 400 Adds series of 3.5 mm to Type-N adapters
- Option 500 Adds series of 3.5 mm (or Type-N) to 7 mm adapters
- UK6 Commercial calibration with measured data
- 010 Four female, 3.5 mm connector
- 020 Four female, Type-N 50 ohm connectors

Calibration Kits
Verification Kits

Cables

Test port cables provide the connection required when using network analyzers with various test devices and equipment. Test port cables are available for two test configurations as shown below. Configuration A utilizes a single test port cable for use when the device under test (DUT) is connected directly to the port on the test set. Configuration B utilizes two test port cables; which provides more flexibility since the DUT is connected between the test port cables.



5

In order to select a cable, find the table below that corresponds to the connector type of your network analyzer. Then, search that table for your device's connector type. If the device's connector type is not present in the table, an adapter needs to be selected to mate the test port cable to your device. Adapters may be provided in a calibration kit, or ordered separately. A full detailed list of calibration kit contents is available from the web site: www.agilent.com/find/accessories

50-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	Type-N (m) to Type-N (m), 24 in (61 cm)	N6314A
Type-N	Type-N (m) to Type-N (f)	N6315A
Type-N	Type-N (m) to Type-N (m), 16 in (40.6 cm)	N3839A
Type-N	Type-N (m) to Type-N (m), 24 in (610 mm), qty 3 Type-N (m) to Type-N (m), 34 in (860 mm)	11851B

75-ohm, Type-N Test Set Ports

Device Connector Type	Cable Connector Description	Model
Type-N	75 ohm, Type-N (m) to Type-N (m) 75 ohm, Type-N (m) to Type-N (f)	11857B
Type-F	75 ohm, Type-N (m) to Type-F (m) 75 ohm, Type-N (m) to Type-F (f)	11857F

7-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
7 mm	7 mm to 7 mm, qty 2	11857D

3.5-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 7 mm adapter set	85132C 85130B
7 mm	Semi-rigid	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	85132D
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 7 mm adapter set	85132E 85130B
7 mm	Flexible	3.5 mm (f) NMD to 7 mm 3.5 mm (f) NMD to 7 mm	85132F
3.5 mm	Semi-rigid	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85131C 85130D
3.5 mm	Semi-rigid	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	85131D
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85131E 85130D
3.5 mm	Flexible	3.5 mm (f) NMD to 3.5 mm (f) 3.5 mm (f) NMD to 3.5 mm (m)	85131F
Type-N	NMD to 7 mm	Use with 7 mm to Type N adapters Type N adapter set	85130C

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

2.4-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 7 mm adapter set	85135C 85130E
7 mm	Semi-rigid	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	85135D
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 7 mm adapter set	85135E 85130E
7 mm	Flexible	2.4 mm (f) NMD to 7 mm 2.4 mm (f) NMD to 7 mm	85135F
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85134C 85130F
3.5 mm	Semi-rigid	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	85134D
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 3.5 mm adapter set	85134E 85130F
3.5 mm	Flexible	2.4 mm (f) NMD to 3.5 mm (f) 2.4 mm (f) NMD to 3.5 mm (m)	85134F
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	85133C 85130G
2.4 mm	Semi-rigid	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	85133D
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm adapter set	85133E 85130G
2.4 mm	Flexible	2.4 mm (f) NMD to 2.4 mm (f) 2.4 mm (f) NMD to 2.4 mm (m)	85133F

NMD is a connector type designed to mate only with the 8510, 8720 and PNA series network analyzer test ports.

1.85-mm Test Set Ports

Device Connector Type	Cable Type	Cable Connector Description	Model
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm adapter set	N4697C 85130H
1.85 mm	Flexible	1.85 mm (f) to 1.85 mm (f) 1.85 mm (f) to 1.85 mm (m)	N4697F

1.0-mm Test Set Ports

Device Connector Type	Cable Connector Description	Model
1.0 mm	1.0 mm (f) to 1.0 mm (f)	11500I
1.0 mm	1.0 mm (f) to 1.0 mm (m), 16 cm	11500J
1.0 mm	1.0 mm (f) to 1.0 mm (m), 20 cm	11500K
1.0 mm	1.0 mm (f) to 1.0 mm (m), 24 cm	11500L

Network Analyzer Accessories

11930A/B Power Limiters

The 11930A/B limiters protect the input circuits of network analyzers, spectrum analyzers, and sources from transients and short-duration overloads.

11850C/D Three Way Power Splitters

The 11850C/D 50 ohm, three-way power splitters are recommended for use with the 8753 (300 kHz to 3 GHz) network analyzers. The 11851B RF cable kit is suggested.



86205A/86207A



85024A

86205A/86207A RF Bridges

The 86205A/86207A high directivity RF bridges offer unparalleled performance in a variety of general-purpose applications. They are ideal for accurate reflection measurements and signal leveling applications.

85024A High-Frequency Probe

The 85024A high-frequency probe makes it easy to perform in-circuit measurements. An input capacitance of only 0.7 pF shunted by 1 MΩ of resistance permits high-frequency probing without adversely loading the circuit-under-test. Excellent frequency response and unity gain guarantee high accuracy in swept measurements with this probe. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of RF analyzers. RF network analyzers such as the 8753ET/ES, 8753E, 3577A, and 4195A are directly compatible. Additionally, the 8560, 8590E, and ESA series signal analyzers are also compatible. You can use the 1122A probe power supply or any dual ±15 V, 130 mA supply.

11852B 50 ohm/75 ohm Minimum Loss Pad

The 11852B is a low SWR minimum loss pad used to transform 50-ohm port impedance to 75-ohm or 75-ohm to 50-ohm.

Type-N Accessory Kits

Each kit contains a Type-N (female) short, a Type-N (male) short, two Type-N (male) barrels, two Type-N (female) barrels, and a storage case.

11853A 50-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm Type-N connectors.

11855A 75-ohm Type-N Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm Type-N connectors. This kit also contains a 75-ohm Type-N (male) termination.

11878A Type-N/3.5mm Adapter Kit

Adapter kit contains: 3.5 (f) to Type-N (M), 3.5 (m) to Type-N (m), 3.5 (f) to Type-N (f), and 3.5 (m) to Type-N (f).

BNC Accessory Kits

The BNC accessory kit contains two Type-N (male) to BNC (female) adapters, two Type-N (male) to BNC (male) adapters, two Type-N (female) to BNC (female) adapters, two Type-N (female) to BNC (male) adapters, a BNC (male) short, and a storage case.

11854A 50-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 50-ohm BNC connectors.

11856A 75-ohm BNC Accessory Kit

Accessory kit furnishes components for measurement of devices with 75-ohm BNC connectors. This kit also contains a 75-ohm BNC (male) termination.

7-16 Adapter Kits

The 11906 family adapter kits.

11906A 7-16 to 7-16 Adapter Kit

Adapter kit contains:	quantity
7-16 male to male adapter	1
7-16 female to female adapter	1
7-16 male to female adapter	2

11906B 7-16 to 50-ohm Type-N Adapter Kit

Adapter kit contains:	quantity
Type-N male to 7-16 male adapter	1
Type-N female to 7-16 female adapter	1
Type-N female to 7-16 male adapter	1
Type-N male to 7-16 female adapter	1

11906C 7-16 to 7-mm Adapter Kit

Adapter kit contains:	quantity
7-mm to 7-16 male adapter	2
7-mm to 7-16 female adapter	2

11906D 7-16 to 3.5-mm Adapter Kit

Adapter kit contains:	quantity
3.5-mm male to 7-16 male adapter	1
3.5-mm female to 7-16 female adapter	1
3.5-mm female to 7-16 male adapter	1
3.5-mm male to 7-16 female adapter	1

For 8510XF Systems (1.0 mm test port connectors)

Adapters	Connector Type
11920A/B/C ¹ adapters	1.0 mm series adapters
11921A/B/C/D ¹ adapters	1.0 mm to 1.85 mm series adapters
11922A/B/C/D ¹ adapters	1.0 mm to 2.4 mm series adapters
11923A adapters	1.0 mm (f) to circuit card launch
V281C/D ² adapters	1.0 mm to V-band waveband guide
W281C/D ² adapters	1.0 mm to W-band waveband guide

¹Suffix 'A' denotes male-to-male, 'B' denotes female-to-female, 'C' denotes male-to-female and 'D' denotes female-to-male.

²Suffix 'C' denotes 1.0 mm female and 'D' denotes 1.0 mm male.

Ordering Information

- 11930A/B Power Limiters
- 11850C/D Three-Way Power Splitters
- 86205A/86207A RF Bridges
- 85024A High-Frequency Probe
- 11852B 50-ohm/ 75-ohm Minimum Loss Pad

Type-N Accessory Kits

- 11853A 50-ohm Type-N Accessory Kit
- 11855A 75-ohm Type-N Accessory Kit
- 11878A Type-N/3.5 mm Adapter Kit

BNC Accessory Kits

- 11854A 50-ohm BNC Accessory Kit
- 11856A 75-ohm BNC Accessory Kit

7-16 Adapter Kits

- 11906A 7-16 to 7-16 Adapter Kit
- 11906B 7-16 to 50-ohm Type-N Adapter Kit
- 11906C 7-16 to 7-mm Adapter Kit
- 11906D 7-16 to 3.5-mm Adapter Kit

11850C/D
11852B
11930A/B
85024A
86205A
86207A

E4416A
E4417A

- Peak, peak-to-average ratio and average power measurements
- Time-gated power measurements
- Analyzer software for pulse and statistical analysis
- Fast measurement speed over the GPIB (up to 1,000 readings per second with the E4416A and E9320 power sensors)
- 5 MHz video (modulation) bandwidth
- Operates with all E-series and 8480 series power sensors
- Standard 3-year global warranty and 2-year calibration cycle



5

E4416A and E4417A Peak and Average Power Meters

Comprehensive Measurement Capability for TDMA, CDMA, and W-CDMA Signals

The E4416A and E4417A high-performance, single and dual-channel power meters and E932x peak and average power sensors, provide a low-cost, single-box solution for peak, peak-to-average ratio, average power and time-gated measurements, for the complex modulation formats used in today's and future wireless communications systems.

Time-gated measurements are performed using the meters comprehensive triggering features, such as an external TTL compatible trigger input. Up to 4 simultaneous time-gated measurements can be made. Individual start and duration times can be setup, allowing user's to measure the average, peak, or peak-to-average ratio. For example, on a GSM signal, this capability can be used to measure the average power over 5% to 95% of the burst duration, as well as measuring the peak power and pulse droop.

Fast Measurement Speed without Compromising Accuracy and Repeatability

Faster test times improve manufacturing productivity and efficiency. Designed for both bench and automatic test equipment (ATE) operation, the EPM-P series power meters along with the E9320 sensors, provides a measurement speed, over the GPIB, of 1,000 corrected readings per second.

The meter's 20 Msamples/second continuous sampling rate provides the capability to accurately profile complex modulation formats of up to 5 MHz bandwidth.

"Agilent EPM-P Analyzer" Software

The "Agilent EPM-P Analyzer" VEE operates via the GPIB in a PC or laptop environment, and provides the statistical, power, frequency and time measurements that are required for CDMA and TDMA signals. When the software is in control of the meter, all the meter functions and pre-defined setups are not relevant as the software overrides the meter. It's a VEE run-time program and is supplied as standard with all EPM-P power meters, free of charge, on a CD-ROM. It also comes with a VEE installation program.

Low Cost of Ownership

The EPM-P series power meters come with a standard 3-year warranty and, 2-year calibration cycle, and are fully compatible with the 8480 and E-series power sensors, therefore protecting your investment. This also gives an additional choice for conventional average power measurements.

Specifications

Frequency Range: 9 kHz to 110 GHz, sensor dependent

Power Range: -70 to +44 dBm, sensor dependent

Single Sensor Dynamic Range:

- 8480 series sensors: 50 dB maximum
- E-series CW power sensors: 90 dB
- E-series E9300 Average power sensors: 80 dB maximum
- E-series E9320 Peak and Average power sensors:
 - 85 dB maximum (CW mode)
 - 75 dB maximum (peak mode)

Display Units:

- Absolute: Watts or dBm
- Relative: Percent or dB

Display Resolution: Selectable resolution of 1.0, 0.1, 0.01, 0.001 dB in logarithmic mode, or 1 to 4 significant digits in linear mode.

Measurement Characteristics:

- Measurements: Average Power, Peak Power, Peak-to-Average Ratio and measurements between two time offsets (time-gating)
- Analyzer Software: statistical and pulse analysis
- Averaging: Averaging over 1 to 1024 readings
- **Modulation Bandwidth:** 5 MHz maximum (set by meter and is sensor dependent)

Instrumentation Accuracy:

- Absolute:
 - Logarithmic: ± 0.02 dB; Linear: $\pm 0.5\%$
- Relative:
 - Logarithmic: ± 0.04 dB; Linear: $\pm 1.0\%$

Time Base Accuracy: 0.1%

Trigger Sources: Internal, External TTL, GPIB, RS232/422,

Sampling Characteristics:

- Sampling Rate: 20 MSamples/second continuous sampling
- Sampling Technique: Synchronous repetitive sampling
- **1 mW Power Reference:** Refer to EPM Series Power Meters

Key Literature

Product Overview, p/n 5980-1471E

Technical Specifications, p/n 5980-1469E

Configuration Guide, p/n 5965-6381E

Application Note 1449 Fundamentals of RF and Microwave Power

Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN,

Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN

Application Note 64-4, Four Steps for Making Better Power

Measurements, p/n 5965-8167EN

Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Application Note 1438, EPM-P Series Power Meters Used in Radar and

Pulse Applications, p/n 5988-8522EN

Ordering Information

E4416A Power Meter (peak and average, single-channel)

E4417A Power Meter (peak and average, dual-channel)

E4417A-002 Supplies rear-panel sensor input

(power reference calibrator is on the front panel)

E4417A-003 Supplies rear-panel sensor input

(power reference calibrator is on the rear panel)

E4417A-004 Deletes the E9288A sensor cable

E4417A-908 Supplies a one-instrument rackmount kit

E4417A-909 Supplies a two-instrument rackmount kit

E4417A-A6J Supplies ANSI Z540 Certificate of Calibration with data

Accessories

34131A Hard transit case

34161A Accessory pouch

34141A Yellow soft carry case

Power Sensor Cables

For operation with E9320 power sensors:

E9288A 1.5 meters (5 ft)

E9288B 3 meters (10 ft)

E9288C 10 meters (31 ft)

Note: The E9288A-C sensor cables will also operate with 8480 and E-series power sensors.

For operation with 8480 series, E441x and E9300 power sensors only:

11730A 1.5 meters (5 ft)

11730B 3 meters (10 ft)

11730C 6.1 meters (20 ft)

11730D 15.2 meters (50 ft)

11730E 30.5 meters (100 ft)

11730F 61 meters (200 ft)

- Operates with the new EPM-P Series Power Meters (E4416A and E4417A)
- Provides peak and average power measurements
- Fast measurement speed over the GPIB (up to 1,000 readings per second)
- 300 kHz, 1.5 MHz and 5 MHz video (modulation) bandwidths
- Wide dynamic range sensors
- Calibration factors stored in EEPROM



E9320 Family Peak and Average Power Sensors

E9320 Family Peak and Average Power Sensors

The E9320 power sensors must be used with an E9288A, B or C sensor cable and only operate with the EPM-P series power meters (E4416A and E4417A). These sensors have two measurement paths, one for peak and time-gated measurements (a fast sampled path) and another for stable, low-level average power measurements.

High Performance Sensors

The E932x sensors have two frequency ranges, from 50 MHz to 6 GHz to cover most wireless communications applications, and a higher frequency range 50 MHz to 18 GHz. Each frequency range has a choice of 3 different video bandwidth sensors:

- 300 kHz for TDMA signals, for example GSM
- 1.5 MHz for cdmaOne
- 5 MHz for W-CDMA and cdma2000

Using just one sensor, user's can measure W-CDMA, cdmaOne and TDMA as each sensor provides a high, medium and low video bandwidth setting, selectable by the meter. So user's can select the modulation bandwidth required for their application, while maintaining the maximum dynamic range.

Fast Measurement Speed

The E9320 power sensors provide fast measurement speed, over the GPIB, up to 1,000 corrected readings per second, with the E4416A power meter.

Optimum Measurement Accuracy and Repeatability

To minimize the sensor and source mismatch, one of the main contributors to the overall measurement uncertainty, the E9320 sensors have a low SWR specification (1.15 for signals <+10 dBm, 50 MHz to 2 GHz). Comprehensive error correction is also provided as the calibration factors, linearity, and temperature compensation data are all stored within the E9320 sensor's EEPROM.

Specifications

Sensor Model	Max. Meas. Bandwidth	Frequency Range	Power Range	Max. Power
E9321A	300 kHz	50 MHz to 6 GHz	-65 to +20 dBm (max.)	+23 dBm average
E9322A	1.5 MHz	50 MHz to 6 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9323A	5 MHz	50 MHz to 6 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9325A	300 kHz	50 MHz to 18 GHz	-65 to +20 dBm (max.)	+23 dBm average
E9326A	1.5 MHz	50 MHz to 18 GHz	-60 to +20 dBm (max.)	+23 dBm average
E9327A	5 MHz	50 MHz to 18 GHz	-60 to +20 dBm (max.)	+23 dBm average

E9321A
E9322A
E9323A
E9325A
E9326A
E9327A

Key Literature

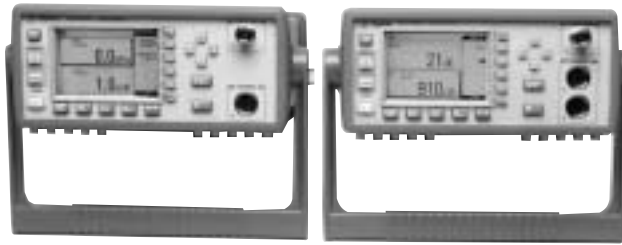
Product Overview, p/n 5980-1471E
 Technical Specifications, p/n 5980-1469E
 Configuration Guide, p/n 5965-6381E
 Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
 Application Note 64-4, Four Steps for Better Power Measurements, p/n 5965-8167EN
 Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E
 Application Note 1438, EPM-P Series Power Meters Used in Radar and Pulse Applications, p/n 5988-8522EN

Ordering Information

E9321A Power Sensor, 50 MHz to 6 GHz, 300 kHz bandwidth
E9321A-A6J Supplies ANSI Z540 Certificate of Calibration with data
E9322A Power Sensor, 50 MHz to 6 GHz, 1.5 MHz bandwidth
E9322A-A6J Supplies ANSI Z540 Certificate of Calibration with data
E9323A Power Sensor, 50 MHz to 6 GHz, 5 MHz bandwidth
E9323A-A6J Supplies ANSI Z540 Certificate of Calibration with data
E9325A Power Sensor, 50 MHz to 18 GHz, 300 kHz bandwidth
E9325A-A6J Supplies ANSI Z540 Certificate of Calibration with data
E9326A Power Sensor, 50 MHz to 18 GHz, 1.5 MHz bandwidth
E9326A-A6J Supplies ANSI Z540 Certificate of Calibration with data
E9327A Power Sensor, 50 MHz to 18 GHz, 5 MHz bandwidth
E9327A-A6J Supplies ANSI Z540 Certificate of Calibration with data

E4418B
E4419B

- Fast measurement speed (up to 200 readings per second with the E4418B, and 100 readings per second with the E4419B, over the GPIB, with E-series sensors)
- Speed improvement of x2 using the 8480-series power sensor (compared to 437B)
- Code-compatible with the 436A and 437B (E4418B) and 438A (E4419B)
- Operates with the 8480 series and E-series (except the E9320A family) plus all 8480 series power sensors
- No range-switching delays with 8480-series sensors (over a 50 dB range), and only one fast-range switch point with E-series sensors (over a 90 dB range)
- Standard 3-year global warranty and 2-year calibration cycle
- Internal rechargeable battery option



EPM Series Power Meters

5

E4418B Single-Channel Power Meter

The E4418B is a low-cost, high-performance, single-channel, programmable power meter. It is fully compatible with the 8480 series and E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4418B can measure from -70 dBm to +44 dBm at frequencies from 9 kHz to 110 GHz. Designed for bench and automatic test equipment (ATE) use, the E4418B makes fast (up to 200 readings per second with E-series sensors), accurate and repeatable power measurements.

The E4418B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a variety of lighting conditions. The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Ten instrument configurations can be saved and recalled, reducing the need to repeat setup sequences.

The E4418B is ideal for service and maintenance applications. The internal rechargeable battery option (option 001), which provides up to 5.5 hours of continuous operation, brings Agilent's accuracy to field applications. Front and rear panel bumpers protect the E4418B from everyday knocks. The meter weighs only 4 kg (9 lbs), and a bail handle makes it easy to carry.

Because the E4418B power meter is designed to be code-compatible with the previous-generation 436A and 437B power meters, a user's investment in automatic-test procedures, software generation and verification is protected.

E4419B Dual-Channel Power Meter

The E4419B is a low-cost, high-performance, dual-channel, programmable power meter. It is fully compatible with the 8480 series and the E-series power sensors, (except the E9320A family). Depending upon which sensor is used, the E4419B can measure from -70 dBm to +44 dBm at frequencies from 9 kHz to 110 GHz.

Designed for bench and automatic test equipment use (ATE), the E4419B makes fast (up to 100 readings per second with E-series sensors), accurate and repeatable power measurements. The E4419B is a true dual-channel power meter, which means that you get two simultaneous power readings on the display.

The E4419B power meter has a high-resolution LCD display with LED backlighting and contrast control. This allows users to see the power readings from a distance, at a wide viewing angle and in a

variety of lighting conditions. Users can display both the digital and analog types of readout on the meter's split screen facility. The analog peaking meter allows users to make accurate adjustments.

The user interface is easy to learn and use, with hardkeys for the most frequently used functions, and softkey menus to simplify instrument configuration for different applications. Difference (A-B, B-A) and ratio (A/B, B/A) functions are provided, and ten instrument configurations can be saved and recalled, reducing the need to repeat set-up sequences.

Because the E4419B power meter is code compatible with the 438A and is the same height (88.5 mm /3.5 in) and width (212.6 mm/ 8.5 in) as the 438A, this makes it easy to substitute into rackmount automatic-test-equipment systems.

Specifications

- Frequency Range:** 9 kHz to 110 GHz, sensor dependent
- Power Range:** -70 dBm to +44 dBm (100 pW to 25 W), sensor dependent
- Power Sensors:** Compatible with all 8480 series and E-series sensors except the E9320A family
- Single Sensor Dynamic Range:**
 - 90 dB maximum (E-series sensors)
 - 50 dB maximum (8480 series sensors)
- Display Units:**
 - Absolute: Watts or dBm
 - Relative: Percent or dB
- Display Resolution:** Selectable resolution of 1.0, 0.1, 0.01, and 0.001 dB in log mode, or 1 to 4 digits in linear mode
- Default Resolution:** 0.01 dB in log mode, 3 digits in linear mode
- Accuracy Instrumentation:**
 - Absolute: ± 0.02 dB (log) or $\pm 0.5\%$ (linear). Add the corresponding power sensor linearity percentage
 - Relative: ± 0.04 dB (log) or $\pm 1.0\%$ (linear). Add the corresponding power sensor linearity percentage

Power Reference

Power Output: 1.00 mW (0.0 dBm). Factory set to $\pm 0.4\%$ traceable to the National Physical Laboratory (NPL), UK.

Accuracy:

- For two years:
 - $\pm 0.5\%$ ($23 \pm 3^\circ\text{C}$)
 - $\pm 0.6\%$ ($25 \pm 10^\circ\text{C}$)
 - $\pm 0.9\%$ (0 to 55°C)

Frequency: 50 MHz nominal

SWR: 1.06 maximum (1.08 maximum for option 003)

Connector Type: Type N (f), 50 ohms

Key Literature

- Brochure, p/n 5965-6380E
- Technical Specifications, p/n 5965-6382E
- Configuration Guide, p/n 5965-6381E
- Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
- Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
- Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

E4418B Power Meter

E4419B Power Meter

- E4419B-001** Supplies internal rechargeable battery
- E4419B-002** Supplies rear-panel sensor input (power reference calibrator is on front panel)
- E4419B-003** Supplies rear-panel sensor input (power reference calibrator is on rear panel)
- E4419B-004** Deletes the 11730A sensor cable
- E4419B-908** Supplies a one-instrument rackmount kit
- E4419B-909** Supplies a two-instrument rackmount kit
- E4419B-A6J** Supplies ANSI Z540 Certificate of Calibration with data (E4418B/E4419B)

- Operates with the E4418A/B, E4419A/B, E4416A and E4417A power meters
- Wide dynamic range, -70 to +44 dBm, sensor dependent
- Frequency range, 9 kHz to 26.5 GHz, sensor dependent
- Fast measurement speed (up to 200 readings per second, over the GPIB, with the E4418A/B power meter)
- Calibration factors, linearity and temperature compensation data stored in EEPROM



Examples of E-Series Power Sensors

E-Series Power Sensors (E4412A, E4413A and E9300 range)

The E-series diode power sensors are wide dynamic range (90 dB maximum) which operate with the EPM and EPM-P series of power meters.

The E4412A and E4413A sensors are designed for providing power measurements on continuous wave (CW) signals over the range -70 to +20 dBm, whereas the E9300 family of power sensors measure the average power of RF and microwave signals, regardless of modulation format, over an 80 dB maximum range.

8480 Power Sensor Family

The 8480 power sensors are designed for use with the EPM and EPM-P series power meters, 70100A, E1416A and the discontinued 43X family power meters. These thermocouple and diode power sensors provide extraordinary accuracy, stability, and SWR over a wide range of frequencies (100 kHz to 110 GHz) and power levels (-70 to +44 dBm).

E-Series Specifications

Model/Frequency Range	Power Range	Maximum Power	Connector Type
E4412A 10 MHz to 18 GHz	100 pW to 100 mW (-70 to +20 dBm)	200 mW (+23 dBm)	Type-N (m)
E4413A 50 MHz to 26.5 GHz	100 pW to 100 mW (-70 to +20 dBm)	200 mW (+23 dBm)	APC-3.5mm (m)
E9300A 10 MHz to 18 GHz	1 nW to 100 mW (-60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 μsec)	Type-N (m)
E9301A 10 MHz to 6 GHz	1 nW to 100 mW (-60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 μsec)	Type-N (m)
E9304A 9 kHz to 6 GHz	1 nW to 100 mW (-60 to +20 dBm)	320 mW (+25 dBm) avg. 2 W (+33 dBm) peak (<10 μsec)	Type-N (m)
E9300B 10 MHz to 18 GHz	1 μW to 25 W (-30 to +44 dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak >6 GHz: 125 W peak 500 Wμs per pulse	Type-N (m)
E9301B 10 MHz to 6 GHz	1 μW to 25 W (-30 to +44 dBm)	0°C to 35°C: 30 W avg. 35°C to 55°C: 20 W avg. <6 GHz: 500 W peak 500 Wμs per pulse	Type-N (m)
E9300H 10 MHz to 18 GHz	10 nW to 1 W (-50 to +30 dBm)	3.16 W avg. 100 W peak 100 Wμs per pulse	Type-N (m)
E9301H 10 MHz to 6 GHz	10 nW to 1 W (-50 to +30 dBm)	3.16 W avg. 100 W peak. 100 Wμs per pulse	Type-N (m)

Best SWR in the Industry

Mismatch uncertainty is usually the largest single source of error in power measurements. The 8480 power sensor family gives you extremely low SWR even at mm-wave frequencies. For example, the W8486A power sensor has a specified SWR of less than 1.08:1 over its entire 75 to 110 GHz frequency range. This low SWR translates into minimum mismatch uncertainty and optimum measurement accuracy.

Accurate Calibration and Traceability

Each power sensor in the 8480 family is individually calibrated and traceable to the U.S. National Institute of Standards and Technology (NIST). The uncertainty in this calibration factor is your link to NIST. The cal factor measurement system used by Standards Lab provides you with minimum cal factor uncertainty.

Millimeter-Wave Sensor Calibration

A 50 MHz calibration port is included in Agilent waveguide power sensors for calibration with the power meter. This calibration provides traceability to NIST at millimeter-wave frequencies, and it eliminates the uncertainties due to temperature changes and the variance in making measurements with different meter/sensor combinations.

Key Literature

- EPM Power Meter Brochure, p/n 5965-6380E
- E9300 Sensors Product Overview, p/n 5968-4960E
- Technical Specifications, p/n 5965-6382E
- Configuration Guide, p/n 5965-6381E
- Application Note 1449 Fundamentals of RF and Microwave Power Measurements, Part 1 p/n 5988-9213EN, Part 2 p/n 5988-9214EN, Part 3 p/n 5988-9215EN, Part 4 p/n 5988-9216EN
- Application Note 64-4, Four Steps for Making Better Power Measurements, p/n 5965-8167EN
- Product Note, Choosing the Right Power Meter and Sensor, p/n 5968-7150E

Ordering Information

- E4412A CW Power Sensor (10 MHz to 18 GHz)
- E4413A CW Power Sensor (50 MHz to 26.5 GHz)
- E9300A Average Power Sensor (10 MHz to 18 GHz)
- E9301A Average Power Sensor (10 MHz to 6 GHz)
- E9304A Average Power Sensor (9 kHz to 6 GHz)
- E9300B Average Power Sensor (10 MHz to 18 GHz)
- E9301B Average Power Sensor (10 MHz to 6 GHz)
- E9300H Average Power Sensor (10 MHz to 18 GHz)
- E9301H Average Power Sensor (10 MHz to 6 GHz)

- E4412A
- E4413A
- E9300A
- E9300B
- E9300H
- E9301A
- E9301B
- E9301H
- E9304A

8480 Series Specifications

Model	Frequency Range	Maximum SWR	Power Linearity ¹	Maximum Power	Connector Type	Weight
25 Watt Sensors 1 mW to 25 W (0 to +44 dBm)						
8481B	10 MHz to 18 GHz	10 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18	+35 to +44 dBm; ±4%	0° to 35°C: 30 W avg ² 35° to 55°C: 25 W avg	Type-N (m)	Net 0.8 kg (1.75 lb) Shipping 1.5 kg (3.25 lb)
8482B	100 kHz to 4.2 GHz	12.4 to 18 GHz: 1.28 100 kHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.18		0.01 to 5.8 GHz: 500 W pk 5.8 to 18 GHz: 125 W pk 500 W-μs per pulse	Type-N (m)	
3 Watt Sensors 100 μW to 3 W (-10 to +35 dBm)						
8481H	10 MHz to 18 GHz	10 MHz to 8 GHz: 1.20 8 to 12.4 GHz: 1.25 12.4 to 18 GHz: 1.30	+25 to +35 dBm; ±5%	3.5 W avg, 100 W pk 100 W-μs per pulse	Type-N (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
8482H	100 kHz to 4.2 GHz	100 kHz to 4.2 GHz: 1.20			Type-N (m)	
100 mW Sensors 1 μW to 100 mW (-30 to +20 dBm)						
8485A	50 MHz to 26.5 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 2.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 33 GHz: 1.40	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz					
8481A	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 to 50 MHz: 1.18 50 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.18 12.4 to 18 GHz: 1.28			Type-N (m)	
8482A	100 kHz to 4.2 GHz	100 to 300 kHz: 1.60 0.3 to 1 MHz: 1.20 1 MHz to 2 GHz: 1.10 2 to 4.2 GHz: 1.30			Type-N (m)	
8483A (75 Ω)	100 kHz to 2 GHz	100 to 600 kHz: 1.80 600 kHz to 2 GHz: 1.18		300 mW avg, 10 W pk	Type-N (m) 75 Ω	
R8486A	26.5 to 40 GHz	1.4	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486A	33 to 50 GHz	1.5			Waveguide Flange UG-383/U	
V8486A	50 to 75 GHz	1.04	+10 to +20 dBm; ±2% -30 to +10 dBm <±1%	200 mV avg 40 W pk 10 us pulse 0.5% duty cycle	Waveguide Flange UG-385/U	Net 0.4 kg (0.91 lb) Shipping 1 kg (2.11 lb)
W8486A	75 to 110 GHz	1.08	±2%	200 mW avg 40 W peak	Waveguide Flange UG-387/U	Net 0.4 kg (0.9 lb) Shipping 1.0 kg (2.1 lb)
8487A	50 MHz to 50 GHz	50 to 100 MHz: 1.15 100 MHz to 2 GHz: 1.10 2 to 12.4 GHz: 1.15 12.4 to 18 GHz: 1.20 18 to 26.5 GHz: 1.25 26.5 to 40 GHz: 1.30 40 to 50 GHz: 1.50	+10 to +20 dBm; ±3%	300 mW avg, 15 W pk 30 W-μs per pulse	2.4 mm (m)	Net 0.14 kg (0.28 lb) Shipping 0.5 kg (1 lb)
High Sensitivity Sensors 100 pW to 10 μW (-70 to -20 dBm)						
8481D ^{3,4}	10 MHz to 18 GHz	10 to 30 MHz: 1.40 30 MHz to 4 GHz: 1.15 4 to 10 GHz: 1.20 10 to 15 GHz: 1.30 15 to 18 GHz: 1.35	-30 to -20 dBm; ±1%	100 mW avg 100 mW pk	Type-N (m)	Net 0.18 kg (0.41 lb) Shipping 0.9 kg (2 lb)
8485D ³	50 MHz to 26.5 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 4 GHz: 1.15 4 to 12 GHz: 1.19 12 to 18 GHz: 1.25 18 to 26.5 GHz: 1.29	-30 to -20 dBm; ±2%	100 mW avg 100 mW pk	APC-3.5 mm (m)	Net 0.2 kg (0.38 lb) Shipping 0.5 kg (1 lb)
Option 033	50 MHz to 33 GHz	26.5 to 33 GHz: 1.35				
8487D ³	50 MHz to 50 GHz	0.05 to 0.1 GHz: 1.19 0.1 to 2 GHz: 1.15 2 to 12.4 GHz: 1.20 12.4 to 18 GHz: 1.29 18 to 34 GHz: 1.37 34 to 40 GHz: 1.61 40 to 50 GHz: 1.89	-30 to -20 dBm; ±2%	100 mW avg 100 mW pk	2.4 mm (m)	Shipping 0.5 kg (1 lb) Net 0.2 kg (0.38 lb)
R8486D ³	26.5 to 40 GHz	1.4	-30 to -25 dBm; ±3%	100 mW avg or pk 40 Vdc max	Waveguide Flange UG-599/U	Net 0.26 kg (0.53 lb) Shipping 0.66 kg (1.3 lb)
Q8486D ³	33 to 50 GHz	1.4	-25 to -20 dBm; ±5%		Waveguide Flange UG-383/U	

¹ Negligible deviation except for those power ranges noted.

² For pulses greater than 30 W the maximum average power (Pa) is limited by the energy per pulse (E) in W-μs according to Pa = 30 - 0.02E.

³ Includes 11708A 30 dB attenuator for calibrating against a 0 dBm, 50 MHz power reference. 11708A is factory set to 30 dB ± 0.05 dB at 50 MHz, traceable to NIST. SWR < 1.05 at 50 MHz.

⁴ This sensor directly replaces the popular 8484A power sensor.

- A flexible and intuitive user interface
- Easy measurement setup
- Low instrumentation uncertainty
- Color graphical display of noise figure and gain versus frequency
- Enhanced PC and printer connectivity
- SNS, 346 and 347 Series noise source compatible
- Ability to automatically upload ENR calibration data from SNS Series noise source
- Local oscillator control through second dedicated GP-IB
- 3-year warranty as standard



N8973A

NFA Series

A Flexible and Intuitive User Interface

The user interface on the new NFA series of Noise Figure Analyzers is intuitive and easy to use, with easy to find keys, which are sized and then placed in the relevant key group according to function. The soft-key depths have been kept to a minimum and there are clear visual indicators on the screen showing the current machine state.

Easy Measurement Setup

The NFA series of Noise Figure Analyzers now takes the pain out of complex measurement setups, with their simple but instructive menus. The built-in help button gives key function and remote programming commands, that should eliminate the need to carry manuals when setting up measurements.

Low Instrumentation Uncertainty

When making noise figure measurements, a key parameter to be aware of is measurement uncertainty. The NFA has a low instrumentation uncertainty to aid in accurate and repeatable measurement of manufacturers' components. In addition, to aid customers in setting their components/systems specifications, Agilent has produced a web-based uncertainty calculator that will give customers information on how to improve and classify their measurement specifications more accurately.

For more information, visit our web site at: www.agilent.com/find/nf

Increase Measurement Throughput

In manufacturing environments, fast measurement speed and repeatability are critical. The NFA series of Noise Figure Analyzers now include many features that can reduce your measurement time and increase throughput. The frequency list function allows you to select specific points within a complete measurement span to make your measurement. The Sweep averaging function allows a real-time update to the screen during a measurement, as you adjust the performance of the DUT during a sweep. Both these functions, as well as the limit line functionality for quick and easy pass/fail testing and the additional ability to recall complete calibrated instrument states, increase productivity and measurement throughput.

Enhanced Connectivity

The built-in floppy disk drive, GPIB, RS232 serial and Printer port connectors allow quick and easy data transfer between the analyzer and a PC or workstation. There is also a built-in VGA connector for connecting a large-screen monitor.

Color Graphical Display

To enhance usability, the new Noise Figure Analyzers now come with an integrated 17 cm full color LCD display, for simultaneous viewing of noise figure and gain against frequency. There are three different formats for viewing measurements, the two separate channel or combined graph format, a table format, and a spot frequency noise figure and gain measurement "meter" format.

Ease of Automation

The NFA series of Noise Figure Analyzers include 2 industry-standard GPIB ports and an RS232 serial port, to aid in the automated control of the instrument. The second GPIB port is dedicated to Local oscillator control. The default control language is SCPI, but users can also define custom LO commands.

Ease of Integration

To aid with the integration of the new analyzer into manufacturing environments, Agilent has produced a Programmers Reference Manual containing example programs to help migrate to the new system. The NFA is not code compatible with the 8970B, nor can it control the 8971C.

Full Measurement Capability

Features present in all NFA series noise figure analyzers

- ENR data automatically loaded into NFA series noise figure analyzer when using SNS noise source
- Floppy disk loading and saving of ENR data when used with a 346 or 347 noise source
- Enhanced analysis through Limit lines and Marker functions
- Enhanced PC and printer connectivity and VGA output
- Internal data storage capable of storing up to 30 different state, trace, and setup files (dependent upon measurement complexity)
- 4 MHz measurement bandwidth
- Frequency list mode, which enables the user to avoid known, polluted frequencies during a measurement or, used tactically to speed up a measurement

Features only Available on the N8973A, N8974A, N8975A

- Lower noise figure measurement uncertainty $\pm < 0.05$ dB
- Six user selectable bandwidths (100 KHz, 200 KHz, 400 KHz, 1 MHz, 2 MHz, and 4 MHz)
- Enhanced speed

N8972A
N8973A
N8974A
N8975A

Noise Figure Analyzers

10 MHz to 1.5 GHz, 3 GHz, 6.7 GHz and 26.5 GHz Noise Figure Analyzers (cont.)

N8972A
N8973A
N8974A
N8975A

NFA Series Key Specifications

Specifications apply over 0°C to +55°C unless otherwise noted. The analyzer will meet its specifications after 2 hours of storage within the operating temperature range, 60 minutes after the analyzer is turned on, with Alignment running. A user calibration is required before corrected measurements can be made.

Frequency Range

NFA Series:

N8972A 10 MHz to 1.5 GHz
N8973A 10 MHz to 3 GHz
N8974A 10 MHz to 6.7 GHz
N8975A 10 MHz to 26.5 GHz

Measurement Speed (nominal)

	8 Averages	64 Averages
N8972A:	<100 ms/measurement	<80 ms/measurement
N8973A:	<50 ms/measurement	<42 ms/measurement
N8974A:	<70 ms/measurement	<50 ms/measurement
N8975A:	<70 ms/measurement	<50 ms/measurement

Measurement Bandwidth (nominal)

N8972A: 4 MHz
N8973A, N8974A, N8975A: 4 MHz, 2 MHz, 1 MHz, 400 kHz, 200 kHz, 100 kHz

Noise Figure and Gain

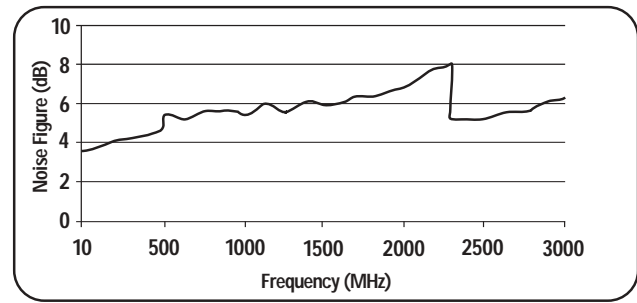
(Performance is dependent upon ENR of noise source used)

	Noise Source ENR		
	4 – 7 dB	12 – 17 dB	20 – 22 dB
N8972A			
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±<0.1 dB	±<0.1 dB	±<0.15 dB
Gain			
Measurement range	-20 to +40 dB		
Instrument uncertainty	±<0.17 dB		

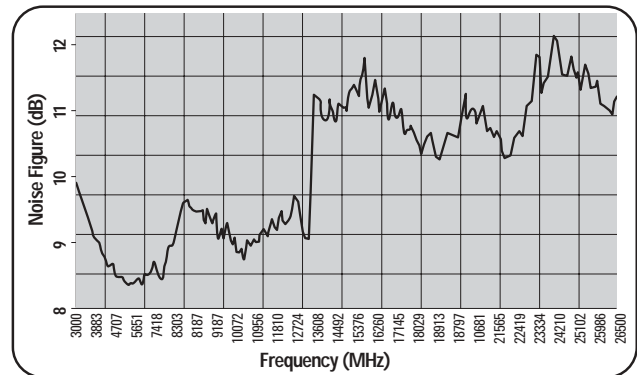
	Noise Source ENR		
	4 – 7 dB	12 – 17 dB	20 – 22 dB
N8973A, N8974A and N8975A (10 MHz to 3.0 GHz)			
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±<0.05 dB	±<0.05 dB	±<0.1 dB
Gain			
Measurement range	-20 to +40 dB		
Instrument uncertainty	±<0.17 dB		

	Noise Source ENR		
	4 – 7 dB	12 – 17 dB	20 – 22 dB
N8974A and N8975A (>3.0 GHz)			
Noise Figure			
Measurement range	0 to 20 dB	0 to 30 dB	0 to 35 dB
Instrument uncertainty	±<0.15 dB	±<0.15 dB	±<0.2 dB
Gain			
Measurement range	-20 to +40 dB		
Instrument uncertainty	±<0.17 dB		

Characteristic¹ Noise figure at 23°C ± 3°C (10 MHz to 3.0 GHz)



Characteristic¹ Noise figure at 23°C ± 3°C (3.0 GHz to 26.5 GHz)



Characteristic values are met or bettered by 90% of instruments with 90% confidence.

Frequency Reference

	Standard	Opt.1D5
Aging	±<2 ppm ¹ /year	±<0.1 ppm/year
Temperature stability	±<6 ppm	±<0.01 ppm
Settability	±<0.5 ppm	±<0.01 ppm

Tuning Accuracy (Start, Stop, Center, Marker)

4 MHz Measurement Bandwidth (default on all models of Noise Figure Analyzer)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 100 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 400 kHz

<4MHz Measurement Bandwidth (functionality not present in N8972A)

Frequency	Error
10 MHz – 3.0 GHz	±<Reference error + 20 kHz
3.0 GHz – 26.5 GHz	±<Reference error + 20% of measurement bandwidth

¹ Parts Per Million (10e-6)

General Specifications**Dimensions**

Without handle: 222 mm H x 375 mm W x 410 mm D
 With handle (max): 222 mm H x 409 mm W x 515 mm D

Weight (typical, without options)

N8972A: 15.3 kg
N8973A: 15.5 kg
N8974A: 17.5 kg
N8975A: 17.5 kg

Data Storage (nominal)

Internal drive: 30 traces, states or ENR tables
 Floppy disk: 30 traces, states or ENR tables

Power Requirements

On (line 1): 90 to 132 V rms, 47 to 440 Hz, 195 to 250 V rms, 47 to 66 Hz
 Power consumption: <300 W
 Standby (line 0): <5 W

Temperature Range

Operating: 0°C to +55°C
 Storage: -40°C to +70°C

Humidity Range

Operating: Up to 95% relative humidity to 40°C (non-condensing)
 Altitude range: Operating to 4,600 meters

Calibration Interval

1-year minimum recommended

Electromagnetic Compatibility

Complies with the requirements of the EMC directive 89/336/EEC. This includes Generic Immunity Standard EN 50082-1:1992 and Radiated Interference Standard CISPR 11:1990/EN 55011:1991, Group 1 Class A. The conducted and radiated emissions performance typically meets CISPR 11:1990/EN 55011:1991 Group 1 Class B limits.

Warranty

3-Year warranty as standard

Key Literature

Noise Figure Analyzers, NFA Series, Brochure, p/n 5980-0166E
 Noise Figure Analyzers, NFA Series, Data Sheet, p/n 5980-0164E
 Noise Figure Analyzers, NFA Series, Configuration Guide, p/n 5980-0163E
 Fundamentals of RF and Microwave Noise Figure Measurements, App note 57-1, p/n 5952-8255E
 Noise Figure Measurement Accuracy, App note 57-2, p/n 5952-3706
 10 Hints for Making Successful Noise Figure Measurements, p/n 5980-0228E
 N8972A and N8973A, NFA Series, Noise Figure Analyzer Programming Examples, p/n 5968-9498E

Ordering Information

N8972A 10 MHz to 1.5 GHz NFA Series Noise Figure Analyzer
N8973A 10 MHz to 3.0 GHz NFA Series Noise Figure Analyzer
N8974A 10 MHz to 6.7 GHz NFA Series Noise Figure Analyzer
N8975A 10 MHz to 26.5 GHz NFA Series Noise Figure Analyzer

All options, other than those marked with *, can be ordered at any time for use with an instrument.

Frequency Reference

N897xA-1D5 NFA series high stability frequency reference*

Calibration Documentation

N897xA-A6J NFA series ANSI Z540 compliant calibration with test data*

Accessories

N897xA-1CP NFA series rackmount and handle kit
N897xA-UK9 NFA series front panel cover
N897xA-1FP NFA series calibration, performance verification and adjustment software

Documentation

A hard copy and CD version of the English language Quick Reference Guide, User's Guide, Programmers Reference, and Calibration and Performance Verification Manual are included with the NFA as standard. Selections can be made to change the localization of the manual set or to delete the hardcopy.

N897xA-AB0 NFA series manual set for Taiwan – Chinese localization
N897xA-AB1 NFA series manual set – Korean localization
N897xA-AB2 NFA series manual set – Chinese localization
N897xA-ABE NFA series manual set – Spanish localization
N897xA-ABF NFA series manual set – French localization
N897xA-ABZ NFA series manual set – Italian localization
N897xA-ABD NFA series manual set – German localization
N897xA-ABJ NFA series manual set – Japanese localization
N897xA-OB0 Delete hardcopy manual set*

Note: The localized options will include a localized version of the Quick Reference Guide and User Guide, and an English language version of the Programmers Reference, and Calibration and Performance Verification Manual.

Additional Documentation

N897xA-OB1 NFA series manual set (English version)
N897xA-OB2 NFA series user manual (English version)
N897xA-OBF NFA series programmers reference (English version)

Service Options:**Warranty and Service**

Standard warranty is 3 years.

For warranty and service of 5 years, please order R-51B-001-5F: "3 year Return-to-Agilent warranty extended to 5 years" (quantity = 1).

Calibration²

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan*

R-50C-002 Standard compliant calibration plan*

² Options not available in all countries

N8972A
 N8973A
 N8974A
 N8975A

Noise Figure Analyzers

250

Agilent Noise Sources

SNS Series
346 Series
N2002A

- Agilent noise sources with frequency range from 10 MHz to 50 GHz
- Excess noise ratio (ENR) selected for a variety of user applications
- SNS series of noise sources have stored ENR data, decreasing the opportunity for user error



SNS Series

Ordering Information

N4000A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 6 dB
N4001A SNS Series Noise Source, 10 MHz to 18 GHz, nominal ENR 15 dB
N4002A SNS Series Noise Source, 10 MHz to 26.5 GHz, nominal ENR 15 dB
 All of the SNS series noise sources are provided with an APC 3.5 (male) connector as standard.

Connector

N400xA-001 Type-N (m) connector

Custom Solution

N400xA-H10 Gold standards calibration (for use with the N2002A)

Service Options:

Warranty and Service

Standard warranty is 1 year.

For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

For warranty and service of 5 years, please order R-51B-001-5C: "1 year Return-to-Agilent warranty extended to 5 years" (quantity = 1).

Calibration²

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan

R-50C-002 Standard compliant calibration plan

² Option not available in all countries

5

SNS Series Noise Sources

The Agilent SNS series of noise sources work in conjunction with the Agilent NFA series of noise figure analyzers to simplify measurement set-up and improve accuracy. When connected to the Agilent, NFA series, the noise source automatically downloads electronically stored calibration data to the analyzers. The noise sources also have the capability to automatically measure their own temperature so that compensation can be applied to the calibration data. These capabilities increase the overall reliability and accuracy of the noise figure measurement. The SNS noise sources can be used for a various applications with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

SNS Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
N4000A	10 MHz to 18 GHz	4.5 – 6.5 dB
N4001A	10 MHz to 18 GHz	14 – 16 dB
N4002A	10 MHz to 12 GHz 12 GHz to 26.5 GHz	12 – 16 dB 14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
N4000A	0.01 to 3.0	<1.04	0.02
	3.0 to 7.0	<1.13	0.06
	7.0 to 18.0	<1.22	0.10
N4001A	0.01 to 3.0	<1.15	0.07
	3.0 to 7.0	<1.20	0.09
	7.0 to 18.0	<1.25	0.11
N4002A	0.01 to 3.0	<1.22	0.10
	3.0 to 7.0	<1.25	0.10
	7.0 to 18.0	<1.25	0.11
	18.0 to 26.5	<1.35	0.15



346A/B/C Broadband Noise Sources

346 Series Noise Sources

The Agilent 346 series of noise sources work in conjunction with the Agilent NFA series noise figure analyzer and the PSA series spectrum analyzer to make accurate and reliable noise figure measurements. Each 346 noise source has individually calibrated ENR values at specific frequencies. The calibration data is printed on the label of the noise source and can be manually entered into the NFA or PSA. A floppy disk is also provided with the calibration data, for rapid entry of ENR data into the NFA or PSA. The 346 noise sources are designed for a broad range of measurement applications, with a range of frequencies, Excess Noise Ratio (ENR) and coaxial connector types.

Customer Solution Noise Sources

346B with option 346B-H01 High ENR Noise Source

The 346B-H01 has high ENR (21 dB typical), suitable for measuring high noise figure devices.*

346B with option 346B-H42 DBS Noise Source

The 346B-H42 was developed especially to test low noise block converters (LNB) used for Direct Broadcast Satellite (DBS). WR75 waveguide output, 5 dB ENR, low ENR calibration uncertainty, and low SWR improve the noise figure measurement accuracy of DBS LNBs.*

346CK01 Broadband Noise Source

This coaxial noise source features coverage from 1 to 50 GHz with the 2.4 mm coaxial connector. ENR is nominally 20 dB at 1 GHz and 7 dB at 50 GHz.*

* Contact Agilent for technical specifications

346 Series Partial Specifications

Instrument Model	Frequency Range	ENR Value
346A	10 MHz to 18 GHz	4.5 – 6.5 dB
346B	10 MHz to 18 GHz	14 – 16 dB
346C	10 MHz to 12 GHz 12 GHz to 26.5 GHz	12 – 16 dB 14 – 17 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
346A/B	0.01 to 3.0	1.3	0.13
	3.0 to 5.0	1.15	0.07
	5.0 to 18.0	1.25	0.11
346C	0.01 to 18.0	1.25	0.11
	18.0 to 26.5	1.35	0.15

Ordering Information

346A 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 5 dB
 346B 10 MHz to 18 GHz 346 Series Noise Source nominal ENR 15 dB
 346C 10 MHz to 26.5 GHz 346 Series Noise Source nominal ENR 15 dB
 All of the 346 series noise sources are provided with an APC 3.5 (male) connector as standard.

Connectors (excludes 346C)

346x-001 Type N (male) connector
 346x-002 APC-7mm connector
 346x-004 Type N (female) connector

Calibration Documentation

346x-A6J ANSI Z540 compliant calibration with test data

Additional Documentation

346x-910 Extra operation manual

Custom Solution Options

346x-H10 Gold standards calibration (for use with the N2002A)
 346B-H01 APC 3.5(m) connector with 21 dB nominal ENR
 346B-H42 DBS Waveguide adapter and nominal ENR 5 dB
 346CK01 1 GHz to 50 GHz 346 Series Noise Source nominal ENR 21 dB

Service Options:

Warranty and Service

Standard warranty is 1 year.

For warranty and service of 3 years, please order R-51B-001-3C: "1 year Return-to-Agilent warranty extended to 3 years" (quantity = 1).

For warranty and service of 5 years, please order R-51B-001-5C: "1 year Return-to-Agilent warranty extended to 5 years" (quantity = 1).

Calibration²

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001 Standard calibration plan
 R-50C-002 Standard compliant calibration plan

² Option not available in all countries

R347B and Q347B Noise Sources

This series of broadband noise sources has been designed to cover high frequency waveguide measurement applications.

Agilent 347 Partial Specifications

Instrument Model	Frequency Range	ENR Value
R347B	26.5 to 44 GHz	10 – 13 dB
Q347B	33 to 42 GHz	10 – 13 dB
	42 to 50 GHz	6 – 12.5 dB

Instrument Model	Frequency Range (GHz)	Max SWR	Reflection Coefficient
R347B	26 to 44	<1.42	0.17
Q347B	33 to 50	<1.57	0.22

Warranty

1-Year warranty as standard

SNS Series
346 Series
N2002A

- Simple calibration of noise sources with reduced uncertainty
- Traceable results to a national standard
- Availability for engineers who require on-site calibration



Key Literature

N2002A Noise Source Test Set 10 MHz to 26.5 GHz, Product Overview , p/n 5988-7228EN
Agilent Noise Source Calibration, Using the Agilent N8975A Noise Figure Analyzer and the N2002A Noise Source Test Set, p/n 5988-7229EN

Ordering Information

N2002A Noise source test set

Accessories

N2002A-001

Accessory cable and adapters

Cable (x1): 11500E

3.5 mm female to female adapter (x 3): 1250-1749

3.5 mm female to type-N (female) adapter (x1): 1250-1745

Warranty

1-Year warranty as standard

N2002A Noise Source Test Set

5

The N2002A Noise Source Test Set offers customers the opportunity to calibrate their own noise sources with minimal levels of uncertainty. With simple straightforward operations and low cost of equipment it is now viable that this process can occur “in-house” and thus drastically reduces downtime.

For engineers that currently run their own noise source calibration service, the N2002A noise source test set is an ideal addition to their test equipment. By incorporating this low-cost, self-contained unit into a wider noise source calibration system, high quality calibrations of noise sources can be made. When used within a noise source calibration system the N2002A and Agilent N8975A NFA series noise figure analyzer can also drastically reduce the calibration time.



Component Measurement

Today's electronic components are designed for higher performance, while being reduced in size, power consumption, and cost. Efficient and accurate component characterization, design evaluation, and manufacturing test are critical to the success of component users and suppliers. Agilent Technologies offers the industry's broadest line of component test instruments for passive as well as active components. The products in this section are designed to measure fundamental impedance-related parameters of electronic components and materials.

Impedance Measuring Instruments

Impedance measuring instruments can be divided into two general categories: LCR meters and impedance analyzers. LCR meters primarily measure inductance,

capacitance, and resistance of the test device at spot frequencies. Impedance analyzers, in addition to all the functions of the LCR meter, measure impedance, phase, and sometimes transmission parameters. These analyzers have extended frequency range, a synthesized source, swept frequency capability, and excellent frequency resolution. Combination network/spectrum/impedance analyzers offer the benefits of impedance analysis as well as vector-network and spectrum analysis. See the Selection Guides that follow for general instrument capabilities. For higher frequencies (above 3 GHz) in a 50 Ω environment, a dedicated vector-network analyzer is the best solution for impedance measurements. See Network Analyzers.

Selecting a test fixture is as important as selecting the right instrument. Agilent offers a wide range of accessories for axial, radial, and SMD chip devices. See page 253.

Impedance Analyzer Selection Guide

Model	Frequency Range	Impedance Range/Other	Additional Information	Page
4294A	40 Hz to 110 MHz	25 m Ω to 40 M Ω *	Color display, equivalent circuit analysis, IBASIC, LAN I/F, SMD fixtures	260, 261
4395A**	100 kHz to 500 MHz	2 Ω to 5 k Ω * S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis, IBASIC	216, 217
4396B**	100 kHz to 1.8 GHz	2 Ω to 5 k Ω * S-parameters, gain-phase	Color display, equivalent circuit analysis, SMD fixture vector-network and spectrum analysis, IBASIC	218, 219
E4991A	1 MHz to 3 GHz	0.1 Ω to 20 k Ω *	Color display, VBA, SMD fixtures, equivalent circuit analysis, material, LAN I/F, temperature characteristic measurement	256, 257

* 10% accuracy range

** with 4395A/4396B-010 and 43961A

Materials Measurements

Materials have two properties that determine how they interact with electromagnetic fields:

- Permittivity (ϵ) or dielectric constant for electric fields
- Permeability (μ) for magnetic fields

Permittivity ($\epsilon^* = \epsilon' - j\epsilon''$) and permeability ($\mu^* = \mu' - j\mu''$) are complex values. The real part (ϵ' or μ') is a measure of how much energy is stored in a material. The imaginary part (ϵ'' or μ'') is a measure of how much energy is lost in a material. These properties are not constant and may change with frequency or temperature, for example. Accurate measurements of these material properties during characterization or inspection help to achieve the best performance for a given application while shortening design cycles and minimizing scrap.

A materials measurement system consists of an instrument, a fixture to hold the material, and software or firmware to calculate complex permittivity or permeability values and display the results. For material testing applications, Agilent currently offers three types of solutions: LCR meter-based, impedance analyzer-based, and network analyzer-based systems.

Agilent offers fixture accessories based on the open-ended coaxial probe, the transmission line measurement, the parallel plate capacitance, and the inductor impedance technique. These choices allow you to best match the fixture, frequency range, and measurement technique with your material's physical and electrical test requirements. The chart of material test applications and solutions is shown in the next page.

Other Component Test

Agilent provides other high performance test solutions for specific applications such as VCO/PLL signal measurements, and resonator, and filter measurements. See pages 269, 270 and 271 for VCO/PLL signal measurements, pages 214 and 215 for resonator and filter measurements.

LCR and Resistance Meter Selection Guide

Model	Frequency Range	Impedance Range/ Other	Additional Information	Page
4263B	100 Hz to 100 kHz (5 test frequencies)	1 mΩ to 100 MΩ	Optional transformer test	264
4268A	120 Hz/1 kHz	0.0001 nF to 10 mF	High-value ceramic capacitor test	262
4284A	20 Hz to 1 MHz (8610 freq. points)	0.01 mΩ to 100 MΩ	42841A for high-current dc bias	266, 267
4285A	75 kHz to 30 MHz (100 Hz steps)	0.01 mΩ to 100 MΩ	42842C for high-current dc bias	266, 267
4287A	1 MHz to 3 GHz (100 kHz steps)	200 mΩ to 3 kΩ	Higher-accuracy, higher-speed RF LCR meter	263
4279A	1 MHz	0.00001 pF to 1280 pF	C-V meter, DC bias level 0 to ±38 V	
4288A	1 kHz/1 MHz	0.00001 pF to 20 μF	High-speed capacitor test	262
4339B	dc	1 kΩ to 1.6 × 10 ¹⁶ Ω	High-resistance meter, volume and surface resistivity, current	265
4338B	1 kHz test signal	10 μΩ to 100 kΩ	Milliohm meter	268

Material Test Applications and Solutions

	DC Resistivity Cell (16008B) Page 265	Dielectric Test Fixture (16451B) Page 259	Liquid Dielectric Test Fixture (16452A) Page 259	Dielectric and Magnetic Test Fixtures (16453A) (16454A) Page 258	Dielectric Probe System (85070M)	Agilent Material Measurement Software (85071B)
Absorber					•	•
Ceramic	•	•		•	•	
Fermentation					•	
Film (thin)		•		•		
Food					•	
Gel, semi-solid					•	
Liquid			•		•	
Loss		•	•	•	•	
Permeability				•		•
Permittivity (dielectrics)		•	•	•	•	•
Plastic	•	•		•	•	
Powder					•	
Printed circuit board		•		•		
Resistivity	•					
Rubber	•	•		•	•	
Solid	•	•		•	•	
Substrate	•	•		•	•	

Other Component Test Solutions

Model	Frequency Range	Brief Description	Page
Resonator/Filter Test E5100A	10 kHz to 180/300 MHz	Network analyzer best fitted for production line especially for resonator and filter manufacturer with fast measurement speed, low noise floor and powerful dedicated commands.	214 – 215



16047E



16034G



16044A



16089E



16196A/B/C

Test Accessories/Fixtures

			4263B	4268A	4279A	4284A	4285A	4287A	4288A	4294A	4294A with 42942A	4395A with 4395A-010 and 43961A	4396B with 4396B-010 and 43961A	E4991A
16034E	SMD/Chip Test Fixtures	DC – 40 MHz	•	•	•	•	•	•	•	•				
16034G	SMD/Chip Test Fixture, Small	DC – 110 MHz	•	•	•	•	•	•	•	•				
16034H	SMD/Chip Test Fixture, General	DC – 110 MHz	•	•	•	•	•	•	•	•				
16043A/B	3-Terminal SMD Test Fixture	DC – 110 MHz	•	•	•	•	•	•	•	•				
16044A	SMD/Chip Test Fixture, Four-Terminal, 10 MHz	DC – 10 MHz	•	•	•	•	•	•	•	•				
16047A	Axial and Radial Test Fixture	DC – 13 MHz	•	•	•	•	•	•	•	•				
16047D	Axial and Radial Test Fixture	DC – 40 MHz	•	•	•	•	•	•	•	•				
16047E	Axial and Radial Test Fixture, 110 MHz	DC – 110 MHz	•	•	•	•	•	•	•	•				
16048A	One Meter Test Leads, BNC	DC – 30 MHz	•	•	•	•	•	•	•	•				
16048B	One Meter Test Leads, SMC	DC – 30 MHz	•	•	•	•	•	•	•	•				
16048D	Two Meter Test Leads, BNC	DC – 30 MHz	•	•	•	•	•	•	•	•				
16048E	Four Meter Test Leads, BNC	DC – 1 MHz	•											
16048G	One Meter Test Leads, BNC, 110 MHz	DC – 110 MHz								•				
16048H	Two Meter Test Leads, BNC, 110 MHz	DC – 110 MHz								•				
16060A	Transformer Test Fixture	DC – 100 KHz	•											
16065A	Ext. Voltage Bias with Safety Cover (<=200 Vdc)	50 Hz – 2 MHz	•	•	•	•	•	•	•	•				
16065C	External Bias Adapter (<=40 Vdc)	50 Hz – 1 Mz	•	•					•					
16085B	4-Terminal Pair to 7 mm Adapter	DC – 40 MHz	•	•	•	•	•	•	•	•				
16089A/B/C/D/E	Kelvin Clip Leads	5 Hz – 100 KHz	•	•	•	•	•	•	•	•				
16092A	RF Spring Clip: Axial, Radial and SMD	DC – 500 MHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16093A	RF Two Terminal Binding Post	DC – 250 MHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16093B	RF Three Terminal Binding Post	DC – 250 MHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16094A	RF Probe Tip/Adapter	DC – 125 MHz	*1,2	*1,2	*1,2	*1,2	*1,2	*4,2	*1,2		*2	*2	*2	*2
16095A	LF Impedance Probe	DC – 13 MHz	*3	*3	*3	*3	*3		*3					
16191A	Side (Bottom) Electrode SMD Test Fixture	DC – 2 GHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16192A	Parallel Electrode SMD Test Fixture	DC – 2 GHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16194A	High Temperature Component Text Fixture	DC – 2 GHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16196A/B/C	Parallel Electrode SMD Test Fixture	DC – 3 GHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16197A	Bottom Electrode SMD Test Fixture	DC – 3 GHz	*1	*1	*1	*1	*1	*4	*1		•	•	•	•
16200B	External DC Bias Adapter	1 MHz – 1 GHz						*4			•	•	•	•
16314A	4-Terminal Balun (50 Ω Bal. to 50 Ω Unbal.)	100 Hz – 10 MHz	•	•	•	•	•	•	•	•				
16315A	1-Terminal Balun (50 Ω Bal. to 50 Ω Unbal.)	100 Hz – 10 MHz										•	•	
16316A	1-Terminal Balun (50 Ω Bal. to 100 Ω Unbal.)	100 Hz – 10 MHz										•	•	
16317A	1-Terminal Balun (50 Ω Bal. to 600 Ω Unbal.)	100 Hz – 3 MHz										•	•	
16334A	SMD/Chip Tweezers	DC – 15 MHz	•	•	•	•	•	•	•	•				
16451B	Dielectric Material Test Fixture	5 Hz – 30 MHz	•	•	•	•	•	•	•	•				
16452A	Liquid Test Fixture	20 Hz – 30 MHz				•	•			•				
16453A	Dielectric Material Test Fixture	1 MHz – 1 GHz												•
16454A	Magnetic Material Test Fixture	1 kHz – 1 GHz									•			•
42842A/B	High Bias Current 20 A/ 40 A Test Fixture	20 Hz – 1 MHz				•								
42842C	High Bias Current 10 A Test Fixture	75 kHz – 30 MHz					•							
42941A	Impedance Probe Kit	DC – 110 MHz								•				
42942A	4-Terminal Pair to 7 mm Adapter	DC – 110 MHz								•				

Note : Refer to the accessory descriptions for frequency and operational limits.
 *1 Compatible when used in conjunction with 16085B. *2 Do not connect the ground lead to the instrument.
 *2 7 mm cable is required. *3 3.5 mm(m) to 7 mm Adapter is required.

E4991A

- Basic accuracy $\pm 0.8\%$
- 3 GHz impedance direct read-out
- Windows-styled user interface
- Sweep parameters (frequency, ac level, dc bias)
- Built-in VBA programming function
- Various test fixture for components
- Data transfer through the LAN interface
- Direct read-out permittivity, permeability [Option]
- Temperature characteristic measurement



E4991A

E4991A RF Impedance/Material Analyzer

The new Agilent E4991A RF impedance/material analyzer offers ultimate impedance measurement performance and powerful built-in analysis function. It will provide innovations in R&D of components and circuit designers who evaluate components in the range of 3 GHz. The E4991A uses an RF-IV technique, as opposed to the reflection measurement technique, for more accurate impedance measurement over wide impedance range. Basic impedance accuracy is $\pm 0.8\%$. High Q accuracy enables low-loss component analysis. The internal synthesizer sweeps frequency from 1 MHz to 3 GHz with 1 mHz resolution.

Versatile Analysis

The E4991A enables display up to 3 scalar and 2 complex parameters. Engineer can easily observe the various impedance parameters. The list-sweep function improves test throughput by segmenting the sweep includes only necessary measurement frequencies. Test signal level ranges enable device evaluation under actual operating conditions. The DC bias, AC signal level swept measurement, and the monitor of test signal functions are available to the E4991A.

Internal VBA programming function is also useful for R&D in order to analyze component or material by using own analysis method. Furthermore, the built-in Equivalent Circuit Analysis Function automatically calculates the circuit constant values of five circuit models. These functions will drastically improve engineering productivity.

Material Evaluation

The E4991A provides the total dielectric/magnetic material measurement solutions in wide frequency range (1 MHz to 1 GHz). See page 258 for more information.

Ease of Use

The 8.4-inch color display and Windows-styled user interface is employed in the E4991A. Color display brings a clear view of measurement settings and results. Windows-styled menu gives you easy access to advanced features. The standard TCP/IP-compliant LAN interface realizes seamless connectivity with PC. With LAN capability, PC can directly read out measurement data from E4991A. It helps you to make documentation and share your test results with others.

Test Fixtures

Various test fixtures are available for the E4991A. Especially the 16196x family, Parallel electrode SMD test fixture, and 16197A, Bottom electrode SMD test fixture, are the new test fixtures for surface mount devices (SMDs) component. These fixtures are covering 3 GHz frequency range. (See page 257 for more information.) The E4991A replaces existing RF impedance material analyzer, 4291B. The E4991A is succeeding most of fundamental features of 4291B and additional new features are significantly improved usability.

Temperature Characteristic Test Solution is Ready

The E4991A provides a temperature characteristic measurement solution for components and materials. This solution provides highly accurate temperature characteristic analysis capability within the wide temperature range from -55°C to $+150^{\circ}\text{C}$. The E4991A covers the wide impedance measurement range with a single test head. Also, the temperature drift compensation function enables you to perform open/short compensation at pre-defined temperature points so that temperature drift error can be drastically reduced.

Accurate Impedance Measurement with Probe Station

When connecting the E4991A to a probe station, accuracy degradation caused by port extension and improper calibration, is a significant concern. E4991A-010, Probe Station Connection Kit, provides all necessary parts in one option and solves this problem. This option includes extension cables, a connecting plate, and detailed installation procedures. Cascade Microtech is an Agilent channel partner and they provide RF probe stations. By combining E4991A-010 with a Cascade Microtech RF probe station, you can create an accurate on-wafer characterization system.

Specifications

Measurement Parameters:

$|Z|, \theta_z, |Y|, \theta_y, R, X, G, B, \text{Cs, Cp, Ls, Lp, Rp, Rs, D, Q, } |\Gamma|, \theta_r, \Gamma_x, \Gamma_y$

Material Parameters: $|\epsilon_r|, \epsilon_r', \epsilon_r'', |\mu_r|, \mu_r', \mu_r'', \tan \delta$

Basic Impedance Accuracy: 0.8%

Operating Frequency: 1 MHz to 3 GHz

Frequency Resolution: 1 mHz

Frequency Reference Accuracy: $< \pm 10 \text{ ppm @ } 23^{\circ}\text{C} \pm 5^{\circ}\text{C}$

Precision Frequency Reference: (E4991A-1D5)

Accuracy: $< \pm 1 \text{ Vppm/year @ } 0^{\circ}\text{C to } 55^{\circ}\text{C}$, referenced to 23°C

Source Characteristics

OSC Level:

4.47 mV to 477 mVrms

89.4 μA to 8.94 mA rms

Display Level Unit: V, I, dBm

Level Monitor Function: Voltage, Current

Connector: 7 mm

Output Impedance (nominal value): 50 Ω

DC Bias (E4991A-001)

DC Level: 0 V to $\pm 40 \text{ V}$, 0 mA to $\pm 50 \text{ mA}$

DC Level Monitor Function: Voltage, Current

Sweep Characteristics

Sweep Parameter: Frequency, AC signal level, DC bias level

Calibration/Compensation

Calibration: Open/Short/Load/Low-loss capacitor

Compensation: Open/Short, Port extension, Fixture electrical length

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature	DUT Size (L x W: mm)
16191A	DC to 2 GHz	-55°C to $+85^{\circ}\text{C}$	2.0 to 12.0
16192A	DC to 2 GHz	-55°C to $+85^{\circ}\text{C}$	1.0 to 20.0
16194A	DC to 2 GHz	-55°C to $+200^{\circ}\text{C}$	2.0 to 15.0
16196A	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	1.6 x 1.8 only
16196B	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	1.0 x 0.5 only
16196C	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	0.6 x 0.3 only
16197A	DC to 3 GHz	-55°C to $+85^{\circ}\text{C}$	0.6 to 3.2

Display

CRT: 8.4-inch color LCD display

Number of Display Channel: 1

Format: Single, dual, active + memory, graphic, and tabular

Storage/Programming functions

Type: Built-in 3.5-inch floppy disk drive, Internal HDD
Disk Format: DOS
Programming: VBA (Built-in)

Input and Output Characteristics

External Reference Input: 10 MHz \pm 100 Hz (typical)
Internal Reference Output: 10 MHz nominal
Reference Oven Output (E4991A-1D5): 10 MHz nominal
External Trigger Input: BNC female, TTL Level

General Specifications

Operating Temperature/Humidity: 5° C to 40° C/20% to 80% RH
Warm-up Time: 30 min
Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 66 Hz, 350 VA max.
Size/Weight:
Mainframe: 234 mm H x 426 mm W x 445 mm D (9.36 in x 17 in x 18.2 in) / 17.0 kg (37.44 lb)
Test Station: 64 mm H x 160 mm W x 160 mm D (2.56 in x 6.4 in x 6.4 in) / 0.9 kg (1.98 lb)

Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E
 E4991A RF Impedance/Material Analyzer Data Sheet, p/n 5980-1233E
 New Generation Analyzer Offers Exceptional and Powerful Analysis Functions for RF Impedance Measurement, p/n 5988-0200EN
 Advanced Impedance Measurement Capability of the RF I-V Method Compared to the Network Analysis Method, p/n 5988-0728EN
 Achieving Fast Cycle Time Using an Electronic Design Automation (EDA) Tool and the E4991A RF Impedance/Material Analyzer, p/n 5988-3029EN
 Accurate Impedance Measurement with Cascade Microtech Probe System, p/n 5988-3279EN

Ordering Information

E4991A RF Impedance/Material Analyzer

Furnished Accessories:

16195B 7 mm Coaxial Calibration Kit, Floppy Disk, CD-ROM (Manual), and Power Cable (No test fixture is furnished with E4991A)

Options

- E4991A-001 Add DC Bias
- E4991A-002 Add Material Measurement Firmware
- E4991A-007 Temperature Characteristic Test Kit
- E4991A-010 Probe Station Connection Kit
- E4991A-800 Standard Frequency Reference, No DC Bias
- E4991A-810 Add Keyboard
- E4991A-820 Add Mouse
- E4991A-1D5 High Stability Frequency Reference
- E4991A-ABA US-English Localization
- E4991A-ABJ Japan-Japanese Localization
- E4991A-1CM Rack Mount Kit
- E4991A-1CN Front Handle Kit
- E4991A-1CP Handle/Rack Mount Kit

Accessories

- 16190B Performance Test Kit
- 16195B 7 mm Coaxial Calibration Kit
- 16191A Side Electrode SMD Test Fixture (up to 2 GHz)
- 16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)
- 16194A High Temperature Test Fixture (up to 2 GHz)
- 16196A/B/C Parallel Electrode SMD Test Fixture (up to 3 GHz)
- 16197A Bottom Electrode SMD Test Fixture (up to 3 GHz)
- 16092A Test Fixture (up to 500 MHz)
- 16094A Probe Test Fixture (up to 125 MHz)
- 16200B External DC Bias Adapter (up to 1 GHz)
- 16453A Dielectric Material Test Fixture (up to 1 GHz)
- 16454A Magnetic Material Test Fixture (up to 1 GHz)

RF SMD Test Fixtures

The following test fixtures can help you achieve the superior accuracy and measurement repeatability you need to evaluate surface mount devices (SMDs) up to 3 GHz.

16196A/B/C Parallel Electrode SMD Test Fixtures

The 16196A, 16196B, and 16196C are coaxial-structured high performance test fixtures for impedance measurements at frequencies up to 3 GHz. These fixtures are your best choice for the characterization of parallel electrode chip inductors and other passive RF components. The 16196A accommodates SMDs with the size code 1.6 mm x 0.8 mm. The 16196B handles SMDs that have the size code 1.0 mm x 0.5 mm. The 16196C is for size code 0.6 mm x 0.3 mm SMDs.



16196A/B/C

16197A Bottom Electrode SMD Test Fixture

The 16197A is designed for impedance evaluations of bottom electrode SMDs components up to 3 GHz. This test fixture accommodates various sizes of SMDs; as small as 0.6 mm x 0.3 mm (16197A-001) and as large as 3.2 mm x 2.5 mm.



16197A

Key Specifications of Test Fixtures

Type of Fixture	Operating Freq. (typ.)	Operating Temperature Configuration	Applicable DUT Electrode	DUT Size (l x w = mm)
16196A	DC to 3 GHz	-55° C to +85° C	Parallel electrodes	1.6 x 0.8 only
16196B	DC to 3 GHz	-55° C to +85° C	Parallel electrodes	1.0 x 0.5 only
16196C	DC to 3 GHz	-55° C to +85° C	Parallel electrodes	0.6 x 0.3 only
16197A	DC to 3 GHz	-55° C to +85° C	Bottom electrodes	1.0 to 3.2

Key Literature

Accessories Selection Guide for Impedance Measurement, p/n 5965-4792E

Ordering Information

- 16196A Parallel Electrode SMD Test Fixtures
 - 16196A-710 Add a magnifying lens and tweezers
- 16196B Parallel Electrode SMD Test Fixtures
 - 16196B-710 Add a magnifying lens and tweezers
- 16196C Parallel Electrode SMD Test Fixtures
 - 16196C-710 Add a magnifying lens and tweezers
- 16197A Bottom Electrode SMD Test Fixtures
 - 16197A-001 Add 0201 (inch)/0603 (mm) Device Guide Set

E4991A
 16196A/B/C
 16197A

E4991A
E4991A-002
16453A
16454A

- Integrated system for permittivity and permeability measurement from 1 MHz to 1 GHz
- Versatile fixtures for substrate materials and toroids
- Built-in firmware for direct parameter measurement and easy data analysis



E4991A System (E4991A, 16453A, and 16454A)

E4991A RF Impedance/Material Analyzer (E4991A-002 required)

The E4991A RF impedance/material analyzers provide an easy and versatile material test solution from 1 MHz to 1 GHz. The analyzers measure impedance accurately and automatically calculate permittivity and permeability data from impedance. Various interchangeable test fixtures, designed specifically to work with the E4991A, let you measure dielectric materials and magnetic materials easily.

16453A Dielectric Test Fixture

The 16453A dielectric test fixture is best used for measuring substrate materials (solid, sheet material samples) less than 3 mm in thickness such as PC boards, substrates, and polymer materials. When used with the 16453A, the firmware (E4991A-002) built into the analyzer automatically calculates permittivity parameters. The flexible firmware also lets you display data as a Cole-Cole plot or find relaxation time.

16454A Magnetic Test Fixture

For permeability analysis, the 16454A magnetic test fixture is designed for testing toroidal-shaped samples up to 20 mm in diameter. An example of suitable materials-under-test is soft ferrite magnetic core. The 16454A comes with different sizes of sample holders for different toroid sizes for maximum flexibility. Built-in firmware (E4991A-002) automatically computes permeability parameters, eliminating cumbersome coil-winding or lengthy calculation.

Temperature Coefficient Testing

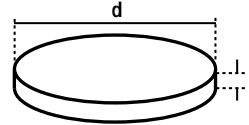
Both 16453A and 16454A have an operating temperature range from -55 °C to +200 °C. Both test fixtures can be used with E4991A-007, temperature characteristic test kit.

Specifications

E4991A-002

Material Parameters: $|\epsilon_r|, \epsilon_r', \epsilon_r''; |\mu_r|, \mu_r', \mu_r''; \tan \delta$
Operating Frequency: 1 MHz to 1 GHz

16453A Dielectric Test Fixture



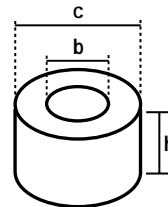
Sample Material Specifications

t: 0.3 mm ≤ t ≤ 3 mm
d: ≥ 15 mm

NOTE: Material surface should be flat and parallel.

Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: -55 °C to +200 °C

16454A Magnetic Test Fixture



Sample Material Specifications

Fixture Holder	Small A	B	Large C	D
c	≤ 8 mm	≤ 6 mm	≤ 20 mm	≤ 20 mm
b	≤ 3.1 mm	≤ 3.1 mm	≤ 6 mm	≤ 5 mm
h	≤ 3 mm	≤ 3 mm	≤ 8.5 mm	≤ 8.5 mm

Operating Frequency Range: 1 MHz to 1 GHz
Operating Temperature Range: -55 °C to +200 °C

Key Literature

E4991A RF Impedance/Material Analyzer Technical Overview, p/n 5980-1234E
Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

- E4991A RF Impedance/Material Analyzer
- E4991A-002 Material Measurement Firmware
- E4991A-007 Temperature Characteristic Test Kit
- 16453A Dielectric Test Fixture
- 16454A Magnetic Test Fixture

- For measuring capacitance or dielectric constant of solid materials
- Designed for four-terminal-pair LCR meters or impedance analyzers



16451B Dielectric Test Fixture

16451B Dielectric Test Fixture

For dielectric constant evaluation of solid materials such as polymer, electric insulator, PC board, ceramic substrate, etc., use the 16451B dielectric test fixture with any Agilent four-terminal-pair LCR meter or impedance analyzer up to 30 MHz. The 16451B has four types of electrodes which can be replaced according to sample size or measurement technique. Stray admittance and residual impedance of the test fixture can be eliminated by the OPEN/SHORT error correction function of the measurement instrument by using the furnished OPEN/SHORT attachments.

Specifications

Frequency Range: ≤ 30 MHz (depends on instruments)
Operating Temperature: 0°C to $+55^{\circ}\text{C}$
Sample Size: Diameter 10 to 56 mm, Thickness ≤ 10 mm
Parameters: Capacitance, Loss Tangent, ϵ_r' , ϵ_r'' (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

16451B Dielectric Test Fixture

- For measuring capacitance or dielectric constant of liquids
- Designed for four-terminal-pair LCR meters or impedance analyzers

16451B
16452A



16452A Liquid Test Fixture

16452A Liquid Test Fixture

For convenient testing of liquids, use the 16452A liquid test fixture with any four-terminal-pair LCR meter or impedance analyzer. With the 16452A, you will be able to measure permittivity and impedance characteristics of liquid materials like plastic resins, or petrochemical products. The fixture has inlet/outlet ports which allow continuous measurements of liquids flowing in a process monitoring environment. The internal cell allows accurate measurements to be performed on a small amount of liquid samples.

Specifications

Operating Frequency: 20 Hz to 30 MHz
Operating Temperature: -20°C to $+125^{\circ}\text{C}$
Sample Size: 3.4 ml to 6.8 ml
Parameters: Capacitance, Loss Tangent, ϵ_r' , ϵ_r'' (must be calculated using external computer or IBASIC)
Electrical Interface: Four-terminal pair

Note: The 16452A is not capable of measuring salt or ionic solutions, or other liquids with bulk conductivity due to the electrode polarization phenomenon.

Key Literature

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

16452A Liquid test fixture
 Recommended measurement cables for connecting the 16452A to an Agilent four-terminal-pair LCR meter or impedance analyzer: 16048A Test Lead (0°C to $+55^{\circ}\text{C}$), 16452-61601 (-20°C to $+125^{\circ}\text{C}$), or 16048G Test Lead (-20°C to 150°C , only for 4294A)

4294A

- Accurate measurement over wide impedance range and wide frequency range
- Basic impedance accuracy: $\pm 0.08\%$
- 40 Hz to 110 MHz, 3 m Ω to 500 M Ω
- Powerful impedance analysis function
- Ease of use and versatile PC connectivity



4294A

4294A Precision Impedance Analyzer

The Agilent 4294A precision impedance analyzer is an integrated solution for efficient impedance measurement and analysis of components and circuits. The 4294A covers a broader test-frequency range (40 Hz to 110 MHz) with Basic impedance accuracy: $\pm 0.08\%$. Excellent High Q/Low D accuracy enables analysis of low-loss components. The wide signal-level ranges enable device evaluation under actual operating conditions. The test signal level range is 5 mV to 1 Vrms or 200 μ A to 20 mArms, and the DC bias range is 0 V to ± 40 V or 0 mA to ± 100 mA. Advanced calibration and error compensation functions eliminate measurement error factors when performing measurements on in-fixture devices. The 4294A is a powerful tool for design, qualification and quality control, and production testing of electronic components. Circuit designers and developers can also benefit from the performance/functionality offered.

Wide-Range Accurate Measurement

The 4294A enables impedance measurement using the auto-balancing bridge technique over the frequency range 40 Hz to 110 MHz. The basic impedance accuracy is $\pm 0.08\%$, and the typical Q accuracy is $\pm 3\%$ @ Q = 100, ≤ 10 MHz. This advantage permits accurate evaluations of impedance characteristics for a wide variety of electronic devices as well as electronic and non-electronic material within a wide frequency range.

Versatile Analysis

The 4294A graphically displays impedance measurement results. This permits easy analysis of the resonant frequency and impedance values of electronic components using the marker functions. The marker functions offer a simple method to pinpoint the resonant frequency of components, as well, these functions assist users in many other observations. The combination of the accumulate mode (to superimpose traces) and the list sweep functions permits observation of the change in a DUT's characteristics due to a change in the measurement condition. Versatile and high-speed automatic testing is possible using the list sweep function in conjunction with the limit line function. The list-sweep function provides the ability to enhance test throughput by segmenting the sweep to include only necessary measurement frequencies, while the limit-line function (for Go/No-Go Testing) provides the ability to apply test limits within each segment. These functions greatly support the quality and performance required evaluating modern and improved electronic components, equipment and materials.

Equivalent Circuit Analysis

The equivalent-circuit analysis function provides advanced modeling (three and four element models) based on circuit constant values of five available circuit models. This function simulates the frequency characteristics of components by using derived circuit values or user-specified values. Comparison of design values to measurement values can assist with efficient component design.

Programming

Full programmability is provided using built-in Instrument (IBASIC). Desired measurements and computations, including graphics analysis, can be programmed simply by storing front-panel key-stroke operations. The one-key execution function allows easy selection and execution of customized IBASIC programs. Several forms of storage are built-in (10 Mbyte non-volatile memory, RAM disk or Floppy Disk).

Good PC Connectivity

Features fit to the latest PC environment include LAN (Local Area Network) capability, VGA monitor output, and the TIFF file format. LAN capability permits simplified networking ability when collecting, sharing and analyzing data. VGA monitor output improves productivity and reduces eyestrain. TIFF file format allows easy transfer of graphics to a PC.

Abundance of Accessories

Various Four-terminal-pair test fixtures can be used with the 4294A. The 42941A impedance probe kit (1.5 m), which covers 40 Hz to 110 MHz, enables in-circuit impedance measurement of electronic circuits or components. Grounded devices can also be measured. The 42942A terminal adapter, which covers 40 Hz to 110 MHz, converts the 4-terminal-pair port configuration to a 7 mm test port. This adapter permits the use of familiar 7 mm test fixtures. Again, grounded measurement is available.

Specifications

Measurement Parameters:

$|Z|$, $|Y|$, θ , R, X, G, B, Cp, Cs, Lp, Ls, Rp, Rs, D, Q

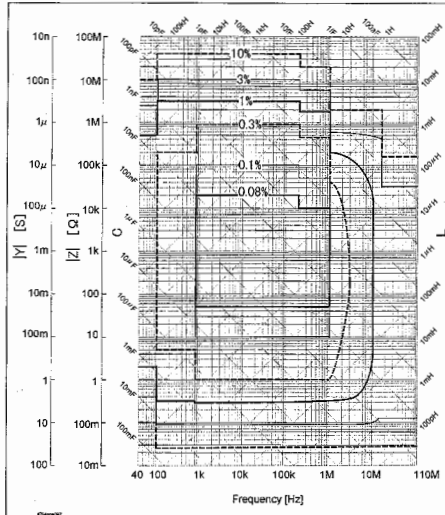
Basic Measurement Accuracy:

Basic Impedance Accuracy (4 Terminal Pair): $\pm 0.08\%$

(See figure in detail)

Basic Impedance Accuracy with 42941A: $\pm 0.8\%$ (typical)

Basic Impedance Accuracy with 42942A: $\pm 0.6\%$



4294A Impedance Accuracy @ 4-Terminal-Pair, OSC = 0.5V

Source Characteristics

Test Frequency: 40 Hz to 110 MHz

Frequency Resolution: 1 mHz

Frequency Accuracy: ± 20 ppm (± 0.13 ppm with 4294A-1D5)

OSC Level: 5 mV to 1 V/200 μ A to 20 mA

OSC Level Resolution: 1 mV/20 μ A

OSC Level Accuracy

Voltage: $\pm((10 + 0.05 * f(\text{MHz}))\% + 1 \text{ mV})$ @ UNKNOWN Terminal OPEN

Current: $\pm(10 + 0.3 * f(\text{MHz}))\% + 50 \mu\text{A}$ @ UNKNOWN Terminal SHORT

Level Monitor Function: Voltage, Current

DC Bias

DC Bias Level: 0 V to ± 40 V, 0 A to ± 100 mA (Auto level control function available)

DC Bias Level Resolution: 1 mV/40 μ A

DC Bias Voltage Accuracy: $\pm(0.1\% + (5 + 30 * I_{\text{mon}}(\text{mA})))$ mV

DC Bias Current Accuracy: $\pm(2\% + (0.2 * V_{\text{mon}}(\text{V})/20)$ mA

DC Level Monitor Function: Voltage, Current

Sweep Characteristic

Sweep Parameter: Frequency, AC voltage, AC current, DC bias voltage, DC bias current

Sweep Type: Linear, Log, List, Zero Span, Manual, Up/Down

Number of Points: 2 to 801

Calibration/Compensation/Adapter Type

Calibration: Open/Short/Load

Compensation: Open/Short/Load, port extension (electrical length)

Adapter Type: None, 1 m, 2 m, 7 mm Adapter (42942A), Probe (42941A)

Display

Size: 8.4 inch

Type: Color LCD (TFT)

Analysis

Marker: 8 markers, delta marker function, search function, analysis function

Equivalent Circuit Function: Approximation, simulation

Others: IBASIC, Limit Line, Accumulate mode

Interface

LAN Interface: 10 Base-T Ethernet, RJ45 Connector, TCP/IP

Other Interface: GPIB Interface, Printer (Centronics), 8 bit I/O, 24 bit I/O, VGA monitor output

Storage

Type: Built-in 3.5 inch floppy disk drive, 10 Mbyte non-volatile memory, 512 kbyte volatile RAM disk memory

Disk Format: DOS

Programming: IBASIC

General Specifications

Operating Temperature and Humidity: 0°C to 40°C, 15% to 80% RH

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 300 VA Max.

Size: 222 mm H x 426 mm W x 502 mm D (8.88 in x 17.04 in x 20.08 in)

Weight: 25 kg (55 lb)

4294A Material Solution

The dielectric constant of a solid material can be measured with the 16451B dielectric test fixture. The magnetic constant of toroidal core can be also measured using the 16454A magnetic material test fixture with the 4294A/42942A configuration.

In both applications, the dielectric or magnetic constant is calculated from measured impedance value. The measurement sequence of impedance measurement, material constant calculation and data analysis can be automatically executed using built-in IBASIC programming function.

The measurement program is provided as a sample programs in the 4294A operating manual. Users need to learn the IBASIC programming first, then the program can be modified as they like. The electronics knowledge is required to use these fixtures, because it is basically an impedance measurement.

16451B Frequency Range when used with 4294A: 40 Hz to 30 MHz

16454A Frequency Range when used with 4294A: 1 kHz to 110 MHz

Applicable Material Size: See page 258.

Key Literature

4294A Precision Impedance Analyzer Technical Overview, p/n 5968-3808E

4294A Technical Specification, p/n 5968-3809E

Reliable Electronic Component Evaluation and Circuit Design with the 4294A, p/n 5968-4505E

New Technologies for Accurate Impedance Measurement (40 Hz to 110 MHz), p/n 5968-4506E

Evaluation of MOS Capacitor Oxide C-V Characteristics Using the Agilent 4294A, p/n 5988-5102EN

Accurate Impedance Measurement with Cascade Microtech Probe System, p/n 5988-3279EN

Ordering Information

4294A Precision Impedance Analyzer

Furnished Accessories: floppy disk, CD-ROM (Manual), and power cable.

(No test fixture is supplied with the 4294A.)

4294A-1D5 Add High-Stability Frequency Reference

4294A-800 Standard Frequency Reference

4294A-810 Add Keyboard

42941A Impedance Probe Kit

42942A 7 mm Terminal Adapter

42942A-700 Add 7 mm Open/Short/Load set

16047E Test Fixture for axial lead components

16034G SMD Test Fixture

16043A Three-Terminal SMD Test Fixture (with slide)

16043B Three-Terminal SMD Test Fixture (without slide)

16044A Kelvin Contact SMD Test Fixture

16048G 1 m Cable

16048H 2 m Cable

16451B Dielectric Material Test Fixture

16454A Magnetic Material Fixture (used with 42942A)

4294A

5

4268A
4288A

- High speed measurement: 7 ms
- Accurate C-D testing: 0.075%, 0.0006
- Small cabinet size

- Constant test level for high value ceramic capacitor tests
- High speed measurement: 25 ms
- Quick contact check
- 9-bin comparator



4288A



4268A

4288A 1 kHz/1 MHz Capacitance Meter

The Agilent 4288A 1 kHz/1 MHz capacitance meter offers a high-speed with reliable measurements for capacitor testing in the production lines. The measurement capabilities of capacitance from low to middle values (up to 20 μF) can be realized with accurate measurements. The 4288A contributes improvements of the test throughput, while attaining excellent component quality for ceramic capacitor testing.

Specifications

Measurement Parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 1 kHz and 1 MHz (–1%, +1%, +2% frequency shift available)
Test Signal Level: 0.1 to 1 Vrms, $\pm 5\%$ in 0.1 Vrms steps
Measurement Range

Measurement Parameter	1 kHz	1 MHz
C	0.001 pF to 20.000 μF	0.00001 pF to 1500.00 pF
D	0.00001 to 9.99999	0.00001 to 9.99999

Measurement Time: 7 ms, 19 ms (typical)
Cable Length Compensation: 0 m, 1 m, 2 m
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB, and Scanner interface

General Specifications

Operating Temperature/Humidity: 0°C to 45°C, $\leq 95\%$ RH @ 40°C
Power Requirements: 90 VAC to 132 VAC, 198 VAC to 264 VAC, 47 Hz to 66 Hz, 100 VA max.
Size: 100 mm H x 320 mm W x 300 mm D (4 in x 12.8 in x 12 in)
Weight: Approximately 3 kg (6.6 lb)

Key Literature

4288A Capacitance Meter 1 kHz/1 MHz Technical Overview, p/n 5980-2861EN

Ordering Information

4288A 1 kHz/1 MHz Capacitance Meter

Accessories

- 16034E SMD Test Fixture
- 16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
- 16047A 4-Terminal Contact Lead Component Test Fixture
- 16047E 2-Terminal Contact Lead Component Test Fixture
- 16334A Tweezers Contact SMD Test Fixture
- 16048A Test Leads, BNC (1 m)
- 16048B Test Leads, SMC (1 m)
- 16048D Test Leads, BNC (2 m)

4268A 120 Hz/1 kHz Capacitance Meter

The 4268A capacitance meter offers the ability to test high value multi-layer ceramic capacitors at a constant large test signal level and at high speed. The constant test level feature allows the MLCCs to be tested, in compliance with IEC 384-10 standard, for up to 70 μF at 1 V rms at 1 kHz. 120 Hz measurement ensures the constant 1 V test signal for up to 600 μF . The 4268A can provide measured values along with comparator results within 25 ms, maximizing test throughput in MLCC production lines.

Major Specifications

Measurement parameters: Cs, Cp, D, Q, Rs, Rp, G
Test Frequency: 120 Hz and 1 kHz
Test Signal Level: 0.1 V to 1 V rms, $\pm 10\%$, in 0.01 V rms steps
Measurement Range

Measurement Parameter	120 Hz	1 kHz
C	0.001 nF to 9.9999 mF	0.0001 nF to 999.99 μF
D	0.0001 to 9.9999	0.0001 to 9.9999

Constant Test Level Range (Typical)

Test Voltage	120 Hz	1 kHz
0.5 V rms	C $\leq 1200 \mu\text{F}$	C $\leq 140 \mu\text{F}$
1 V rms	C $\leq 600 \mu\text{F}$	C $\leq 70 \mu\text{F}$

Measurement Time: 25 ms/43 ms/59 ms (typical)
Contact Check: Detects contact failure in 4T connection within 5 ms
Comparator: 9 bin output to Handler Interface
Interface: Handler, GPIB and optional scanner interface

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 Vac, 47 to 66 Hz, 100 VA max.
Operating Temperature/Humidity: 0°C to 45°C, $\leq 95\%$ RH @ 40°C
Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)
Weight: Approximately 5 kg (11 lb)

Key Literature

4268A Capacitance Meter Technical Overview, p/n 5967-5873E

Ordering Information

4268A 120 Hz/1 kHz Capacitance Meter

Options

4268A-001 Scanner Interface

Accessories

- 16034E SMD Test Fixture
- 16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
- 16044A 4-Terminal Test Fixture for Chip Components
- 16334A Tweezers Contact SMD Test Fixture
- 16048A Test Leads, BNC (1 m)
- 16048B Test Leads, SMC (1 m)
- 16048D Test Leads, BNC (2 m)

- 1 MHz to 3 GHz, with 100 kHz steps
- Wide impedance measurement range from 200 mΩ to 3 kΩ
- Superior measurement repeatability at low test signal level
- 1% basic accuracy
- High-speed measurements: 9 ms



4287A with the 16196A

4287A RF LCR Meter

The Agilent 4287A RF LCR meter offers accurate, reliable and fast measurements from 1 MHz to 3 GHz to improve quality and throughput of electronic component testing in production lines. The 4287A employs the direct-current voltage-measurement technique, as opposed to the reflection-measurement technique, which yields accurate measurements over a wide impedance range.

High Throughput and Reliable Measurement

The 4287A is suitable for testing electronic components in the RF range. The 4287A's measurement speed is remarkably fast. In addition, the superior measurement repeatability at low test currents such as 100 μA provides a fast throughput since less averaging is required.

Simplified System Integration

The test head cable (1 m or 2 m by using an extension cable) can be easily connected closely to the tip of the device-under-test (of the component handler) without any increase in error. The built-in comparator function, a high-speed GPIB interface, and an handler interface, are available for simple integration with the component handler and PC. The enhanced comparator function makes sophisticated binning possible for multi-frequency or array chip testing.

Ease of Use

The 8.4-inch color display provides a clear view of measurement settings and results. The newly developed user interface makes operability easy and error-free. The built-in statistical analysis functions provide a process for monitoring test quality and efficiency. The LAN interface helps centralize production control and monitor. Also, a number of 7 mm SMD test fixtures can be used with the 4287A's furnished fixture stand and 3.5 mm-to-7 mm adapter, eliminating the need to build custom fixtures.

Specifications

(Refer to Data Sheet for complete specifications)

Measurement Parameters: |Z|, |Y|, θ-z (deg/rad), θ-y (deg/rad), G, B, Ls, Lp, Cs, Cp, Rs, Rp, Q, D (Four Meas.Parameters can be displayed at the same time.)

Test Frequency: 1 MHz to 3 GHz

Frequency Resolution: 100 kHz

Test Signal:

• V: 4.47 mV to 502 mV @ f ≤ 1 GHz, 4.47 mV to 447 mV @ f > 1 GHz

• I: 0.0894 mA to 10 mA @ f ≤ 1 GHz, 0.0894 mA to 8.94 mA @ f > 1 GHz

Level Monition Function: Voltage, Current

Basic Z Accuracy: ±1.0%

Measurement Range: 200 mΩ to 3 kΩ (@ 1 MHz, accuracy ≤ 10%)

Measurement Time: 9 msec per point (max.speed)

Rdc Measurement: Available for contact check

Calibration: Open/Short/Load/Low Loss Capacitor

Compensation: Open/Short, Electrical Length

Mass Storage Function: 30 MB solid-state mass-storage or 2 GB HDD (Option Selection)

Interface: GPIB, LAN (10 Base-T/100 Base-Tx Automatic Selection), Handler Interface

Display: 8.4 inch color LCD display

General Specifications

Power Requirements: 90 V to 132 V, or 198 V to 264 V, 47 Hz to 63 Hz, 350 VA max.

Operating Temperature/Humidity: 5°C to 40°C/20% RH to 80% RH

Size: 234 mm H x 425 mm W x 445 mm D (9.36 in x 17 in x 17.8 in)

(Main Frame)

Weight: 16 kg/0.3 kg (35.2 lb/.66 lb) (typical) (Main Frame/Test Head)

Key Literature

4287A RF LCR Meter Technical Overview, p/n 5968-5443E

4287A Technical Specifications, p/n 5968-5758E

LCR Meters, Impedance Analyzers, and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4287A RF LCR Meter

Furnished Accessories: Test Head (1 m), CD-ROM (Manual), and Power Cable. (No test fixture is supplied with the 4287A)

Options

4287A-004 Add Working Standard Set

4287A-010 Hard-Disk Drive Mass Storage

4287A-011 Solid-State Mass Storage

4287A-020 Add Test Fixture Extension Cable Set

4287A-700 16195B Calibration Kit

4287A-710 Test Fixture Stand

Accessories

16190B Performance Test Kit

16195B 7 mm Coaxial Calibration Kit

16191A Side Electrode SMD Test Fixture (up to 2 GHz)

16192A Parallel Electrode SMD Test Fixture (up to 2 GHz)

16194A High Temperature Test Fixture (up to 2 GHz)

16092A Test Fixture (up to 500 MHz)

16094A Probe Test Fixture (up to 125 MHz)

16200B External DC Bias Adapter (up to 1 GHz)

4263B

- 0.1% basic accuracy
- 100 Hz, 120 Hz, 1 kHz, 10 kHz, 100 kHz test frequencies
- 20 mV to 1 Vrms in 5 mVrms steps
- Test signal level monitor function
- High-speed measurement: 25 ms
- High-speed contact check
- Wide capacitance test range
- Transformer parameter measurements (optional)



4263B

4263B LCR Meter

The 4263B LCR meter is Agilent Technologies' most cost-effective low-end LCR meter, designed for both component evaluation on the production line and fundamental impedance testing for bench-top applications. The 4263B has five test frequencies that allow you to simulate testing under the correct conditions: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz. An optional 20 kHz test frequency can be added to those five frequencies (4263B-002).

High-Speed Measurements

The 4263B can boost throughput with a measurement speed of 25 ms at any test frequency. This ability improves the throughput of electrolytic capacitor and transformer testing. The 4263B can check the contact condition between the test terminals and the device-under-test (DUT). This function ensures the reliability of PASS/FAIL testing with automatic handlers in production. The quick recovery system of the 4263B improves throughput. Normal operation is resumed the instant a faulty DUT is removed from the handler, so the handler can always be operated at its full speed.

Electrolytic Capacitor Measurements

The 4263B's accuracy and wide measurement range are the right tools to make precise measurements of electrolytic capacitors. Charged capacitors can discharge through the front end and destroy an instrument. The 4263B's front end is designed for protection and maintains test integrity.

Transformer Parameter Measurements

With the 4263B's ability to make turns ratio (N), mutual inductance (M), and dc resistance (DCR) measurements, data calculations and changing test setups are no longer time-consuming tasks (4263B-001). The flexible signal level setting and the voltage-and-current monitor function facilitate the use of the 4263B for level dependent DUTs, such as core inductors.

Specifications

(Refer to Technical Overview for complete specifications.)

Measurement Functions

- Measurement Parameters: |Z|, |Y|, u, R, X, G, B, L, C, Q, D, ESR
 - 4263B-001: Add DCR (dc resistance), N (turns ratio), and M (mutual inductance) measurement
- Measurement Circuit Mode: Series and parallel

Mathematical Functions:

Deviation and percent deviation
Test Cable Lengths: 0 m, 1 m, 2 m, 4 m (freq. = 100/120/1 kHz);
 0 m, 1 m, 2 m (freq. = 10 k/20 kHz); 0 m, 1 m (freq. = 100 kHz)

Test Signal Information

- Test Frequency: 100 Hz, 120 Hz, 1 kHz, 10 kHz, and 100 kHz
 - 4263B-002: Add 20 kHz test frequency
- Frequency Accuracy: ±0.01% (freq. = 100 Hz, 1 kHz, 10 kHz, 20 kHz, 100 kHz), ±1% (freq. = 120 Hz)
- Output Impedance: 100 Ω ±10%, 25 Ω ±10% (≤1 Ω range)
- AC Test Signal Level: 20 mV to 1 Vrms in 5 mVrms steps
- Accuracy: ±(10% + 10 mV)
- Internal dc Bias
 - Level: 1.5 and 2 V; Accuracy: ±(5% + 2 mV)
- External dc Bias: 0 V to +2.5 V

Measurement Range

Parameter	Measurement Range
Z , R, X	1 mΩ to 100 MΩ
Y , G, B	10 nS to 1000 S
C	1 pF to 1 F
L	10 nH to 100 kH
D	0.0001 to 9.9999
Q	0.1 to 9999.9
θ	–180° to +180°
DCR	1 mΩ to 100 MΩ
N	0.9 to 200 (unspecified)
L, M	1 μH to 100 H (unspecified)
Δ%	–999.99% to +999.99%

Measurement Accuracy: ±0.1% (basic) (for |Z|, R, X, |Y|, G, B, C, L)
Measurement Time

Mode	Time (typical)
SHORT	25 ms
MEDIUM	65 ms
LONG	500 ms

Test Signal Level Monitor: Voltage and current

Front-End Protection: Internal circuit protection when a charged capacitor is connected to the input terminals. The maximum capacitor voltage is:
 $V_{max} = \sqrt{8/C}$ (typical) @ $V_{max} \leq 250$ V; $V_{max} = \sqrt{2/C}$ (typical) @ $V_{max} \leq 1000$ V, C is in Farads

Display Digits: 3, 4, or 5 (selectable)

Correction Function

- PEN/SHORT/LOAD: Eliminates measurement errors due to stray parasitic impedances in the test fixtures
- **Comparator Function:** HIGH/IN/LOW for each primary measurement parameter and secondary measurement parameter
- **Contact Check Function:** Contact failure between the test fixture and device can be detected. Additional time for contact check: 5 ms

Other Functions

- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings (except dc bias on/off) are automatically memorized (≤72 hours at 23°C ± 5°C)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors. Output signals include HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include keylock and external trigger

General Specifications

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 45 VA max.

Operating Temperature: 0°C to 45°C

Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)

Weight: 4.5 kg (9.9 lb)

Key Literature

- 4263B LCR Meter Technical Overview, p/n 5964-6181E
- Effective Electrolytic Capacitors Testing, p/n 5967-5378E
- Effective Transformer/LF Coil Testing, p/n 5967-5377E
- Effective Multi-tap Transformer Measurement using a Scanner and the Agilent 4263B LCR Meter, p/n 5091-6310E

Ordering Information

4263B LCR Meter

Options

- 4263B-001 Add Transformer Parameter Measurement Function
- 4263B-002 Add 20 kHz Test Frequency
- 4263B-ABA US-English Localization
- 4263B-ABJ Japan-Japanese Localization

Accessories

- 16060A Transformer Test Fixture (4263B-001 Required)
- 16065C External Bias Adapter (up to 40 Vdc)
- 16034G Small SMD Test Fixture (0603 [mm]/0201 [in] SMD)
- 16044A Kelvin Contact SMD Test Fixture
- 16047A 4-Terminal Contact Lead Component Test Fixture
- 16047E 2-Terminal Contact Lead Component Test Fixture
- 16334A Tweezers Contact SMD Test Fixture
- 16064B Comparator LED Display/Trigger Box

- **Wide measurement range:** $1 \times 10^3 \Omega$ to $1.6 \times 10^{16} \Omega$
- **Stable test fixtures:** resistivity cell, component test fixture
- **High-speed measurement:** 10 ms
- **Test sequence programming**
- **Resistivity calculations**
- **Grounded DUT measurement**



4339B

4339B High-Resistance Meter

The 4339B high-resistance meter is Agilent Technologies' most advanced tool for making precision high-resistance measurements.

Precise and Stable Measurement

The measurement range is from $1 \times 10^3 \Omega$ to $1.6 \times 10^{16} \Omega$, with a basic accuracy of 0.6%. This wide range allows accurate, high-resistance measurement of capacitors, relays, switches, connectors, materials, cables, and PC boards. The grounded device-under-test (DUT) measurement capability of the 4339B gives you the ability to evaluate cables and transformers under grounded conditions. The 16008B resistivity cell and the 16339A component test fixture are designed for stable and safe measurements of materials or components.

Simple Operation

The test-sequence program function allows you to control a series of resistance measurements in a sequence (charge-measure-discharge). You can set the charge time, measurement interval time, and number of measurements in a sequence through the front panel. The remaining time can be displayed when executing the sequence measurements. Surface resistivity (ρ_s) and volume resistivity (ρ_v) functions can be called to act upon measurement data. Calculated results are then automatically displayed, saving you time and effort.

High-Test Throughput

The 10 ms measurement time, 2 ms high-speed contact check function, built-in comparator, and GPIB/handler interfaces deliver high-speed test throughput for production environments.

Specifications

(Refer to Technical Overview for complete specifications.)

Measurement Parameters: R (dc resistance), I (dc current), ρ_s (surface resistivity), ρ_v (volume resistivity)

Mathematical Functions: Deviation and percent deviation

Display Digits: 3, 4, or 5 (selectable)

Test Voltage: 0.1 Vdc to 1000 Vdc, 0.1 V steps @ 0.1 V to 200 V, 1 V steps @ 200 V to 1000 V

Voltage Accuracy: (0.16% + 100 mV) @ ≤ 200 V, (0.16% + 500 mV) @ > 200 V

Maximum Current: 10 mA @ ≤ 100 V, 5 mA @ ≤ 250 V,

2 mA @ ≤ 500 V, 1 mA @ ≤ 1 kV

Current Compliance Setting: 0.5 mA, 1 mA, 2 mA, 5 mA, 10 mA

Output Resistance: $1 \text{ k}\Omega \pm 10\%$

Input Resistance: $1 \text{ k}\Omega \pm 10\%$

Test Cable Lengths: 2 m maximum

Measurement Range/Accuracy

Parameter	Measurement Range	Basic Accuracy
I	60 fA to 100 μ A	$\pm 0.4\%$
R (Ω)	$1 \times 10^3 \Omega$ to 1.6×10^{16}	$\pm 0.6\%$

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port (range: hold, display, off)

Mode	Time (typical)
SHORT	10 ms
MEDIUM	30 ms
LONG	390 ms

Correction Function

- **Zero OPEN:** Eliminates measurement errors due to stray parasitic resistance in the test fixtures

Test Sequence Program: Controls a series of resistance measurements. Charge time, measurement interval time, and measurement number can be programmed

Comparator Function: HIGH/IN/LOW for the measurement parameter

Contact Check Function

Contact failure between the test fixture and device can be detected

- Available DUT Type: Capacitive DUTs only
 - DUT Capacitance: $\geq 1 \text{ pF} + 5\%$ of residual stray capacitance
 - Residual Stray Capacitance of the Fixture: $\leq 50 \text{ pF}$
- Additional Measurement Time for Contact Check: 2 ms

Other Functions

- **Save/Recall:** Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- **Continuous Memory Capability:** If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at $23^\circ \text{C} \pm 5^\circ \text{C}$)
- **GPIB Interface:** All control settings, measured values, and comparator information
- **Handler Interface:** All output signals are negative-logic, optically isolated open collectors. Output signals include: HIGH/IN/LOW, no contact, index, end of measurement, and alarm. Input signals include: high voltage off, keylock, and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.

Operating Temperature: 0°C to 45°C

Size: 100 mm H x 320 mm W x 450 mm D (3.94 in x 12.6 in x 17.72 in)

Weight: 6.5 kg (14.3 lb)

Complies with 73/23/EEC and 92/68/EEC safety standard EN61010-1

Furnished Accessories

Operation manual, shunt connector, power cable (test fixtures and/or test leads must be ordered separately.)

Key Literature

4339B/4349B High Resistance Meters Technical Overview, p/n 5964-6182E

Insulation Resistance Measurement of Plate Type Materials, p/n 5968-3400E

Insulation Resistance Measurements of Electromechanical Components, p/n 5968-0325E

Agilent Solutions for Measuring Permittivity and Permeability with LCR Meters and Impedance Analyzers, p/n 5980-2862EN

Ordering Information

4339B High-Resistance Meter

4339B-ABA US-English Localization

4339B-ABJ Japan-Japanese Localization

16339A Component Test Fixture

16008B Resistivity Cell (50 mm Diameter Electrode)

16008B-001 Add 26/76 mm Diameter Electrodes

16008B-002 Add 26 mm Diameter Electrode

16117B Low-Noise Test Leads

16117B-001 Add Pin Probes

16117B-002 Add Soldering Sockets

16117B-003 Add Alligator Clips

16117C Low-Noise Test Leads (1 m, connectors)

16118A Tweezer Test Fixture

16064B LED Display/Trigger Box

4284A
4285A

- 20 Hz to 1 MHz, with over 8,600 test frequencies
- 0.05% basic accuracy, 6-digit resolution
- Constant V or I test signal level
- 20 Vrms level option (4284A-001)
- 40 Adc with 42841A
- List sweep measurement capability

- 75 kHz to 30 MHz in 100 Hz steps
- 0.1% basic accuracy
- High-speed measurements: 30 ms/meas.
- Constant V or I test signal level
- 10 Adc with 42841A
- List sweep measurement capability



4284A



4285A

4284A, 4285A Precision LCR Meters

The Agilent 4284A and 4285A precision LCR meters are cost-effective solutions for component and material measurement. They can be used to improve component quality by providing an accurate, high-throughput test solution. The wide 20 Hz to 1 MHz test frequency range and superior test-signal performance allow the 4284A to test components to the most commonly-used test standards, such as IEC/MIL standards, and under conditions that simulate the intended application. For demanding RF component tests, the 4285A offers a higher test-frequency range, from 75 kHz to 30 MHz. Whether in research and development, production, quality assurance, or incoming inspection, the 4284A and 4285A will meet all of your LCR meter test and measurement requirements.

Specifications

(Refer to Data Sheet for complete specifications.)

Measurement Parameters: Z , $|Y|$, θ , R, X, G, B, L, C, D, Q, ESR; Deviation and % deviation

Measurement Circuit Modes: Series and parallel

Ranging: Auto and manual

Trigger: Internal, external, manual, and bus (GPIB)

Delay Time: 0 s to 60.000 s in 1 ms steps

Measurement Terminals: Four-terminal pair

Test Cable Length:

- 4284A: Standard: 0 and 1 m; with 4284A-006: 0, 1, 2 and 4 m
- 4285A: 0, 1 and 2 m

Integration Time: Short, medium, and long

Averaging: 1 to 256, programmable

Test Signal:

- 4284A: 20 Hz to 1 MHz \pm 0.01%, 8610 selectable frequencies
- 4285A: 75 kHz to 30 MHz \pm 0.01%, 100 Hz steps

Test Signal Modes:

Normal: Programs selected voltage or current at the measurement terminals open or shorted, respectively, and not at the device-under-test

Constant: Maintains selected voltage or current at the device-under-test independent of changes in the device's impedance

Test Signal Levels (rms)	Normal	Constant
4284A	5 mV to 2 V, 50 μ A to 20 mA	10 mV to 1 V, 100 μ A to 10 mA
4284A-001	5 mV to 20 V, 50 μ A to 200 mA	10 mV to 10 V, 100 μ A to 100 mA
4285A	5 mV to 2 V, 200 μ A to 20 mA	10 mV to 1 V, 100 μ A to 20 mA

DC Bias:

- 4284A Standard: 0 V, 1.5 V and 2 V
- 4284A/4285A-001: 0 V to \pm 40 V

Measurement Display Range

Parameter	Range
Z , R, X	0.01 m Ω to 99.9999 M Ω
$ Y $, G, B	0.01 nS to 99.9999 S
C	4284A: 0.01 fF to 9.9999 F
	4285A: 0.01 fF to 999.999 μ F
L	4284A: 0.01 nH to 99.9999 kH
	4285A: 0.001 nH to 99.9999 H
D	0.000001 to 9.99999
Q	0.01 to 99999.9
θ	-180.000° to 180.000°
$\Delta\%$	-999.999% to 999.999%

Basic Measurement Accuracy

	Z , C, L	D
4284A	0.05%	0.0005
4285A	0.1%	0.001

@ 23°C \pm 5°C, after OPEN and SHORT correction

Supplemental Characteristics

Measurement Time: Typical measurement time from the trigger command to the end of measurement (EOM) output at the handler interface connector

	4284A at 1 KHz	4285A 75 kHz to 30 MHz
SHORT	40 ms	30 ms
MEDIUM	190 ms	65 ms
LONG	830 ms	200 ms

4284A/4285A-001 DC Bias Current Output: 100 mA max.

Display

LCD dot-matrix display: Displays measured values, control settings, comparator limits and decisions, list sweep tables, self-test messages, and annunciations.

Correction Function

OPEN/SHORT/LOAD: Eliminates measurement errors due to the test fixture's stray parasitic impedance.

List Sweep Function

A maximum of ten frequencies or test signal levels can be programmed. Single or sequential testing can be performed. When 4284A/4285A-001 is installed, dc voltage bias testing can also be performed.

Comparator

Ten-bin sorting for the primary measurement parameter. IN/OUT for the secondary measurement parameter.

Bin Count: 0 to 999999

List Sweep Comparator: HIGH/IN/LOW decision output for each measurement point in the list sweep table

Other Functions

STORE/LOAD: Ten instrument setups can be stored/loaded from the internal non-volatile memory. Ten additional setups can also be stored/loaded from a memory card.

GPIB: All instrument control settings, measured values, comparator limits, list sweep table, and self-test results.

Memory: The memory buffer can store a maximum of 128 measurement results and output the data over GPIB, ASCII, and 64-bit binary data formats.

General Specifications

Power Requirements: 100/120/220 V \pm 10%, 240 V 5%/-10%, 47 to 66 Hz

Power Consumption: 200 VA max.

Operating Temperature and Humidity: 0°C to 55°C, \leq 95% RH at 40°C

Size: 177 mm H x 426 mm W x 498 mm D (6.97 in x 16.77 in x 19.61 in)

Weight: Approximately 16 kg (35.2 lb)

Accessories

42841A Bias Current Source

- Bias Current Output: (23°C \pm 5°C): 0.01 A to 20.0 A
- Basic Impedance Accuracy: 1% when used with the 4284A/4285A (1 kHz to 1 MHz)
- Interface: Custom, directly controllable by the 4284A/4285A with 4284A/4285A-002

42842A/B Bias Current Test Fixture

Used with the 4284A and 42841A for high dc bias current measurements:

- 42842A: 20 A max.
- 42842B: 40 A max.

42842C Bias Current Test Fixture

Used with the 4285A and 42841A for high dc bias current measurement. 10 A max.

42843A Bias Current Cable

Used with the 4284A, 42841A (2 units), and 42842B for 40 A maximum applications (necessary for I_{dc} > 20 A)



4284A with 42841A and 42842A

4284A
4285A

Key Literature

4284A/4285A Precision LCR Meter Family Data Sheet, p/n 5963-5391E

4284A Data Sheet, p/n 5963-5390E

4285A Data Sheet, p/n 5963-5395E

LCR Meters, Impedance Analyzers and Test Fixtures Selection Guide, p/n 5952-1430E

Ordering Information

4284A Precision LCR Meter

4285A Precision LCR Meter

4284A-700 Standard Power (2 V, 20 mA, 2 V DC Bias)

4285A-700 No DC Bias

4284A/4285A-001 Power Amplifier/DC Bias (4284A) DC Bias (4285A)

4284A/4285A-002¹ Bias Current Interface (4284A)

Accessory Control Interface (4285A)

4284A/4285A-004 Memory Card (4284A/4285A)

4284A-006 2 m/4 m Cable Length Operation (4284A only)

4284A/4285A-201 General Purpose Handler Interface

4284A/4285A-202 Handler Interface

4284A/4285A-301 Scanner Interface

4284A/4285A-710 Blank Panel

42841A Bias Current Source

42842A Bias Current Test Fixture (20 A max.)

42842B Bias Current Test Fixture (40 A max.)

42842C Bias Current Test Fixture (10 A max.)

42842C-001 SMD Test Fixture (42842C only)

42843A Bias Current Cable

¹4284A/4285A-001 and 4284A/4285A-002 do not operate simultaneously.

4338B

- Low and selectable test signal current: 1 μ A to 10 mA
- Wide measurement range: 10 $\mu\Omega$ to 100 k Ω
- 10 $\mu\Omega$ resolution
- Contact check function
- 1 kHz ac measurement
- High-speed measurement: 34 ms
- Built-in comparator
- Auto-measurement mode



4338B

4338B Milliohmmeter

The 4338B milliohmmeter is a precise, reliable, high-speed test tool for measurements of low resistance.

5

Precise, Low-Resistance Measurement

Contact failure of electromechanical components in a low-current circuit is a key issue for component reliability. The 4338B offers selectable low ac test signals (1 μ A to 10 mA). Users can now characterize low resistances of electromechanical components under low-current conditions. A high resolution of 10 $\mu\Omega$ allows you to determine the slightest differences in contact resistance testing of relays, switches, connectors, PC board traces and cables. The 1 kHz test signal eliminates potential errors introduced by thermoelectric effects on the device-under-test (DUT) contacts. The 1 kHz ac test signal is the best solution to evaluate the internal resistance of batteries, because it avoids dc energy consumption.

High-Speed Measurements

The high-speed (34 ms), built-in comparator and GPIB/handler interfaces make it possible to construct a measurement system using an automatic handler and external computer to minimize production test time.

Auto-Measurement Mode

When performing gross continuity testing where the test signal level is not a significant factor in the test, the auto-measurement function allows the instrument to select an appropriate test signal and measurement range setting.

Specifications

(Refer to Technical Overview for complete specifications.)

Measurement Function

Measurement Parameters: R (ac resistance), X (reactance), L (inductance), |Z| (impedance), θ (phase [°])

Combinations: R, R-X, R-L, |Z|, $-\theta$ (series mode only)

Mathematical Functions: Deviation and percent deviation

Display Digits: 3, 4, or 5 (selectable)

Test Signal Characteristics

- Test Frequency: 1 kHz
- Frequency Accuracy: $\pm 0.1\%$
- Test Signal Level: 1 μ A, 10 μ A, 100 μ A, 1 mA, 10 mA rms
- Level Accuracy: $\pm(10\% + 0.2 \mu$ A)
- Maximum Voltage Across Sample: 20 mV peak in any case

Measurement Range

Parameter	Measurement Range
R	10 $\mu\Omega$ to 100 k Ω
X, Z	10 $\mu\Omega$ to 100 k Ω (typical)
L	10 nH to 10 H (typical)
θ	-180° to +180° (typical)

Measurement Accuracy: $\pm 0.4\%$ Basic for R

Measurement Time: Time interval from a trigger command to the end of measurement (EOM) signal output at the handler interface port

Mode	Time (typical)
SHORT	34 ms
MEDIUM	70 ms
LONG	900 ms

Correction Function

- Zero SHORT: Eliminates measurement errors due to parasitic impedances in the test fixture

Comparator Function

HIGH/IN/LOW for each primary measurement parameter and the secondary measurement parameter

Contact Check Function

Contact failure between the test fixture and device can be detected

Other Functions

- Superimposed dc: ± 42 Vdc maximum may be present on measurement terminals
- Save/Recall: Ten instrument setups can be saved/recalled from the internal nonvolatile memory
- Continuous Memory Capability: If the instrument is turned off, or if a power failure occurs, instrument settings are automatically memorized (≤ 72 hours at 23° C \pm 5° C)
- GPIB Interface: All control settings, measured values, and comparator information
- Handler Interface: All output signals are negative-logic, optically isolated open collectors
- Output Signals Include: HIGH/IN/LOW, index, end of measurement, and alarm. Input signals are keylock and external trigger

General Specifications

Power Requirements: 90 V to 132 V or 198 V to 264 V, 47 Hz to 66 Hz, 45 VA max.

Operating Temperature: 0° C to 45° C

Size: 100 mm H x 320 mm W x 300 mm D (3.94 in x 12.6 in x 11.81 in)

Weight: 4.5 kg (9.9 lb)

Key Literature

4338B Milliohmmeter Technical Overview, p/n 5964-6183E

Furnished Accessories

Operation manual, power cable (mating cable and test leads, or 16338A test lead set, must be ordered separately)

Ordering Information

4338B Milliohmmeter

Furnished Accessories: CD-ROM (manual), power cable (mating cable and test leads, or 16338A test lead kit, must be ordered separately)

Options

4338B-ABA US-English Localization

4338B-ABJ Japan-Japanese Localization

Accessories

16064B LED Display/Trigger Box

16338A Test Lead Kit

The 16338A contains the following accessories.

16005B Kelvin Clip Lead (large, 2 ea)

16005C Kelvin IC Clip Lead (red, 1 ea)

16005D Kelvin IC Clip Lead (black, 1 ea)

16006A Pin-Type Probe Lead (2 ea)

16007A Alligator Clip Leads (red, 1 ea)

16007B Alligator Clip Leads (black, 1 ea)

16143B Mating Cable (1 ea)

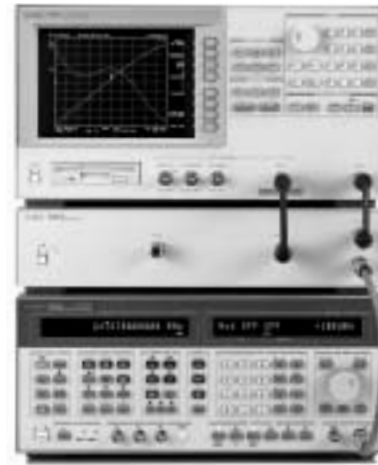
- Dedicated VCO and PLL parameters test system
- Excellent solution for LAB and production line
- Simple configuration and multifunctional system
- VCO tuning characteristics evaluation

- Outstanding phase noise measurement capability
- High resolution frequency transient measurement
- Automatic measurement capability and powerful analysis functions

4352S



3 GHz System



12.6 GHz System

4352S VCO/PLL Signal Test System

The Agilent 4352S test system can evaluate the characteristics of VCOs and PLLs that are essential to designing local oscillators used in RF wireless communication equipment. This system can provide both powerful analyzing capability for design evaluation in LAB and high speed measurement capability for production line test with 2 operating modes, "Signal Analyzer" and "VCO Tester" mode. The 4352S, which consists of the 4352B VCO/PLL Signal Analyzer and low-noise signal generator controlled by the 4352B, covers up to 3 GHz and can measure the main VCO/PLL evaluation parameters, RF power, frequency, phase noise, spectrum, frequency transient, DC consumption current and FM deviation. In addition, the 4352B provides and controls the DC power supply, the ultra low-noise DC control voltage source and the 1 kHz signal source necessary for VCO tuning characterizing.

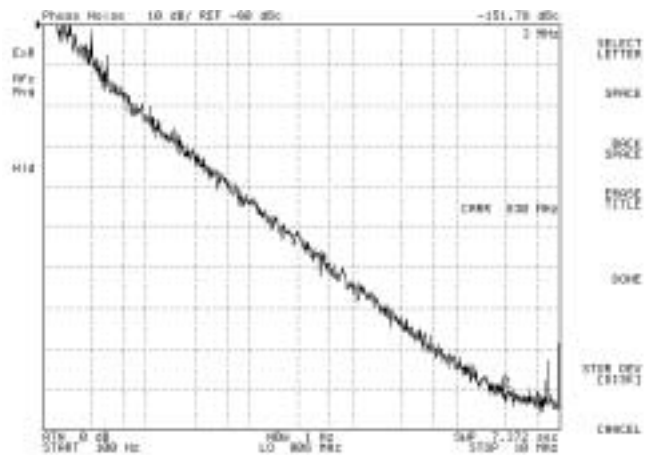
When configured with the 43521A downconverter unit, the 4352S offers a dedicated and comprehensive VCO/PLL design and production measurement solution for manufacturers that must test at frequencies over 3 GHz. The enhanced 4352S is a complete system that offers a frequency range from 10 MHz to 12.6 GHz and is capable of measuring phase noise, RF power, transients, settling time, and many more parameters required for VCO/PLL evaluations.

This system can make high-speed measurements thanks to the dedicated firmware and "carrier lock multi-mode PLL" technology for phase noise measurement that enables the system lock unto the carrier of the measured signal automatically. In addition, the 4352B has excellent phase noise performance such as -157 dBc/Hz at 1 MHz offset typically, so that this test system can make reliable and repeatable phase noise measurement with up to 10 times reduction in measurement time. Actually it can measure 801 measurement points from 100 Hz to 10 MHz offset in 7.4 seconds/sweep. Besides the powerful phase noise measurement capability, the 4352S can measure frequency transient with 50 Hz frequency resolution and 12.5 micro seconds time resolution.

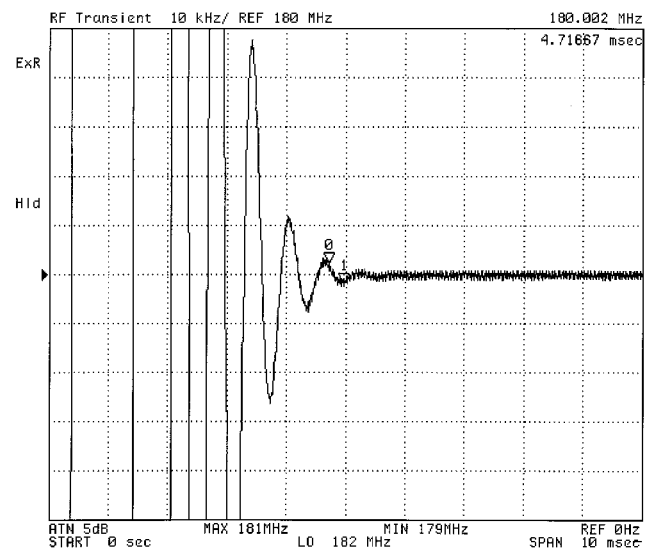
When the 71707A Microwave Downconverter is added to the standard system, the phase noise measurement can be performed up to 26.5 GHz.

The 4352S improves your VCO and PLL evaluation efficiency and testing productivity dramatically.

Measurement Display Examples



VCO phase noise measurement



PLL frequency lockup time measurement

Efficient Evaluation in Oscillator Circuit Design

The 4352S can measure the following characteristics:

For VCO Evaluation

- RF power vs. tuning voltage
- Frequency vs. tuning voltage
- Tuning sensitivity
- Phase noise (Carrier-to-Noise)
- Harmonics
- FM deviation
- DC power consumption current

For PLL Evaluation

- RF power
- Phase noise (Carrier-to-Noise)
- Frequency and Frequency transient
- Spurious
- Harmonics

Each parameter can be measured without changing any cable connections. So, you can easily evaluate a VCO/PLL with powerful analysis functions such as marker or limit line.

High Throughput and Easy Test Automation

Thanks to the high-speed phase noise measurement capability, it only takes about 2.5 seconds to measure five VCO parameters (RF power, frequency, phase noise, DC power consumption current and FM deviation) by using "VCO Tester" mode. The 4352S has the Instrument BASIC programming functions, built-in 3.5 inch disk drive (LIF/DOS format) and a 24-bit I/O. These capabilities allow you to interface to an automatic handler so that you can achieve automatic production-line testing without an external computer.

Specifications**Source Characteristics**

DC Power Voltage: 0 to +15.5 V with 1 mV step, 50 mA max.

DC Control Voltage: 0 to +20 V with 100 μ V step, 20 mA max.

- 4352S-001: -15 to +35 V
- Accuracy: $\pm(0.1\% + 2 \text{ mV})$
- Settling Time: <20 ms @ 0.1% error (typical)
- Noise Density: <1 nV/ $\sqrt{\text{Hz}}$ @ 10 kHz offset (typical)
- FM Signal: 1 kHz, 0 to 1 Vrms with 1 mV step @ open load

Receiver Characteristics

- Measurement Frequency Range: 10 MHz to 3 GHz/12.6 GHz (with 43521A/refer to 43521A)/26.5 GHz (with 71707A/phase noise measurement only)
- Input Power Level: -10 to +20 dBm
- Input Impedance: 50 Ω
- SWR: <1.2 (@ <2 GHz); <1.3

RF Power Measurement

- Accuracy $\pm 0.2 \text{ dB}$ (@ 1 GHz, -5 dBm, typical); $\pm 1 \text{ dB}$
- Resolution: 0.01 dB

Frequency Measurement

- Frequency Resolution: 1 kHz

Frequency Transient Measurement

- Accuracy: $\pm(1 \text{ kHz} + \text{time base accuracy of the external signal generator})$
- Minimum Frequency Resolution: 50 Hz
- Maximum Sweep Time: 10 sec.
- Minimum Time Resolution: 12.5 μ sec.

Phase Noise (Carrier-to-Noise Ratio) Measurement

- Offset Frequency Range: 100 Hz to 10 MHz

System Noise Level

Offset	Specification (dBc/Hz)	Typical (dBc/Hz)
100 Hz	-85	-90
1 kHz	-110	-117
10 kHz	-130	-137
100 kHz	-140	-147
1 MHz	-150	-157

Spectrum Measurement

- Absolute Level Accuracy: 2 dB (-5 dBm input, @ ATT = 0 dB, typical)
- Relative Level Accuracy: 0.5 dB (typical)

FM Deviation Measurement

- Measurement Range: 2 kHz, 20 kHz, 200 kHz (peak)
- Accuracy: $\pm(2\% + 0.1\% \text{ of measurement range})$ @ 1 kHz FM rate; $\pm 0.8\%$ (typical)
- Residual FM: <3 Hzrms (@ 300 Hz to 3 kHz BW)

DC Consumption Current Measurement

- Measurement Range: 0 to 50 mA
- Accuracy: $\pm(0.2\% \pm 100 \mu\text{A})$

Storage

3.5-inch FDD: LIF/DOS format, 2DD/2HD
Internal RAM Disk: LIF/DOS format, 512 kB max.

Interfaces

GPIB I/F, 24-bit parallel I/O I/F

General Characteristics

Display: 8.5-inch color LCD

Operating Temperature: 0 to +40°C

Operating Humidity: 15 to 95% RH

Storage Temperature/Humidity: 0 to +40°C/15 to 95% RH

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 66 Hz, 300 VA max.

Size: 235 mm H x 425 mm W x 553 mm D (9.4 in x 17 in x 22.12 in)

Weight: 21.5 kg (47.3 lb) (typical)

Key Literature

Signal Generators RF and Microwave Models, p/n 5965-3094E
71707A Microwave Downconverter Technical Data, p/n 5091-4435E

Ordering Information

4352S VCO/PLL Signal Test System

Agilent 4352B VCO/PLL Signal Analyzer

4352B-700 Standard DC Control Voltage

4352B-001 Expand DC Control Voltage

4352B-810 Add Keyboard

4352B-1CM Rack Mount Kit

4352B-1CN Handle Kit

4352B-1CP Rack Mount & Handle Kit

4352B-ABA English Localization

4352B-ABJ Japan Localization

43521A Downconverter Unit

Recommended Signal Generators

8664A Synthesized Signal Generator with 8664A-004

8644B Synthesized Signal Generator with 8664B-002

71707A 26.5 GHz Microwave Downconverter

E8247C PSG Series Microwave Signal Generator with Option 1ED and UNR

E8257C PSG Series Microwave Signal Generator with Option 1ED and UNR

E8267C PSG Series Microwave Signal Generator with Option 1ED and UNR

See Signal Sources section for more details. When using the other signal generators, please contact the Agilent Call Center in your region for details.



43521A

43521A Downconverter Unit

The 43521A Downconverter Unit is designed to operate with the 4352S VCO/PLL signal test system. When configured with the 43521A downconverter unit, the 4352S offers a dedicated and comprehensive VCO/PLL design and production measurement solution for manufacturers that must test at frequencies above 3 GHz. The enhanced 4352S is a complete system that offers a frequency range from 10 MHz to 12.6 GHz and is capable of measuring phase noise, RF power, lockup time, and many more parameters required for VCO/PLL evaluations.

Specifications

RF-in Port:

- Connector: N(f)
- Frequency: 10 MHz to 12.6 GHz

RF Power (Heterodyne Path):

- Input VSWR: <1.5
- Frequency: 2.4 GHz to 12.6 GHz
- Level:
 - @ ATT = 0 dB: –20 to 0 dBm
 - @ ATT >0 dB: –20 to +20 dBm
- Resolution: 0.01 dBm
- Accuracy: (@ 23°C ± 10°C)
 - @ ≤15 dBm:
 - ±1.5 dB @ ≤4 GHz
 - ±2.0 dB @ ≤8 GHz
 - ±2.5 dB @ ≤12.6 GHz
 - @ ≤20 dBm:
 - ±1.5 dB @ ≤4 GHz (SPC*)
 - ±2.0 dB @ ≤8 GHz (SPC*)
 - ±2.5 dB @ ≤12.6 GHz (SPC*)
 - @ –5 dBm: ±0.8 dB @ 6 GHz (Typical)
 - @ –5 dBm: ±1.0 dB @ 12 GHz (Typical)

Heterodyne Path Gain: 20 dB @ 6 GHz (SPC*)

Direct Path Insertion Loss: 0.5 dB @ 3 GHz (SPC*)

LO-in Port:

- Connector: N(f)
- Input Level: +10 dBm Nominal
- Frequency Range: 10 MHz to 6 GHz

LO-out Port:

- Connector: N(f)
- 600 MHz Output Level: ≥+8 dBm (SPC*)
- 600 MHz Accuracy: 600 MHz ± 50 ppm (SPC*)

Power Requirements: 90 to 132 V or 198 to 264 V, 47 to 63 Hz, 100 VA max

Size: 101 mm H x 425 mm W x 553 mm D (4.04 in x 17 in x 22.12 in)

Weight: 8 kg (35.2 lb) (Typical)

*SPC = Supplemental Performance Characteristics

System Performance with 43521A

The system performance is the capacity achieved by the combination of the 4352B, the Signal Generator, and the 43521A when the 43521A is phase-locked to the 40 MHz on the 4352B. All data except for RF Power measurement are typical.

The operating frequency depends on the synthesized signal generator as follows.

Signal Generator	4352S Frequency Range
8664A	10 MHz to 6.6 GHz
8665B, E8247C, E8257C, E8267C	10 MHz to 12.6 GHz

Direct Path (10 MHz to 3 GHz)

RF Power: Add ±0.1 dB to 4352B spec. (@ ≤2 GHz)
Add ±0.2 dB to 4352B spec. (@ 2 GHz < Freq. ≤3 GHz)
Other Parameters: Same as the 4352B spec.

Heterodyne Path (2.4 GHz to 12.6 GHz)

Tester Mode

RF Power: Same as 43521A spec.

Frequency

- Frequency Range: 2.4 GHz to 12.6 GHz
- Resolution: Same as 4352B spec.
- Accuracy: Same as 4352B spec.

FM Deviation

- Measurement Range: Same as 4352B spec.
- Resolution: Same as 4352B spec.
- Accuracy: Same as 4352B spec.

Residual FM: Same as 4352B spec.

Phase Noise: (C/N ratio (dBc/Hz))

- Offset Frequency Range: 100 Hz to 10 MHz
- Noise Floor:
 - (when equipped with the 8665B** up to 12.6 GHz)
 - ≤6 GHz when equipped with the 8664A**

**with 8664A/8665B-004

Offset Frequency (Hz)	100	1 k	10 k	100 k	1 M
3 GHz	–68	–93	–125	–137	–150
6 GHz	–63	–88	–119	–131	–147
9 GHz	–57	–84	–114	–125	–143
12 GHz	–58	–81	–113	–125	–142

Accuracy: Same as 4352B spec.

Analyzer Mode

RF Power: Same as the 43521A spec.

Frequency: Same as the tester mode spec.

Phase Noise: (C/N ratio) Same as the tester mode spec.

Frequency Transient

- Frequency Range: 2 MHz, 20 MHz, 512 MHz
- Frequency Accuracy: ±(Measurement Range x 0.1% + Time Base Accuracy of the External Signal Generator)
- Resolution: 50 Hz, 500 Hz, 12.8 kHz

Spectrum

- Absolute Accuracy: ±3 dBm @ to 10 dBm, RF ATT = 10 dB
- Relative Accuracy: Same as the 4352B spec.

Ordering Information

- Agilent 4352B VCO/PLL Signal Analyzer**
- 4352B-700 Standard DC Control Voltage
 - 4352B-001 Expand DC Control Voltage
 - 4352B-810 Add Keyboard
 - 4352B-1CM Rack Mount Kit
 - 4352B-1CN Handle Kit
 - 4352B-1CP Rack Mount & Handle Kit
 - 4352B-ABA English Localization
 - 4352B-ABJ Japan Localization

Recommended Signal Generators when configured with the 43521A

- 8664A Synthesized Signal Generator with 8664A-004
- 8665B Synthesized Signal Generator with 8665B-004
- E8247C PSG Series Microwave Signal Generator with Option 1ED and UNR
- E8257C PSG Series Microwave Signal Generator with Option 1ED and UNR
- E8267C PSG Series Microwave Signal Generator with Option 1ED and UNR

Various models

- Ultra broadband to 50 GHz
- Up to 1 watt output power
- Compact size



Microwave System Amplifiers

Use these amplifiers to increase output power from microwave sources and to increase test system measurement speed with improved dynamic range. Drive a variety of narrowband travelling wave tubes with a single driver solution that is highly reliable and low in cost to maintain year after year. With excellent noise figure relative to its broad bandwidth and high gain, these amplifiers can make significant improvement to system noise figure. By using feedback to an external source ALC input, system designers can level output power at the test port, negating the effects of post sweeper reflections and losses. Place power where you need it with a remotely-locatable dc power supply. The amplifier and the power supply are provided with a 2-m dc bias cable.

Specifications (+20°C to +30°C)

Model	Frequency (GHz)	Power out Psat (dBm)	Power out P1dB (dBm)	Gain dB (min)	Noise Figure (dB typ.)	Detected Output	DC Bias volt/amp	RF Connectors (Input/Output)
83006A	0.01 to 26.5	+18 typ. 0.01 to 10 +16 typ. 10 to 20 +14 typ. 20 to 26.5	+13, 0.01 to 20 +10, 20 to 26.5	20	13, 0.01 to 0.1 GHz 8, 0.1 to 18 GHz 13, 18 to 26.5 GHz	No	+12 V at 450 mA -12 V at 50 mA	3.5 mm (f)
83017A	0.5 to 26.5	+20 typ. 0.5 to 20 +15 typ. 20 to 26.5	+18, 0.5 to 20 GHz +13, 20 to 26.5	25	8, 0.5 to 20 GHz 13, 20 to 26.5 GHz	Yes	+12 V at 700 mA -12 V at 50 mA	3.5 mm (f)
83018A	2 to 26.5	+24, 2 to 20 GHz +21, 20 to 26.5 GHz	+22, 2 to 20 GHz +17, 20 to 26.5 GHz	27, 2 to 20 GHz 23, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+12 V at 2 A -12 V at 50 mA	3.5 mm (f)
83020A	2 to 26.5	+30, 2 to 20 GHz +30, 20 to 26.5 GHz*	+28, 2 to 20 GHz +28, 20 to 26.5 GHz*	30, 2 to 20 GHz 27, 20 to 26.5 GHz	10, 2 to 20 GHz 13, 20 to 26.5 GHz	Yes	+15 V at 3.2 A -15 V at 40 mA	3.5 mm (f)
83050A	2 to 50	+20, 2 to 40 GHz +19, 40 to 50 GHz**	+15, 2 to 40 GHz +13, 40 to 50 GHz	21	6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 830 mA -12 V at 50 mA	2.4 mm (f)
83051A	0.045 to 50	+12, 0.045 to 45 GHz +10, 45 to 50 GHz	+8, 0.045 to 45 GHz +6, 45 to 50 GHz	23	12, 0.045 to 2 GHz 6, 2 to 26.5 GHz 10, 26.5 to 50 GHz	No	+12 V at 425 mA -12 V at 50 mA	2.4 mm (f)
87405A/ 87405B	0.01 to 3	+26 typ.	+4	22 – 27 min./max.	6.5, 0.01 to 2 GHz 7.5, 2 to 3 GHz	No	+15 V at 80 mA	N (f)/N (m)
87415A	2 to 8	+26 typ.	+23	25	13	No	+12 V at 900 mA	SMA (f)

* -0.7 dB/ GHz (20<f<26.5)
** 19 dBm -0.2 dB/ GHz (40<f<50)

Dimensions

83006A, 83017A, 83050A, 83051A, 87415A: 45 mm H x 103 mm W x 132 mm L (5.2 in x 1.8 in x 4 in)
83018A: 76 mm H x 114 mm W x 212 mm L (8.3 in x 3 in x 4.5 in)
83020A: 87 mm H x 202 mm W x 275 mm L (10.8 in x 3.4 in x 8 in)
87405A/87405B: 28 mm H x 28 mm W x 125 mm L (1.1 in x 1.1 in x 4.9 in)

Weight

83006A, 83017A, 83050A, 83051A, 87415A: .64 kg (1.4 lb);
83018A: 1.8 kg (4 lb); 83020A: 3.9 kg (8.5 lb);
87405A/87405B: 0.27 kg (0.6 lb)

Bias Cable

2-m cable with a connector on one end and bare wires on the other, shipped with the amplifiers below
83006A, 83017A, 83018A, 83050A, 83051A, 87415A: p/n 83006-60004
83020A: p/n 83020-60004
2-m cables to connect between amplifier and power supplies, shipped with power supplies below
87421A: p/n 83006-60005
87422A: p/n 87422-60001, 83006-60005

Power Supply	AC Input Voltage	DC Output Voltage/Current	Output Power	Size (H, W, D)
87421A	100 to 240 VAC 50/60 Hz	+12 V at 2.0 A, -12 V at 200 mA	25 W max	57 mm, 114 mm, 176 mm (2.3 in, 4.5 in, 6.9 in)
87422A	100 to 240 VAC 50/60 Hz	+15 V at 3.3 A, -15 V at 50 mA +12 V at 2.0 A, -12 V at 200 mA	70 W max	86 mm, 202 mm, 276 mm (3.4 in, 8.0 in, 10.9 in)

Key Literature

For more information, visit our web site: <http://www.agilent.com/find/MTA>



87130A

11713A Attenuator/Switch Driver

The 11713A attenuator/switch driver provides simple GPIB control of up to ten, 24 Vdc solenoid-activated switch or attenuator sections. The 11713A supplies 24 Vdc common and ten pairs of current sinking contacts to achieve control of up to ten relays. Each 11713A is supplied with two plug-in drive cables to simplify connection to programmable attenuators.

70611A Attenuator/Switch Driver for MMS

The 70611A is a one-slot MMS module capable of driving up to 248 electromechanical switches or attenuator switch sections. The 70611A is MSIB, SCPI, and GPIB compatible. In addition to being programmable, the 70611A features an extremely user-friendly manual interface via any MMS display unit. The highlight of the manual interface is the operator's ability to customize groups of switch control lines and their settings, then identify these switch settings with user-defined alphanumeric labels. In this manner, end users of the 70611A can define custom menus with their own identification labels for simplified manual control.

The 70611A can store up to 256 user-defined labeled paths. Path definitions can be stored in non-volatile EEROM. Groups of paths can be stored in directories for easy access to similar path commands. The 70612A/C and 70613A/C offer compatible capacity with built-in RF switches. (Configurations vary and custom configurations are available.)

87130A Attenuator/Switch Driver

The 87130A is a 3.5-inch, full rack width attenuator/switch driver capable of driving up to 248 electromechanical switch or attenuator sections. The 87130A is controlled over GPIB via Standard Commands for Programmable Instruments (SCPI) commands. The 87130A has been designed for use in both ATE switching systems and computer-controlled bench top applications.

The 87130A is electronically identical to the 70611A and shares its performance characteristics, with the exception of the manual control method. The 87130A has no front panel controls. Manual control of the 87130A is realized through its ITG driver and a computer controller. The 87130A can drive 31 switch or attenuator sections directly, and up to an additional 217 switches via seven additional 84940A driver cards.

E1368A, E1369A and E1370A VXI Attenuator/Switch Drivers

Agilent's VXI family of instrumentation includes modules for microwave switching and attenuation control up to 18.0 GHz. E1368A contains three factory-installed SPDT switches such as the 8762B which features all-port termination, dc to 18.0 GHz. E1369A is identical to the E1368A except the switches are not included. This allows user-substitution of 8763 or 8764 transfer switches. E1370A allows the user to customize the internal configuration for 8766 series multi-port switches or 8494/95/96/97 step attenuators.

84940A Switch Driver and 84941A Distribution Card

The 84940A is an expansion driver card for the 70611A family of MMS attenuator/switch drivers and the 87130A attenuator/switch driver. The 84940A has been designed for incorporation into large interfaces located remotely from their controller. A single 84940A can control up to 31 switches when located up to 150 feet (45 m) from an 70611A or 87130A. The physical interconnection to the switches or attenuators is realized via 31 four-pin output connectors, which permit quick connection and disconnection of the switches or attenuators.

Key Literature

For more information, visit our web site:
<http://www.agilent.com/find/accessories>

Ordering Information

11713A Attenuator/Switch Driver
11761A; 8765 to 11713A Adapter Cable
44476B Microwave Switch Module for 3488A
(Holds up to two 8762/3/4 Option 011 Switches)
70611A MMS Switch Driver
84940A Attenuator/Switch Driver Expansion Card
84941A Distribution Expansion Card
87130A Attenuator/Switch Driver
E1368A 18 GHz Microwave Switch
E1369A Microwave Switch Driver
E1370A Microwave Switch/Step Attenuator Driver

RF & Microwave Test Accessories

The complete line of Agilent's microwave accessories – from adapters to waveguides and everything between, it's all here. Amplifiers, detectors, filters, step and fixed attenuators, switches and switch drivers – the entire Agilent Technologies product line, with all the technical specs. To receive your free copy in the U.S., call 800-452-4844 and ask for the RF & Microwave Test Accessories Catalog, p/n 5968-4314E, contact your local Agilent representative, or order on the Internet. The entire RF & Microwave Test Accessories can be accessed at: <http://www.get.agilent.com/accessories>

11713A
70611A
87130A
84940A
84941A
E1368A
E1369A
E1370A

5

N1810UL
N1810TL
N1811TL
N1812UL

- Low SWR
- Low insertion loss
- High isolation – up to 134 dB @ 4 GHz
- Long life – 5 million cycles
- Excellent repeatability



N181x Series

5

Coaxial Switches

Featuring unparalleled reliability and the longest life available, Agilent switches are the clear choice for high volume wireless communications manufacturing test. All switches utilize magnetically latched solenoids and break-before-make RF contacts for test simplicity. In precision measurements and monitoring applications where insertion loss repeatability is crucial, these switches will operate in excess of 5 million cycles with better than 0.03 dB of insertion loss repeatability at 25°C.

N1810UL – Unterminated Latching SPDT

The 1810UL is a single-pole, double throw switch available in the frequency range from DC to 26.5 GHz.

N1810TL – Terminated Latching SPDT

The 1810TL is a single-pole, double throw switch available in the frequency range from DC to 26.5 GHz. The unused port is terminated into 50 Ω, making it ideal for applications where source matching is required.

N1811TL – Terminated Latching Bypass

The 1811TL is a terminated bypass switch available in the frequency range from DC to 26.5 GHz. The switch's internal load can terminate the device under test when in the through mode (up to 1 watt). Because of its compact design, it is ideal for drop-in, drop-out applications.

N1812UL – Unterminated Latching 5-port

The 1812UL is a versatile, unterminated 5-port switch available in the range of frequency from DC to 26.5 GHz. In bypass switch applications, the fifth port can be terminated externally with a high power termination. It can also be utilized for signal path reversal or as a calibration port.

General Operating Characteristics: N181x series

Switching Speed	Repeatability	Life	Impedance
<15 ms	<0.03 db typical	5 mil cycles	50 Ω

Standard Performance Specifications: N181x series

Isolation (dB)	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	90	85	76	67	60
Insertion	= 0.35 + 0.45/26.5 x F, where F is specified in GHz = 0.35 + 0.45/26.5 x F				
Loss (dB)	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	0.35	0.42	0.56	0.69	0.80
SWR	dc – GHz	dc – 4 GHz	4 – 12.4 GHz	12.4 – 20 GHz	20 – 26.5 GHz
	1.10	1.15	1.25	1.30	1.60

Optional High Performance Specifications: N181x series

Isolation (dB)	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 301	125	120	109	99	90
Insertion	= 0.15 + 0.013 x F, where F is specified in GHz				
Loss (dB)	dc	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Opt. 302	0.15	0.27	0.41	0.53	0.65
SWR	dc – GHz	dc – 4 GHz	4 – 12.4 GHz	12.4 – 20 GHz	20 – 26.5 GHz
Opt. 302	1.05	1.10	1.20	1.23	1.45

Key Literature

N1810/1/2 Coaxial Switches Product Overview, p/n 5968-9653E

Ordering Information

N1810UL, N1810TL, N1811TL, N1812UL

Frequency

- 002 dc – 2 GHz w/SMA(f) RF connector
- 004 dc – 4 GHz w/SMA(f) RF connector
- 020 dc – 20 GHz w/SMA(f) RF connector
- 026 dc – 26.5 GHz w/SMA(f) RF connector

Voltage

- 105 5 volts
- 115 15 volts
- 124 24 volts

dc Connector

- 201 D-subminiature 9 pin (f)
- 202 Solder lugs

Options

Performance (chose any)

- 301 Higher isolation (see specs)
- 302 Low SWR and insertion loss (see specs)

Drive (chose any)

- 401 TTL/5V CMOS compatible drive
- 402 Position Indicators
- 403 Current Interrupts

Ordering example: For an unterminated 5-port switch, operating up to 20 GHz, with 15 volt coils, D-sub connector, TTL drive, and high isolation, the order should look as follows: **N1812UL-020, -115, -201, -301, -401**



8761
8762
8763
8764
8765 Series

Coaxial Switches

Agilent coaxial switches feature low SWR, low insertion loss, and excellent isolation. Agilent offers a broad line of coaxial switches, covering up to 40 GHz, for use in test and measurement applications. All switches use magnetically-latched solenoids and break-before-make RF contacts for test simplicity.

8761 Series

8761A/B is a SPDT switch which operates up to 18 GHz. Each port features six connector options plus 50 Ω termination for design flexibility. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles.

8762 Series

8762A/B/C switches operate up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. They also provide excellent isolation of 90 dB to 18 GHz and all-port switched terminations, so that all ports maintain a 50 Ω match. Internal loads are rated at 1 watt average (100 W peak, 10 μ sec pulse width). Control voltage options T15 and T24 are compatible with TTL/5 V CMOS drive circuitry. Another model, 8762F is designed for 75 Ω transmission lines, making it valuable for commercial communication applications up to 4 GHz.

8763 Series

8763A/B/C switches operate up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. They are preferred for drop-out or drop-in applications due to their compact design. These switches are used to automatically insert or remove a test component from a signal path. Because of their excellent isolation, they can also be used as the intersection (crosspoint) switch in full-access matrix switching applications. One port is internally terminated. Options T15 and T24 are available for TTL/5 V CMOS compatibility.

8764 Series

8764A/B/C switches are available in three models up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 1 million switching cycles. These switches are similar to the 8763, but with the internal termination replaced with a fifth port. The fifth port can be utilized for signal path reversal or as a calibration port. Options T15 and T24 offer TTL/5 V CMOS compatibility.

8765 Series

8765A/B/C/D/F are available in four models up to 40 GHz, as well as a 75 Ω model to 4 GHz. These SPDT switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. Unlike the 8762 switches, they do not have internal, switched RF loads or dc current interrupts. Coil voltage options cover the complete range from 5 Vdc to 24 Vdc. Since the coils are not interrupted, the coil voltage may be continuous or may be switched off after 15 ms.

The 8765 comes with either ribbon cables or solder terminals. The ribbon cable also connects with the 11761A Cable/Adapter, which permits direct connection to the 11713A Attenuator/Switch Driver. The 8765 can also be driven by the 87130A driver, but position monitoring and reporting are not available.

Key Literature

<http://www.get.agilent.com/accessories>

Ordering Information

8761A/B Coaxial Switches

Specify voltage and connectors (including built-in 50 Ω terminations) by alphabetic suffix on the switch model number and the appropriate 3-digit option number. Specify all connectors.

8761A 12 to 15 V Supply Voltage

8761B 24 to 30 V Supply Voltage

Connector Options (Port 1, Port 2, Port C):

Option Code	Connector Type
100/200/300	Type-N Female
101/201/301	Type-N Male
102/202/302	7-mm Threaded Sleeve (APC-7) ³
103/203/303	7-mm Coupling Nut (APC-7) ³
104/204/304	7-mm for UT-250 Coax
105/205/305	3-mm Female (SMA)
106/206/306	3-mm Male (SMA)
107/207/307	50-ohm Termination

8762, 8763, 8764 Coaxial Switches

Specify the frequency and voltage by the alphabetic suffix and option number. The standard model has 24 V supply voltage.

8762A SPDT, DC to 4 GHz

8762B SPDT, DC to 18 GHz

8762C SPDT, DC to 26.5 GHz

8762F SPDT, DC to 4 GHz, 75 Ω

8763A 4-Port, DC to 4 GHz

8763B 4-Port, DC to 18 GHz

8763C 4-Port, DC to 26.5 GHz

8764A 5-Port, DC to 4 GHz

8764B 5-Port, DC to 18 GHz

8764C 5-Port, DC to 26.5 GHz

8765 Coaxial Switches

A voltage option must be ordered with the switch. Specify frequency, voltage, dc connectors, and ribbon cable extension options by alphabetic suffix and option number.

8765A SPDT, DC to 4 GHz

8765B SPDT, DC to 20 GHz

8765C SPDT, DC to 26.5 GHz

8765D SPDT, DC to 40 GHz

8765F SPDT, DC to 4 GHz, 75 Ω

¹Option 292 available for 8765D only.

²8765D-292 and 8765F do not have Option UK6.

³Either option will connect to a standard, sexless, 7-mm connector. To daisy-chain two 8761A's you must use one option 102, 202, or 302 and one option 103, 203, or 303 on the two mating connectors. If you have two of the same options, you will need to use a cable with two standard 7-mm connectors.

8761 – 5 Series Specifications

Model	Frequency Range (GHz)	SWR 50 Ω Nominal	Insertion Loss	Isolation	Switching Speed	Repeat-ability ²	Life ³	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)
8761A SPDT Unterminated	dc to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10 ⁶		38 x 41 x 38	300
8761B SPDT Unterminated	dc to 18	<1.2 to 12.4 GHz <1.25 to 18 GHz	<0.5 dB to 12.4 GHz <0.8 dB to 18 GHz	>50 dB to 12.4 GHz >45 dB to 18 GHz	35 to 50 mS	0.03 dB	1 x 10 ⁶		38 x 41 x 38	300
8762A SPDT Terminated	dc to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 db to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8762B SPDT Terminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8762C SPDT Terminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10 ⁶	3.5 mm (f)	53 x 14 x 54	220
8762F SPDT, 75 Ω Terminated	dc to 4	<1.15 to 1 GHz <1.3 to 4 GHz	<0.4 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10 ⁶	75 Ω, SMB (m)	53 x 14 x 54	300
8763A Coaxial Terminated	dc to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8763B Coaxial Terminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8763C Coaxial Terminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10 ⁶	3.5 mm (f)	53 x 14 x 54	220
8764A Coaxial Unterminated	dc to 4	<1.1 to 2 GHz <1.2 to 4 GHz	<0.2 dB to 2 GHz <0.25 dB to 4 GHz	>100 dB to 4 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8764B Coaxial Unterminated	dc to 18	<1.10 to 2 GHz <1.2 to 12.4 GHz <1.3 to 18 GHz	<0.2 dB to 2 GHz <0.5 dB to 18 GHz	>90 dB to 18 GHz	<30 mS	0.03 dB	1 x 10 ⁶	SMA (f)	53 x 14 x 54	220
8764C Coaxial Unterminated	dc to 26.5	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.4 to 18 GHz <1.8 to 26.5 GHz	<0.25 dB to 2 GHz <0.5 dB to 18 GHz <1.25 dB to 26.5 GHz	>90 dB to 18 GHz >50 dB to 26.5 GHz	<30 mS	0.03 dB	1 x 10 ⁶	3.5 mm (f)	53 x 14 x 54	220
8765A SPDT Unterminated	dc to 4	<1.2 to 4 GHz	0.2 + 0.025 f (GHz) max <0.2 to 4 GHz ¹	>120 dB to 4 GHz	<15 mS	0.03 dB	5 x 10 ⁶	SMA (f)	33 x 14 x 45	200
8765B SPDT Unterminated	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.2 + 0.025 f (GHz) max <0.2 to 4 GHz ¹ <0.5 to 20 GHz ¹	>120 dB to 4 GHz >90 dB to 20 GHz	<15 mS	0.03 dB	5 x 10 ⁶	SMA (f)	33 x 14 x 45	200
8765C SPDT Unterminated	dc to 26.5	<1.25 to 4 GHz <1.45 to 18 GHz <1.7 to 26.5 GHz	0.25 + 0.027 f (GHz) max <0.2 to 4 GHz ¹ <0.5 to 20 GHz ¹ <0.7 to 26.5 GHz ¹	>120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz	<15 mS	0.03 dB	5 x 10 ⁶	3.5 mm (f)	33 x 14 x 45	200
8765D SPDT Unterminated	dc to 40	<1.25 to 4 GHz <1.45 to 26.5 GHz <1.7 to 40 GHz	0.2 + 0.23 f (GHz) max <0.2 to 4 GHz ¹ <0.5 to 20 GHz ¹ <0.7 to 26.5 GHz ¹ 0.75 + 0.023 f (GHz) max <1.0 to 40 GHz ¹	>120 dB to 4 GHz >90 dB to 20 GHz >60 dB to 26.5 GHz >50 dB to 40 GHz	<15 mS	0.03 dB	5 x 10 ⁶	2.4 mm (f) 2.92 mm (f)	33 x 14 x 45	200
8765F SPDT, 75 Ω Unterminated	dc to 4	<1.15 to 1 GHz <1.20 to 4 GHz	<0.18 dB to 1 GHz <0.24 dB to 2 GHz <0.40 dB to 4 GHz	>100 dB to 1 GHz >90 dB to 4 GHz	<15 mS	0.03 dB	5 x 10 ⁶	75 Ω, SMB (m)	33 x 14 x 45	200

¹Typical insertion loss

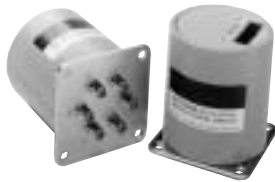
²Measured at 25°C

³Cycles per section minimum

For more information, visit our web site: <http://www.agilent.com/find/mta>



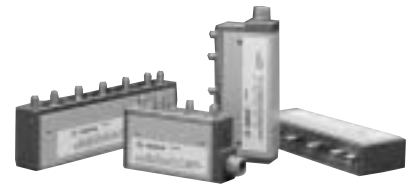
87222C/D/E



87406B



87204B



8766

87104
87106 Series
87204
87206 Series
87222
87406
87606
8766
8767
8768
8769 Series

Transfer Switches – High Performance

The 87222C/E 4-port, coaxial transfer switches offer versatility in a number of applications from drop-out to signal reversal. They provide exceptional repeatability <math><0.03\text{ dB}</math>, a low insertion loss and high isolation. The 87222C operates from dc-26.5 GHz, 87222D to 40 GHz, and are warranted for 5 million cycles. The 87222E operates from dc-50 GHz. The option 161 87222C/D/E provides a 10-pin connector while Option 100 includes solder terminals. Option 201 provides a mounting bracket.

Matrix Switches – High Performance, Terminated

87406/606 Series

The 87406B and 87606B 6-port, coaxial matrix switches will provide a valuable tool for 3 x 3, 2 x 4, and 1 x 5 configurations. These high performance matrix switches offer excellent repeatability and life greater than 5 million cycles. The 87406B, 87606B operate from dc to 20 GHz with excellent isolation, VSWR <math><2.0:1</math>, and with an input power of 1 W avg./50 W peak (10 μs max). Option 161 for the 87406B/606B provides a 16-pin connector while Option 100 provides solder terminals. Option T24 is available which provides internal circuits that are compatible with external TTL/5 V CMOS digital ICs while 024 provides 24 Vdc without TTL.

Multiport – High Performance, Terminated

87104/106 and 87204/206 Series

87104A/B/C and 87106A/B/C multiport switches are available in 3 models up to 26.5 GHz. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. 87104 is a Single-Pole-4-throw (SP4T) and 87106 is a SP6T function. Both switches have internal solid-state logic that automatically programs the non-used ports to a matched load when any one port is programmed to “on.” This relieves the user from having to provide external logic drive pulses.

87204A/B/C and 87206A/B/C switches are fully equivalent to models 87104/06 in their RF switching performance. However, their drive circuits are primarily designed to work with the 87130A/11760A switch drivers. These switches do not provide independent position indicators. Option 161 87204/06 provides a 16-pin connector while Option 100 provides solder terminals.

Multiport – Low Profile, Unterminated

8766/67/68/69K Series

8766/67/68/69K series switches are modified versions of the 8494/95/96/97 series step attenuators (dc – 26.5 GHz) for applications requiring a single-pole, 3-throw, 4-throw, 5-throw or 6-throw coaxial switch. The switch ports are unterminated. These switches offer exceptional repeatability of 0.03 dB over 5 million switching cycles. The switches are available with several optional cables and connectors to make them compatible with standard 14-pin DIP sockets. Isolation and insertion loss vary with frequency, and depend upon the port selected.

Key Literature

For more information, visit our web site:
<http://www.agilent.com/find/mta>

Ordering Information

- 87104A SP4T, DC to 4 GHz
 - 87104B SP4T, DC to 20 GHz
 - 87104C SP4T, DC to 26.5 GHz
 - 87106A SP6T, DC to 4 GHz
 - 87106B SP6T, DC to 20 GHz
 - 87106C SP6T, DC to 26.5 GHz
 - 87204A¹ SP4T, DC to 4 GHz
 - 87204B¹ SP4T, DC to 20 GHz
 - 87204C¹ SP4T, DC to 26.5 GHz
 - 87206A¹ SP6T, DC to 4 GHz
 - 87206B¹ SP6T, DC to 20 GHz
 - 87206C¹ SP6T, DC to 26.5 GHz
 - 87222C Transfer, DC to 26.5 GHz
 - 87222D Transfer, DC to 40 GHz
 - 87222E Transfer, DC to 50 GHz
 - 87222E-201³ Mounting Bracket
 - 87406B Matrix, DC to 20 GHz
 - 87606B Matrix, DC to 20 GHz
 - 87606B-100 Solder Terminals
 - 87606B-161 16-pin DIP with Ribbon Cable
 - 87606B-T24⁴ TTL/5 V CMOS Compatible Logic
 - 87606B-024² 24 Vdc without TTL Logic
 - 87606B-UK6 Commercial Calibration Test Data with Certificate
 - 8766K, 8767K, 8768K, 8769K Coaxial Switches
- Specify RF connectors (and frequency), supply voltages, dc connectors by option number. Standard unit is 24 Vdc, 3.5-mm (f) RF connectors (dc to 26.5 GHz), and Viking-type dc connector.
- 8766K SP3T Multi-Port Switch
 - 8767K SP4T Multi-Port Switch
 - 8768K SP5T Multi-Port Switch
 - 8769K SP6T Multi-Port Switch
 - 8769K-002 SMA (f) Connectors
 - 8769K-004 3.5 mm (f)
 - 8769K-008 8-inch Ribbon Cable w/DIP Connector
 - 8769K-011 5 Vdc Supply Voltages
 - 8769K-015 15 Vdc Supply Voltages
 - 8769K-016 16-inch Ribbon Cable w/DIP Connector
 - 8769K-024 24 V Solenoids
 - 8769K-060 5 foot dc Control Cable, 12 pin “Viking”
 - 8769K-UK6 Commercial Calibration Test Data with Certificate

¹ Provides sensing capability with 87130A and 70611A

² 87406B only

³ 87222C/D/E only

⁴ Not available with 87204, 87206, or 87606 switches

RF & Microwave Test Accessories

278

Switching Solutions – Multiport Coaxial Switches (cont.)

87104/6 Series, 87204/6, 87222C/E, 87406B/606B, 8766/7/8/9 Series Specifications

Model	Frequency Range (GHz)	SWR (50 Ω Nominal)	Insertion Loss (dB)	Isolation (dB)	Switching Time (max)	Repeat-ability ¹	Life (min.)	RF Connectors	Dimensions W x H x D (mm)	Shipping Weight (g)
87104A/204A SP4T	dc to 4	<1.2 to 4 GHz	0.3 + 0.015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104B/204B SP4T	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + 0.015 x f (GHz)	>100 to 12 GHz >70 at 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87104C/204C SP4T	dc to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + 0.015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106A/206A SP6T	dc to 4	<1.2 to 4 GHz	0.3 + 0.015 x f (GHz)	>100 to 4 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106B/206B SP6T	dc to 20	<1.2 to 4 GHz <1.35 to 12.4 GHz <1.45 to 18 GHz <1.7 to 20 GHz	0.3 + 0.015 x f (GHz)	>100 to 12 GHz >70 at 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87106C/206C SP6T	dc to 26.5	<1.7 to 20 to 26.5 GHz	0.3 + 0.015 x f (GHz)	>65 20 to 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
87222C	dc to 26.5	<1.1 to 2 GHz <1.15 to 4 GHz <1.25 to 12.4 GHz <1.4 to 20 GHz	0.2 + 0.025 x f (GHz)	>90 dB at 26.5 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	32 x 69 x 32	100
87222E	dc to 50	<1.3 to 10 GHz <1.4 to 20 GHz <1.5 to 30 GHz <1.6 to 40 GHz <1.7 to 50 GHz	0.26 + 0.026 x f (GHz)	60 at 50 GHz	15 ms	0.03 dB	5,000,000 cycles	2.4 mm (f)	32 x 69 x 32	100
87406B/606B	dc to 20	<1.21 to 4 <1.35 to 10 <1.5 to 15 <1.7 to 18 <1.9 to 20	0.34 + 0.033 x f (GHz)	>100 dB to 12 GHz >80 dB to 15 GHz >70 dB to 20 GHz	15 ms	0.03 dB	5,000,000 cycles	SMA (f)	57 x 74 x 57	229
8766K SP3T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 1: 0.2 dB + 0.05 dB/GHz Port 2: 0.2 dB + 0.06 dB/GHz	Consult Technical Data Sheet	20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 82	178
8767K SP4T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 3: 0.2 dB + 0.08 dB/GHz Port 4: 0.25 dB + 0.095 dB/GHz		20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 105	235
8768K SP5T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.5 to 12.4 GHz <1.6 to 18 GHz <1.8 to 26.5 GHz	Port 5: 0.25 dB + 0.108 dB/GHz Port 6: 0.25 dB + 0.12 dB/GHz		20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 133	292
8769K SP6T	dc to 26.5 or dc to 18 for Option 002	<1.3 to 8 GHz <1.55 to 12.4 GHz <1.8 to 18 GHz <2.05 to 26.5 GHz			20 ms	0.03 dB	5,000,000 cycles	3.5 mm (f)	45 x 23 x 160	349

¹ Measured at 25°C

For more information, visit our web site: <http://www.agilent.com/find/mta>

5



84904/6/7K and L

The 84904/905/906/907/908 family of programmable step attenuators offers unmatched attenuation performance to 50 GHz. The K model brings superior accuracy and reliability to 26.5 GHz, while the L model offers unparalleled performance to 40 GHz and the M to 50 GHz.

Agilent step attenuators consist of 3 or 4 cascaded sections of specific attenuation values, e.g., 1, 2, 4, 5, 10, 20 and 40 dB. These families offer the selection, performance, accuracy and reliability expected from Agilent attenuators: attenuation ranges of 11, 70, or 90 dB, 1 dB and 10 dB step sizes, 5 million cycles per section, better than 0.03 dB repeatability, connector size options and the choice of male or female connectors. RF connector choices include precision 3.5-mm or 2.92-mm on the 26.5 GHz K model, and precision 2.4-mm or 2.92-mm on the L model. While the 2.92-mm connector format is compatible with both 3.5-mm and SMA connectors, Agilent recommends the more rugged 2.4-mm and 3.5-mm connectors. The M models offer 2.4 mm (f) connectors.

Programmable step attenuators feature electromechanical designs which achieve 20 milliseconds switching time, including settling time. The permanent magnet latching allows automatic interruption of the dc drive voltage to cut power consumption and simplify circuit design. They are equipped with 10-pin DIP sockets (m) with interconnect cables available.

84904K
84906K
84907K
84904L
84906L
84907L
84904M
84905M
84908M

High-Performance Programmable Step Attenuators – dc to 50 GHz

- 84904K/L/M (0 – 11, 1 dB steps)
- 84905M (0 – 60, 10 dB steps)
- 84906K/L (0 – 90, 10 dB steps)
- 84907K/L (0 – 70, 10 dB steps)
- 84908M (0 – 65, 5 dB steps)

Programmable Driver Instruments

Drive options include the 11713A and 87130A attenuator/switch drivers, which permit users to easily integrate the attenuator into GPIB compatible automatic test systems, and the 70611 MMS attenuator/switch driver. Cabling options include a 5-foot Interconnect Cable with 10-pin DIP socket (f), and a “Viking” connector for the 11713A driver, and a 5-foot Interconnect Cable (11764B) with a 10-pin DIP socket (f) and bare leads for custom applications.

5

84904/6/7K/L Specifications

Model	Frequency Range (GHz)	Attenuation Range	Maximum SWR Std (Option 006)	Insertion Loss 0 dB Setting	Repeatability ¹	Life ²	Shipping Weight	Attenuation Accuracy	
								DC to 26.5 GHz	26.5 to 40 GHz
84904K	dc to 26.5	0 to 11 dB	1.3 (1.5) to 12.4 GHz	0.8 dB +	0.03 dB	5 x 10 ⁶	291 g	1 dB: 0.4 dB	1 dB: 0.6 dB
84904L	dc to 40	1 dB steps	1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	0.04 dB/GHz			(10.3 oz)	2 dB: 0.5 dB	2 dB: 0.6 dB
84906K	dc to 26.5	0 to 90 dB	1.3 (1.5) to 12.4 GHz	0.8 dB +	0.03 dB	5 x 10 ⁶	291 g	3 dB: 0.7 dB	3 dB: 0.8 dB
84906L	dc to 40	10 dB steps	1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz	0.04 dB/GHz			(10.3 oz)	4 dB: 0.7 dB	4 dB: 0.8 dB
84907K	dc to 26.5	0 to 70 dB	1.25 (1.4) to 12.4 GHz	0.6 dB +	0.03 dB	5 x 10 ⁶	229 g	5 dB: 0.7 dB	5 dB: 0.8 dB
84907L	dc to 40	10 dB steps	1.5 (1.7) to 34 GHz 1.7 (1.9) to 40 GHz	0.03 dB/GHz			(8.1 oz)	6 dB: 0.7 dB	6 dB: 0.9 dB
								7 dB: 0.8 dB	7 dB: 1.1 dB
								8 dB: 0.8 dB	8 dB: 1.1 dB
								9 dB: 0.85 dB	9 dB: 1.2 dB
								10 dB: 0.9 dB	10 dB: 1.3 dB
								11 dB: 1.10 dB	11 dB: 1.5 dB
								10 dB: 0.5 dB	10 dB: 0.5 dB
								20 dB: 0.6 dB	20 dB: 0.6 dB
								30 dB: 0.7 dB	30 dB: 0.7 dB
								40 dB: 1.0 dB	40 dB: 1.0 dB
								50 dB: 1.2 dB	50 dB: 1.2 dB
								60 dB: 1.6 dB	60 dB: 1.6 dB
								70 dB: 1.9 dB	70 dB: 1.9 dB
								80 dB: 2.7 dB	80 dB: 2.7 dB
								90 dB: 2.9 dB	90 dB: 2.9 dB

Sensitivity power: dB/watt (temperature dB/°C): 0.001 (0.0001)
Power rating: 1 W ave, 50 W peak, 10 μs max. pulse width
Supply voltage/speed/power: 20 to 30 V/<20 ms/2.7 W

¹ Measured at 25°C
² Cycles per section minimum

Agilent 84904/5/8 M Attenuation Data Uncertainties

Attenuation (dB)	DC to 2 GHz	2 to 20 GHz	20 to 40 GHz	40 to 50 GHz
0	±0.0305	±0.0546	±0.1256	±0.1597
1 – 11	±0.0297	±0.0515	±0.1238	±0.1699
15	±0.0342	±0.0516	±0.1263	±0.1968
20	±0.0334	±0.0521	±0.1240	±0.1849
25	±0.0358	±0.0522	±0.1251	±0.1997
30	±0.0432	±0.0535	±0.1283	±0.2219
35	±0.0729	±0.1050	±0.2521	±0.3918
40	±0.0729	±0.1050	±0.2521	±0.3918
45	±0.0774	±0.1051	±0.2546	±0.4187
50	±0.0766	±0.1056	±0.2523	±0.4068
55	±0.0790	±0.1057	±0.2534	±0.4216
60	±0.0864	±0.1070	±0.2566	±0.4438
65	±0.1161	±0.1585	±0.3804	±0.6137

Attenuation Setting

Attenuation Accuracy (±dB; referenced from 0 dB setting):

Model Number 84904M

Attenuator Setting (dB):	1	2	3	4	5	6	7	8	9	10	11
Frequency Range											
DC to 18 GHz	0.35	0.45	0.55	0.55	0.55	0.55	0.60	0.60	0.65	0.70	0.80
18 to 26.5 GHz	0.40	0.50	0.70	0.70	0.70	0.70	0.80	0.80	0.85	0.90	1.10
26.5 GHz to 40 GHz	0.60	0.60	0.80	0.80	0.80	0.90	1.10	1.10	1.20	1.30	1.50
40 to 50 GHz	0.60	0.70	0.80	0.80	0.80	0.90	1.10	1.10	1.20	1.30	1.50

Model Number 84905M

Attenuator Setting (dB):	10	20	30	40	50	60
DC to 40 GHz	0.5	0.6	0.7	1.0	1.2	1.6
40 to 50 GHz	0.7	0.8	1.0	1.3	1.5	1.8

Model Number 84908M

Attenuator Setting (dB):	5	10	15	20	25	30	35	40	45	50	55	60	65
DC to 40 GHz	0.5	0.5	0.6	0.6	0.7	0.7	1.0	1.0	1.2	1.2	1.6	1.6	1.8
40 to 50 GHz	0.7	0.7	0.8	0.8	1.0	1.0	1.3	1.3	1.5	1.5	1.8	1.8	2.0

¹ Step-to-step accuracy is the maximum variation from the nominal step size when changing attenuation values. It is a second specification on accuracy, and is used in combination with the absolute accuracy specifications to limit maximum allowable variation from nominal. Typical step-to-step accuracy for the 84905M and 84908M is ±1.0 dB to 50 GHz; for the 84904M is ±0.5 to 50 GHz.

Specifications

Maximum insertion loss	84904M	84905M	84908M
DC to 40 GHz (in dB 0 dB position, $(0.8 + 0.04 \cdot f)$ $(0.6 + 0.03 \cdot f)$ $(0.8 + 0.04 \cdot f)$ f = frequency in GHz)			
40 to 50 GHz	3.0	2.6	3.0

Note: At 75°C, increase insertion loss by $0.006 \cdot f$ (where f = frequency in GHz)

SWR	84904M	84905M	84908M
DC to 12.4 GHz	1.3	1.25	1.3
12.4 to 34 GHz	1.7	1.5	1.7
34 to 40 GHz	1.8	1.7	1.8
40 to 50 GHz	3.0	2.6	3.0

Attenuation Temperature Coefficient: Less than 0.0001 dB/dB/°C

Power Sensitivity: 0.001 dB/Watt

RF Input Power (Maximum): 1 Watt average, 50 Watts peak (10 microseconds max. pulse width)

Life (Minimum): 2 million cycles per section

Repeatability: 0.03 dB, typical

Environmental Capabilities: (Up to 2 million cycles)

Temperature, Operating: -20°C to +75°C

Temperature, Non-operating: -55°C to +85°C

Altitude, Operating: 4,570 meters (15,000 feet)

Altitude, Non-operating: 137,000 meters (50,000 feet)

Humidity: Cycling 10 days, 65°C at 95% RH

Shock, Operating: 10 Gs, 6 ms, on six sides, three blows

Shock, Non-operating: 500 Gs, 0.5 ms, in six directions

Vibration, Operating: 5 Gs, 34 – 500 Hz; 2 Gs, 500 – 2000Hz

EMC: Radiated interference is within the requirements of MIL-STD-461 method RE02, VDE 0871 and CISPR Publication II

Mechanical Information**Net Weight**

84904M: 291 grams (10.3 oz)

84905M: 229 grams (8.1 oz)

84908M: 291 grams (10.3 oz)

Mounting Position (any)**RF Connectors**

2.4 mm female connectors (Option 101)

2.4 mm female and 2.4 mm male (Option 100)

Switching Speed

Maximum 20 milliseconds including settling time

Solenoids	Coil Voltage	Switching Current	Nominal Coil Impedance
Option 024	24 V (20 to 30 V)	125 mA (at 24 V)	185 Ohms
Option 015	15 V (13 to 22 V)	188 mA (at 15 V)	80 Ohms
Option 011	5 V (4.5 to 7 V)	325 mA (at 5 V)	17 Ohms

Switching current is current per section; approximately 10 ms duration before internal contacts open the coil circuit

Key LiteratureFor more information, visit our web site: <http://www.agilent.com/find/mta>**Ordering Information****Attenuators**

84904K 0 to 11 dB, 1 dB steps, 26.5 GHz

84904L 0 to 11 dB, 1 dB steps, 40 GHz

84904M 0 to 11 dB, 1 dB steps, 50 GHz

84905M 0 to 60 dB, 10 dB steps, 50 GHz

84908M 0 to 65 dB, 5 dB steps, 50 GHz

84906K 0 to 90 dB, 10 dB steps, 26.5 GHz

84906L 0 to 90 dB, 10 dB steps, 40 GHz

84907K 0 to 70 dB, 10 dB steps, 26.5 GHz

84907L 0 to 70 dB, 10 dB steps, 40 GHz

84907L-006 Female 2.92-mm Connectors (L models only)

84907L-011 5 Vdc Supply Voltage

84907L-015 15 Vdc Supply Voltage

84907L-024 24 Vdc Supply Voltage

84907L-100 Male 2.4-mm Connector (L models only)

84907L-104 Male 3.5-mm Connector (K models only)

84907L-106 Male 2.92-mm Connector (L models only)

84907L-UK6 Commercial Calibration Test Data with Certificate

84904K

84906K

84907K

84904L

84906L

84907L

84904M

84905M

84908M

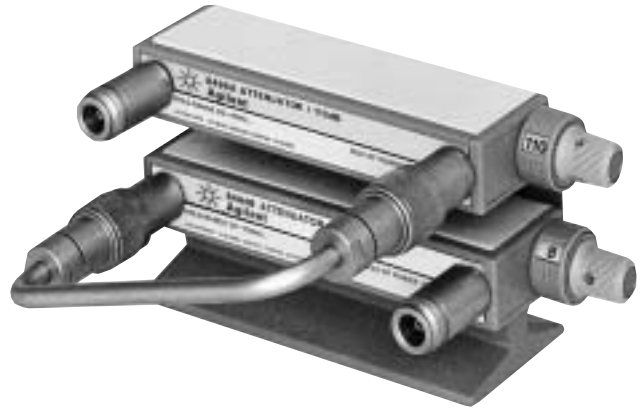
355 Series
8494
8495
8496
8497 Series
11716
Series



8495D



8495K



11716A

Programmable and Manual Step Attenuators DC – 1000 MHz

Manual

355C (0 – 12 dB, 1 dB steps)
355D (0 – 120 dB, 10 dB steps)

Programmable

355E (0 – 12 dB, 1 dB steps)
355F (0 – 120 dB, 10 dB steps)

The manual and programmable 355 C/D/E/F attenuators offer exceptional attenuation accuracy to 1 GHz; +0.1 dB to 1 kHz, 0.25 dB to 500 MHz, 0.35 to 1 GHz. They feature BNC (f) RF connectors, with optional type-N (Option 001) and TNC (Option 005) also available. To achieve 1 dB steps to 132 dB range, serially connect two attenuators using a standard UG-491A/U BNC (m)-to-BNC (m) adapter. Programmable 355 E/F models feature a 7-pin connector (supplied). To protect your transistor driver against transients during the switching cycle, order Option 007 to install a protective diode between each solenoid and driver.

Programmable and Manual Step Attenuators DC – 26.5 GHz

8494A/B/G/H (0 – 11 dB, 1 dB steps)
8495A/B/D/G/H/K (0 – 70 dB, 10 dB steps)
8496A/B/G/H (0 – 110 dB, 10 dB steps)
8497K (0 – 90 dB, 10 dB steps)

The 8494/95/96/97 family of step attenuators offer fast, precise signal level control in three frequency ranges, dc to 4 GHz, dc to 18 GHz and dc to 26.5 GHz. They feature exceptional repeatability and reliability in a wide range of frequency, attenuation and connector options.

Attenuation repeatability is specified to be less than 0.03 dB (0.05 dB, 18 – 26.5 GHz) for 5 million cycles per section. This assures low measurement uncertainty and high user confidence when designed into automatic test systems. Electromechanical step attenuators offer low SWR, low insertion loss and high accuracy required by high-performance test and measurement equipment.

Precision plated leaf-spring contacts remove attenuator sections (miniature tantalum nitride thin-film T-pads on sapphire and alumina substrates) from the signal path. Unique process controls and material selection ensure unmatched life and contact repeatability.

Programmable Models

Miniature drive solenoids in the programmable models keep switching time, including settling, down to less than 20 milliseconds. Once switched, strong permanent magnets hold the solenoids (and attenuation value) in place. Current interrupts automatically disconnect solenoid current, simplifying driver circuit design and minimizing heat dissipation. Programming is done through a 12-pin Viking socket or optional ribbon cables with DIP plugs.

To simplify connecting programmable attenuators to the drive circuit, each unit is supplied with a 5-ft. cable assembly. With an 11713A attenuator driver, 87130A attenuator driver, or an 70611A driver for MMS-based systems, automatic drive control is easy using the Agilent Technologies Interface Bus (GPIB) automated system.

11716A/C Attenuator Interconnect Kits

Quickly and conveniently connect 1 dB step and 10 dB step attenuators together to achieve greater dynamic range with 1 dB steps. The 11716A/C interconnect kits contain a rigid RF cable, mounting bracket, and necessary hardware to connect any pair of 8494/95/96/97 attenuators in series (see photo above). Attenuators must be ordered separately.

Key Literature

Latest RF & Microwave Test Accessories Catalog, p/n 5968-4314E

For more information, visit our web site: <http://www.agilent.com/find/mta>

Ordering Information

11716A Interconnect Kit (Type-N)
11716C Interconnect Kit (SMA)

355 Series, 8494/5/6/7 Series Specifications

355 Series
8494
8495
8496
8497

Model (Switching Mode)	Frequency Range (GHz)	Attenuation Range (dB)	Maximum SWR	Insertion Loss @ 0 dB	Attenuation Accuracy	Power Rating, Minimum Life	Solenoid Voltage Speed Power	Size, Shipping Weight	Connector Options
355C (Manual)	dc to 1	0 to 12 1 dB steps	1.2 to 250 MHz 1.3 to 500 MHz 1.5 to 1 GHz	0.2 dB + 2.3 dB/GHz	±0.1 dB @ 1000 Hz ±0.25 dB: dc to 0.5 GHz ±0.35 dB: dc to 1.0 GHz	0.5 W avg. 350 W peak 0.5 million cycles per section	— 15 to 18 V <65 ms 3.0 W	70 mm W x 67 mm H x 152 mm D (2.75 in x 2.6 in x 6 in) 1.4 kg (3 lb)	001 005 101 See Note 1
355E (Programmable)									
355D (Manual)	dc to 1	0 to 120 10 dB steps	1.2 to 0.25 GHz 1.3 to 0.5 GHz 1.5 to 1 GHz	0.2 dB + 2.3 dB/GHz	±0.3 dB @ 1000 Hz ±1.5 dB to 90 dB, and ±3 dB to 120 dB @ 1 GHz	0.5 W avg. 350 W peak 0.5 million cycles per section	— 15 to 18 V <65 ms 3.0 W	70 mm W x 67 mm H x 152 mm D (2.75 in x 2.6 in x 6 in) 1.4 kg (3 lb)	001 002 See Note 1
355F (Programmable)									
8494A (Manual)	dc to 4	0 to 11 1 dB steps	1.5	0.6 dB + 0.09 dB/GHz	±0.2 dB: 1 to 2 dB ±0.3 dB: 3 to 6 dB ±0.4 dB: 7 to 10 dB ±0.5 dB: 11 dB	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8494G (Programmable)									
8494B (Manual)	dc to 18	0 to 11 1 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	dc to 12.4 GHz ±0.3 dB: 1 to 2 dB ±0.4 dB: 3 to 4 dB ±0.5 dB: 5 to 6 dB ±0.6 dB: 7 to 10 dB ±0.7 dB: 11 dB dc to 18 GHz ±0.7 dB: 1 to 5 dB ±0.8 dB: 6 to 9 dB ±0.9 dB: 10 to 11 dB	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8494H (Programmable)									
8495A (Manual)	dc to 4	0 to 70 10 dB steps	1.35	0.4 dB + 0.07 dB/GHz	±1.7 dB of setting or 0.4 dB, whichever is greater	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8495G (Programmable)									
8495B (Manual)	dc to 18	0 to 70 10 dB steps	1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	0.4 dB + 0.07 dB/GHz	±3dB: dc to 12.4 GHz ±4dB: dc to 18 GHz	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 130 mm D (2.9 in x 1.7 in x 5.1 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 141 mm D (3.1 in x 1.7 in x 5.5 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8495H (Programmable)									
8495D (Manual)	dc to 26.5	0 to 70 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18.0 GHz 1.8 to 26.5 GHz	0.5 dB + 0.13 dB/GHz	±0.3 dB at 6 GHz 10 dB attenuation to ±2.8 dB at 26.5 GHz 70 dB attenuation	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	52 mm W x 43 mm H x 159 mm D (2.1 in x 1.7 in x 6.2 in) 0.9 kg (2 lb) 52 mm W x 43 mm H x 168 mm D (2.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	004 3.5 mm See Note 2
8495K (Programmable)									
8496A (Manual)	dc to 4	0 to 110 10 dB steps	1.5	0.6 dB + 0.09 dB/GHz	±1.8 dB of setting	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8496G (Programmable)									
8496B (Manual)	dc to 18	0 to 110 10 dB steps	1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	0.6 dB + 0.09 dB/GHz	±3 dB: dc to 12.4 GHz ±4 dB: dc to 18 GHz	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	— 20 to 30 V <20 ms 2.7 W	73 mm W x 43 mm H x 159 mm D (2.9 in x 1.7 in x 6.2 in) 0.9 kg (2 lb) 79 mm W x 43 mm H x 168 mm D (3.1 in x 1.7 in x 6.6 in) 0.9 kg (2 lb)	001 002 003 See Note 2
8496H (Programmable)									
8497K (Programmable)	dc to 26.5	0 to 90 10 dB steps	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18.0 GHz 1.8 to 26.5 GHz	0.4 dB + 0.09 dB/GHz	±0.3 dB at 6 GHz 10 dB attenuation to ±2.8 dB at 26.5 GHz 90 dB attenuation	1 W avg. 100 W peak 10 µs max. 5 million cycles per section	5 V or 24 V	52 mm W x 43 mm H x 143 mm D (2.1 in x 1.7 in x 5.6 in) 0.9 kg (2 lb)	004 3.5 mm See Note 2

5

How to Order the 8494/5/6/7 Series Attenuators

Each order must include basic model number, suffix letter, and connector option.

Ordering example: 8494 A Option 001

4	A	001
4 (1 dB step, 11 dB max)	A (Manual, dc to 4 GHz)	001 (N female)
5 (10 dB step, 70 dB max)	B (Manual, dc to 18 GHz)	002 (SMA female)
6 (10 dB step, 110 dB max)	D (Manual, dc to 26.5 GHz) ¹	003 (APC-7)
7 (10 dB step, 90 dB max)	G (Programmable, dc to 4 GHz)	004 (3.5 mm female) ¹
	H (Programmable, dc to 18 GHz)	
	K (Programmable, dc to 26.5 GHz) ¹	

¹ Option 004 is only available on D and K models, other options not available on D/K models.

Note 1: 355C/D/E/F connector options:

- Option 001 N(f)
- Option 005 TNC(f)
- Option 007 Transistor protection (355E/F only)
- Option 101 BNC (355C/E/F only)
- Option 002 BNC (355D only)
- Option 201 No protection

Note 2: 8494/5/6/7 orders must specify connector option. See ordering example.

- Option 001 N(f)
- Option 002 SMA(f)
- Option 003 APC-7
- Option 004 3.5 mm (8495D/K, 8497K only)
- Option UK6 Commercial Calibration Test Data with Certificate

8490D
8491 Series
8493 Series
8498A
11581A
11582A
11583A
11583C



8498A High Power Attenuator

The 8498A Option 030 is designed to meet the needs of high-power attenuation applications in the RF and microwave frequency range. It is a 25-watt average, 30 dB fixed attenuator with a frequency of dc to 18 GHz. The maximum peak power specification is 500 watts (dc to 5.8 GHz) and 125 watts (5.8 to 18 GHz). Available only in a 30 dB version, the unit offers a 1.3 SWR and ±1 dB accuracy at 18 GHz. Large heat-dissipating fins keep the unit cool even under continuous maximum input power conditions.

8491A/B, 8493A/B/C Fixed Attenuators

Agilent coaxial fixed attenuators provide precise attenuation, flat frequency response, and low SWR over broad frequency ranges. Attenuators are available in nominal attenuations of 3 dB and 6 dB, as well as 10 dB increments from 10 dB to 60 dB. These attenuators are swept-frequency tested to ensure they meet specifications at all frequencies. Calibration points are provided on a nameplate chart attached to each unit.

8490D 50-GHz Fixed Attenuator

Agilent coaxial fixed attenuators have been the standard for accurate flat response and low SWR. The 8490D offers exceptional performance to 50 GHz using the 2.4-mm connector. Attenuation values available are 3, 6, 10, 20, 30 and 40 dB. Ideally suited for extending the range of sensitive power meters, or for use as calibration standards, these broadband attenuators are manufactured with the same meticulous care as their lower frequency counterparts.

8490D, 8491A/B/C, 8492A, 8493A/B/C, 8498A, Specifications

Model	Frequency Range (GHz)	SWR (max.)	Input Power (max.)	Attenuation Accuracy (+dB)										Connectors
				3 dB Opt 003	6 dB Opt 006	10 dB Opt 010	20 dB Opt 020	30 dB Opt 030	40 dB Opt 040	50 dB Opt 050	60 dB Opt 060			
8490D	dc to 50	dc to 26.5 GHz: 1.15 (1.08 Opt 040 only) 26.5 to 40 GHz: 1.25 (1.15 Opt 040 only) 40 to 50 GHz: 1.45 (1.25 Opt 040 only)	2 W avg. 100 W peak	dc to 26.5 26.5 to 50	+0.9 -0.5 +1.8 -0.5	+0.9 -0.6 +1.8 -0.6	+0.9 -0.6 +1.3 -0.6	+1.3 -0.8 +1.7 -0.8	+1.3 -0.8 +1.7 -0.8	+2.5 -1.8 +2.5 -1.8				2.4 mm
8491A 3 to 30 dB 40 to 60 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	1.5	1.5	2		N (m,f)
8491B 3 to 30 dB 40 to 60 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak		0.3	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	1.5	1.5	2		N (m,f)
8493A 3 to 20 dB 30 dB	dc to 12.4	1.2 to 8 GHz 1.3 to 12.4 GHz	2 W avg. 100 W peak		0.3	0.3	0.5	0.5	1.0	—	—	—		SMA (m,f)
8493B 3 to 20 dB 30 dB	dc to 18	1.2 to 8 GHz 1.3 to 12.4 GHz 1.5 to 18 GHz	2 W avg. 100 W peak		+0.3 dB	0.3 to 12.4 GHz 0.4 to 18 GHz	0.6	0.6 to 12.4 GHz 1.0 to 18 GHz	1.0	—	—	—		SMA (m,f)
8493C 3 to 30 dB 40 dB	dc to 26.5	1.1 to 8 GHz 1.15 to 12.4 GHz 1.25 to 26.5 GHz	2 W avg. 100 W peak		0.5 to 18 GHz 1.0 to 26.5 GHz	0.6	0.3	0.5	0.7	1.0	—	—		3.5 mm (m,f)
8498A 30 dB	dc to 18	1.15 to 8 GHz 1.25 to 12.4 GHz 1.30 to 18 GHz	25 W avg. 500 W peak (dc to 5.8 GHz) 125 W peak 500 W/ms max. per pulse (5.8 to 18 GHz)		—	—	—	—	1.0	—	—	—		N (m,f)

Models	Options UK6
8491A, 8491B, 8492A, 8493A, 8493B, 8493C, 8498A	Opt UK6-Commercial Calibration Test Data with Certificate

11581A, 11582A, 11583C Attenuator Sets

A set of four Agilent attenuators – 3, 6, 10, and 20 dB – are furnished in a handsome walnut accessory case. The 11581A set consists of 8491A attenuators; the 11582A set, 8491B attenuators; 8492A attenuators; and the 11583C set, 8493C attenuators. These sets are ideal for calibration labs or where precise knowledge of attenuation and SWR is desired. Also includes commercial calibration certificate with test data.

Key Literature

For more information, visit our web site: <http://www.agilent.com/find/mta>

Ordering Information

11581A 3, 6, 10, 20 dB 8491A Set
11582A 3, 6, 10, 20 dB 8491B Set
11583C 3, 6, 10, 20 dB 8493C Set



8474 Series



8471D/E



83036C

Low-Barrier Schottky Diode Detectors

423B, 8470B, 8472B, 8473B/C

These Low-Barrier Schottky Diode (LBSD) detectors have been widely used for many years in a variety of applications including leveling and power sensing. They offer good performance and ruggedness. Matched pairs (Option 001) offer very good detector tracking. A video load option (Option 002) extends the square-law region to at least 0.1 mW (-10 dBm).

Planar-Doped Barrier Detectors

8471D/E

The 8471D/E are economy detectors based on the Planar-Doped Barrier (PDB) diodes. The PDB diodes give them superior frequency response, square-law response, and temperature performance. The 8471D has a BNC (m) input connector and a frequency range of 100 kHz to 2 GHz, making it ideal for use in RF and low microwave applications. The 8471E has a SMA (m) input connector and a SMC (m) output connector. Its frequency range is 10 MHz to 12 GHz. Both models come with a negative polarity output, option 301; a positive polarity output can be specified as Option 103.

8473D

The 8473D detector was the first gallium arsenide PDB diode introduced. It features broadband performance and excellent flatness vs. frequency, along with superior temperature stability. The 8473D is available with a 3.5-mm (m) RF connector and a BNC (f) output connector.

High-Performance Planar-Doped Barrier Detectors

8474B/C/E

Utilizing a gallium arsenide PDB diode as the detecting element, these detectors offer superior performance when compared to earlier detector designs. They feature extremely flat frequency response over their entire band of operation (typically better than ± 1 dB to 50 GHz) and very good frequency response stability versus temperature. For applications where broadband frequency coverage is not required, octave band options are available in specific bands.

The 8474 detectors are available with BNC(f) (0.01 to 18 GHz), Type N (0.01 to 18 GHz), 3.5 mm (mates with SMA, 0.01 to 33 GHz), or 2.4 mm (0.01 to 50 GHz) connectors. These detectors are offered with options for optimal square-law loads (Option 102) and for positive polarity output (Option 103). Because the unit-to-unit frequency response tracking of these devices is typically better than ± 0.3 dB, no matched response option is offered.

Broadband Directional Detector

83036C

The 83036C is a broadband microwave power sampler that operates in much the same way as a directional coupler and detector combination. It is composed of a resistive bridge and PDB diode that yields a very broadband device with excellent frequency response, superior temperature response and square-law response characteristics. With a 10 MHz to 26.5 GHz frequency range, a single 83036C can be used in many applications where two directional couplers and detectors were once required, such as in broadband power monitoring and source leveling.

The maximum SWR is 1.7 above 50 MHz on both the input and output ports. Directivity of 14 dB matches that of most miniature couplers currently available. The maximum insertion loss is 2.2 dB.

The 83036C has been used with great success as the sampling element for external leveling of broadband swept frequency sources. The extended frequency range increases the usable band from 100 MHz to 26 GHz, giving the user full use of the broadband source with external leveling. Other uses include the internal leveling element for sources, and forward/reverse power monitoring.

Key Literature

For more information, visit our web site: <http://www.agilent.com/find/mta>

Planar-Doped Barrier Diode Detectors Specifications

Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR	Low-level Sensitivity	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	102 Optimum Square-Law Load	Opt. 103/301 Positive Polarity Output	Input/Output Connector
8471D	0.0001 to 2	±0.2 to 1 GHz ±0.4 to 2 GHz	1.23 to 1 GHz 1.46 to 2 GHz	>0.5 mV/μW	100 mW	0.7 W	Opt. 102	Opt. 103 Opt. 301	BNC (m) BNC (f)
8471E	0.01 to 12	±0.23 to 4 GHz ±0.6 to 8 GHz ±0.85 to 12 GHz	1.2 to 4 GHz 1.7 to 8 GHz 2.4 to 12 GHz	>0.4 mV/μW	200 mW	0.75 W	No	Opt. 103 Opt. 301	SMA (m) SMC (m)
8473D	0.01 to 33	±0.25 to 14 GHz ±0.40 to 26.5 GHz ±1.25 to 33 GHz	1.2 to 14 GHz 1.36 to 26.5 GHz 2.96 to 33 GHz	>0.4 mV/μW	200 mW	1 W	Note 1	Opt. 003 Opt. 301	3.5 mm (m) BNC (f)
8474B ¹	0.01 to 18	±0.35 to 18 GHz	1.3 to 18 GHz	>0.4 mV/μW	200 mW	0.75 W	Note 1	Opt. 103 Opt. 301 Note 1	Type N (m) BNC (f)
8474C ¹	0.01 to 33	±0.45 to 26.5 GHz ±0.70 to 33 GHz	1.4 to 26.5 GHz 2.2 to 33 GHz	>0.4 mV/μW	200 mW	0.75 W	No	Opt. 103 Opt. 301 Note 1	3.5 mm (m) SMC (m)
8474E ¹	0.01 to 50	±0.4 to 26.5 GHz ±0.6 to 40 GHz ±1.0 to 50 GHz	1.2 to 26.5 GHz 1.6 to 40 GHz 2.8 to 50 GHz	>0.4 mV/μW	200 mW	0.75 W	No	No Note 1	2.4 mm (m) SMC (m)

¹ Octave band options available (see Data Sheet).

5

Broadband Directional Detector Specifications

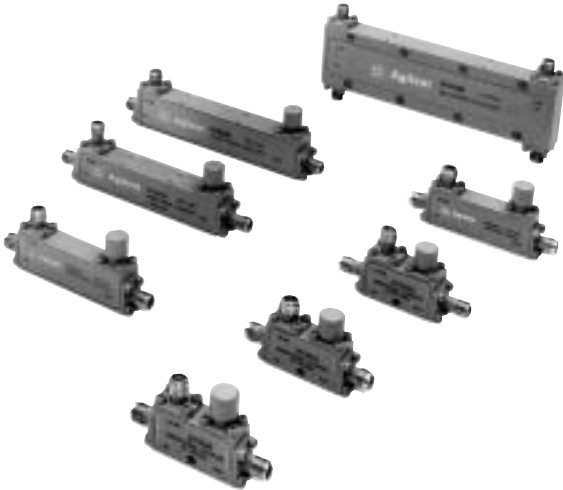
Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR Input/Output (50 Ω Nom.)	Max. Thru Line Loss (dB)	Low-level Sensitivity	Min. Directivity (dB)	Max. Input (Into 50 Ω Load) w/ 2:1 Source Match	Max. Input (Into Open) w/ 2:1 Source Match	Input/Output Connector
83036C	0.01 to 26.5	±1.0	1.7	2.2	18 mV/μW	14	32 dBm	21 dBm	3.5 mm (f)

Low-Barrier Schottky Diode Detectors Specifications

Model	Freq. Range (GHz)	Freq. Response (dB)	Max. SWR (50 Ω Nom.)	Low-level Sensitivity (mV/μW)	Max. Input (Peak or Average)	Short-term Max. Input (<1 min.)	Matched Response Opt. 001	Optimum Square-law Load ¹	Positive Polarity Output	Input/Output Connector
423B	0.01 to 12.4	±0.3 to 12.4 GHz	1.15 to 4 GHz 1.3 to 12.4 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz	Opt. 002	Opt. 003	N (m) BNC (f)
8470B	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4 GHz 1.3 to 15 GHz 1.7 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	APC-7 BNC (f) N (m) BNC (f)
8472B	0.01 to 18	±0.3 to 12.4 GHz ±0.5 to 15 GHz ±0.6 to 18 GHz	1.15 to 4.5 GHz 1.35 to 7 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	SMA (m) BNC (f) SMA (m) OSSM (f)
8473B	0.01 to 18	±0.3 to 12.4 GHz ±0.6 to 18 GHz	1.2 to 4 GHz 1.5 to 18 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz	Opt. 002	Opt. 003	3.5 mm (m) BNC (f)
8473C	0.01 to 26.5	±0.3 to 12.4 GHz ±0.6 to 20 GHz ±1.5 to 26.5 GHz	1.2 to 4 GHz 1.5 to 18 GHz 2.2 to 26.5 GHz	>0.5	200 mW	1 W (typical)	±0.2 dB to 12.4 GHz ±0.3 to 18 GHz ±0.5 to 26.5 GHz	Opt. 002	Opt. 003	3.5 mm (m) BNC (f)

¹ Defined as ±0.5 from ideal square law response.

For more information, visit our web site: <http://www.agilent.com/find/mta>



87300B/C/D, 87301B/C/D, 87310B, 87301E



772D and 773D

770 Series
11691D
11692D
87300 Series

87300 Series Directional Couplers

This line of compact, broadband directional couplers is ideal for signal monitoring, or when combined with a coaxial detector, for signal leveling. Available in a variety of frequency ranges, they can be matched to specific applications. The Agilent 8474 series coaxial detectors are recommended if output detection is desired. The 87300B is supplied with SMA (f) connectors, the 87300C has 3.5-mm (f) connectors, and the 87301D has 2.4-mm (f) standard or optional 2.92-mm (f) connectors.

87310B Hybrid Coupler

87310B is a 3 dB hybrid coupler, intended for applications requiring a 90 degree phase difference between output ports. In that sense, it is different from typical power dividers and power splitters, which have matched signal phase at their output ports. The 87310B features SMA (f) connectors.

87300 Series Specifications

Model	Freq. Range (GHz)	Nominal Coupling & (dB) Variation	Directivity (dB)	Max. SWR	Insertion Loss (dB)
87300B	1 to 20	10 ± 0.5	16	1.35	<1.5
87300C	1 to 26.5	10 ± 1	>14 to 12.4 GHz >12 to 26.5 GHz	1.50	<1.2 to 12.4 <1.7 to 26.5
87300C Opt 020	1 to 26.5	20 ± 1	>14	1.4	<1.2
87300D	6 to 26.5	10 ± 0.5	>13	1.4	<1.3
87301B	10 to 46	10 ± 0.7	>10	1.8	<1.9
87301C	10 to 50	10 ± 0.7	>10	1.8	<1.9
87301D	1 to 40	13 ± 1	>14 to 20 >10 to 40	1.5 to 20 1.7 to 40	<1.2 to 20 <1.9 to 40
87310B	1 to 18	3 ± 0.5	—	1.35	<2.0
87301E	2 to 50	10 ± 1	>13 to 26.5 >10 to 50	1.5 to 26.5 1.8 to 50	<2.0

773D Directional Coupler and 772D Dual-Directional Coupler

The 772D and 773D are high-performance couplers designed for broadband swept measurements in the 2 to 18 GHz range. The 773D is ideal for leveling broadband sources when used with an 8474B detector. (See also the 83036C directional detector.) For reflectometer applications, the 772D is the best coupler to use with power sensors and power meters (such as the 438A dual power meter). Forward and reverse power measurements on transmitters, components or other broadband systems are made simpler using the 772D. The broadband design allows the use of a single test setup and calibration for tests spanning the entire 2 to 18 GHz frequency range.

775D to 779D Dual-Directional Couplers

The economical 775D-778D couplers cover octave frequency spreads of more than 2:1, each centered on one of the important VHF/UHF bands. With their high directivity and mean coupling accuracy of ±0.5 dB, these are ideal couplers in reflectometer applications. The close tracking of the auxiliary arms makes these couplers particularly useful for reflectometers. Power ratings are 50 W average, 500 W peak.

772-779D, 11691D, 11692D Specifications

Model	Freq. Range (GHz)	Nominal Coupling (dB)	Max. Coupling Variation (dB)	Min. Directivity (dB)	SWR Primary Line Max. (50 Ω Nom.)
772D	2 to 18	20	±0.9	2 to 12.4: 30 12.4 to 18: 27	2 to 12.4: 1.3 12.4 to 18: 1.4
773D	2 to 18	20	±0.9	2 to 12.4: 30 12.4 to 18: 27	1.3 1.4
775D ¹	0.45 to 0.94	20	±1	40	1.15
776D ¹	0.94 to 1.9	20	±1	40	1.15
777D	1.9 to 4	20	±0.4	30	1.2
778D	0.1 to 2	20	±1.5	0.1 to 1 GHz: 36 ² 1 to 2 GHz: 32 ²	1.1
779D	1.7 to 12.4	20	±0.75	1.7 to 4 GHz: 30 4 to 12.4 GHz: 26	1.2
11691D	2 to 18	20	±1.0	2 to 8 GHz: 30 ³ 8 to 18 GHz: 26 ³	1.3 1.4
11692D	2 to 18	20	±1 incident to test port	2 to 8 GHz: 30 ³ 8 to 18 GHz: 26 ³	2 to 12.4 GHz: 1.3 12.4 to 18 GHz: 1.4

¹Maximum auxiliary arm tracking: 0.3 dB for 776D; 0.5 dB for 777D

²30 dB, 0.1 to 2 GHz, input port

³24 dB with Type-N connector on the test port (11692D) or on the input port (11691D)

87302C, 87303C, and 87304C Hybrid Power Dividers

The 87302C, 87303C, and 87304C power dividers are compact, hybrid microwave couplers designed for power splitting applications that require minimal insertion loss and high isolation.

The 87302C covers the entire 0.5 to 26.5 GHz frequency range with a maximum insertion loss of 1.9 dB. The 87303C and 87304C cover the frequency range of 1 to 26.5 GHz and 2 to 26.5 GHz with an even lower insertion loss of 1.6 dB and 1.4 dB, respectively. These hybrid power dividers are excellent for any application requiring low loss power division. They typically exhibit an insertion loss that is 1 to 2 dB lower than an equivalent resistive power divider.

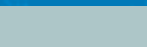
Model	Freq. Range (GHz)	Band Segments	Insertion Loss (dB)	Isolation (dB)
87302C	0.5 to 26.5	0.5 to 18 GHz 18 to 26 GHz	1.5 1.9	19 19
87303C	1.0 to 26.5	1.0 to 18 GHz 18 to 26.5 GHz	1.2 1.6	19 21
87304C	2.0 to 26.5	2.0 to 18 GHz 18 to 26.5 GHz	1.1 1.4	19 18

Power Rating: 10 W, CW (2:1 maximum SWR)

Connectors: 3.5 mm (f), SMA compatible

6 Digital Design and Test

288 Debug, Verification & Characterization



Digital Design and Test 290

Characterization Tools &
Solutions 307

Verification Tools & Solutions 309

16700 Series
1680 Series
1670 Series
1690 Series
E9340A

- Handle the most complex multibus, multiprocessor architectures
- Configure for individual or team needs
- Intuitive single window operation
- Straightforward triggering capabilities help easily identify problems

Fast, Accurate Answers Throughout the Design Validation Cycle

Agilent's logic analyzers help minimize your project risk by providing the most reliable, accurate data capture and the most complete view of system behavior. A comprehensive family of products offers a variety of form factors, acquisitions speeds, memory depths, channel counts and application-specific analysis and protocol tools to create a solution that will meet your toughest digital-debug needs.



16700 Series, 1680 Series, 1670 Series, 1690 Series, E9340A

Selection Guide for Logic Analysis Solution

	Modular Systems		Standalone Logic Analyzers		PC-Hosted Logic Analyzers	
	16700 Series		1680 Series	1670 Series	1690 Series	E9340A
Form Factor	Modular systems offer the most measurement flexibility and highest performance. Either built-in color touch screen (12.1 inch) or external monitor		Fixed configuration offers a small footprint, mobility, with a built-in color display		Fixed configuration, compact size, hosted by a desktop or laptop PC at an affordable price	
Typical Applications (includes but is not limited to)	<ul style="list-style-type: none"> • Multiple processor/bus analysis analysis • Timing and state analysis • Single-ended and differential signal acquisition • Inverse assembly and source code correlation • System performance analysis • Signal integrity validation • Stimulus and analog parametric measurement • Application-specific protocol tools 		<ul style="list-style-type: none"> • Single processor/bus analysis • Timing and state analysis • Single-ended signals • Inverse assembly 	<ul style="list-style-type: none"> • Single processor/bus analysis • Timing and state analysis • Single-ended signals • Inverse assembly • Optional stimulus or analog parametric measurement 	<ul style="list-style-type: none"> • Single processor/bus analysis • Timing and state analysis • Single-ended signals • Inverse assembly 	<ul style="list-style-type: none"> • Single processor/bus analysis • Timing and state analysis • Single-ended signals
Maximum High-Speed Timing	4 GHz timing at 64 K depth		N/A	N/A	N/A	N/A
Maximum State Clock	1.5 Gb/s		200 MHz	150 MHz	200 MHz	100 MHz
Maximum Timing Sampling Rate	1.2 GHz		800 MHz	500 MHz	800 MHz	250 MHz
Maximum Channels	8,160 (68 and 102 channel modules)		136/102/68/34	136/102/68/34	136/102/68/34	34
Maximum Memory Depth	128 M		4 M	4 M	4 M	128 K
Additional Considerations	Probes and accessories, wide variety of processor, bus and FPGA solutions, emulation probes, E5904B trace port analyzers, 54620 and 54640 Series MSOs (mixed signal oscilloscopes) with 16-channels of timing analysis					

- Configure a basic or multi-frame system suited to your needs
- Protect your investment with a system that adapts to multiple, current and future projects
- View cross-domain measurements, correlated in time
- Easily master powerful logic-analysis capabilities with 16702B touch-screen interface

Power and Flexibility to Provide the Most Complete View of System Behavior

Agilent Technologies modular logic analysis systems provide the ultimate power and flexibility to match your digital system debug needs. The comprehensive family of modules includes a full line of timing/state analyzers as well as oscilloscopes and pattern generators. Select the measurement modules and probing and analysis options suited to your application and configure a solution that provides a complete view of your system behavior and solves your debug and validation needs quickly and efficiently.

16700B
16701B
16702B



Selection Guide for Agilent Modular Logic Analysis Systems

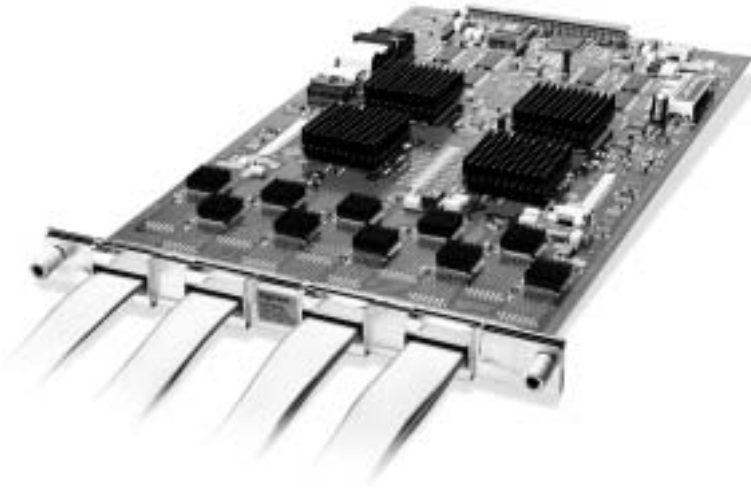
	16702B Modular System	16700B Modular System	16701B Expansion Frame for Modular Systems
Interface Control	Touch screen, knobs, and dedicated hot keys (mouse, keyboard also provided)	Mouse, keyboard	N/A
Number of Slots	5 measurement, 1 emulation/multiframe	5 measurement, 1 emulation/multiframe	5 measurement, 2 emulation
Measurement Capability	Timing and state analysis, pattern generation, oscilloscope, emulation		
Display Type(s) and Resolution	Internal: Color touch screen, 12.1 inch, 800 x 600 External: Supports resolutions up to 1600 x 1200 with option 003	Requires external display. Supports up to 1280 x 1024 standard, 1600 x 1200 requires option 003	N/A
Data Viewing Types	Waveform, listing, histogram, chart, compare – standard eye diagrams – module specific Optional: source code, protocol decode, serial analysis, system performance analysis (SPA)		N/A
Connectivity	<ul style="list-style-type: none"> • Time-correlate logic analyzer trace to external 6 GHz Infiniium 54855 oscilloscope trace. Automated de-skew and tracking of markers • Offline analysis • Remote programmability via Microsoft Active X/COM for PCs and TCP/IP socket based ASCII commands for UNIX • Web enabled for remote access of the analyzer from a web browser • E-mail on trigger • Individual user logins for network security • File transfer and storage via mapped shares or mounted drives (Windows and UNIX) 		N/A

1671xA
1674xA
1675xA
1675xB
16760A

- Choose from a wide variety of timing/state analysis, oscilloscope, or pattern generator modules
- Acquire state analysis up to 1.5 Gb/s, 4-GHz timing zoom, memory depths up to 128 M samples
- Capture LVDS and other differential signals

Configure Custom Measurement Solutions for Demanding Applications

Agilent Technologies offers a wide variety of timing and state analysis modules that provide the speed and memory depth to isolate and analyze your debug problems. Create a custom solution or expand your existing analysis system by selecting the timing/state analyzer, pattern generator, or oscilloscope modules that meet your debug and validation needs.

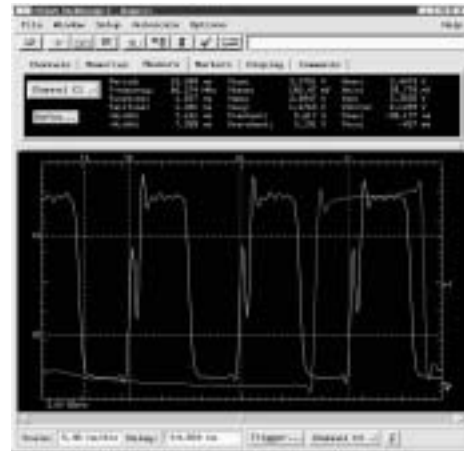
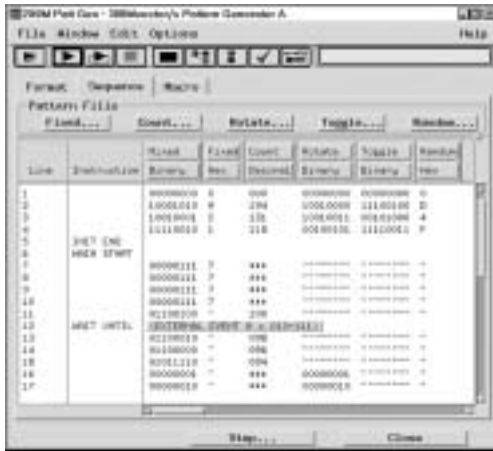


6

Selection Guide for Agilent State and Timing Logic Analysis Modules

	16710A/11A/12A	16715A/16A/17A	16740A/41A/42A	16750B/51B/52B	16753A/54A/55A/56A	16760A
Channels per module/max Channels on Single Timebase and Trigger	102/204	68/340	68/340	68/340	68/340	34/170
Supported Signal Types	Single-ended	Single-ended	Single-ended	Single-ended	Single-ended Differential	Single-ended Differential
Maximum State Clock	100 MHz	16715A/16A:167 MHz 16717A: 333 MHz	200 MHz	400 MHz	600 MHz	800 MHz
Maximum State Data Rate	100 Mb/s	16715A/16A:167 Mb/s 16717A: 333 Mb/s	200 Mb/s	400 Mb/s	600 Mb/s	1.5 Gb/s
Maximum Timing Sampling Rate (half/full channels)	500 MHz (2 ns)/ 250 MHz (4 ns)	667 MHz (1.5 ns)/ 333 MHz (3 ns) 16715A: N/A	800 MHz (1.25 ns)/ 400 MHz (2.5 ns)	800 MHz (1.25 ns)/ 400 MHz (2.5 ns)	1.2 GHz (833 ps)/ 600 MHz (1.67 ns)	800 MHz (1.25 ns)
High-Speed Timing Zoom (all channels, all the time, simultaneous with state through same probe)	N/A	16716A/17A: 2 GHz (500 ps) with 16 K depth	2 GHz (500 ps) with 16 K depth	2 GHz (500 ps) with 16 K depth	4 GHz (250 ps) with 64 K depth	N/A
Maximum Transitional Timing Rate	125 MHz	333 MHz	400 MHz	400 MHz	600 MHz	N/A
Maximum Memory Depth (half/full channels)¹	16710A: 16 K/8 K 16711A: 64 K/32 K 16712A: 256 K/128 K	16715A: 4 M/2 M 16716A: 1 M/512 K 16717A: 4 M/2 M	16740A: 2 M/1 M 16741A: 8 M/4 M 16742A: 32 M/16 M	16750B: 8 M/4 M 16751B: 32 M/16 M 16752B: 64 M/32 M	16753A: 2 M/1 M 16754A: 8 M/4 M 16755A: 32 M/16 M 16756A: 128 M/64 M	128 M/64 M ²
Eye Scan	N/A	N/A	N/A	N/A	Yes	Yes
Setup/Hold Window (with eye finder) Adjustment Resolution	4.0 ns (eye finder N/A) 500 ps	1.25 ns 100 ps	1.25 ns 100 ps	1.25 ns 100 ps	1 ns, 600 ps typical 80 ps typical	500 ps 10 ps

¹ Increased memory depth in half-channel timing mode only.
² 128 M in half-channel 1.25 Gb/s and 1.5 Gb/s modes only.



16720A
16534A
54800 Series

Agilent 16720A Pattern Generator Module

	Half Channels	Full Channels
Maximum Clock Speed	300 MHz	180 MHz
Memory Depth	16 M vectors	8 M vectors
Channels per Module	24	48
Maximum Number of Channels per Timebase	120	240
Stimulus Commands	Initialize, block, repeat, and break macros	
Logic Levels Supported	5 V TTL, 3 state TTL, 3 state CMOS, 3 state 3.3 V, ECL, 5 V PECL, 3.3 V LVPECL, 3 state 2.5 V, 3 state 1.8 V, LVDS	
Ordering Information	Order at least one clock pod for each module used as a master and at least one data pod for every 8 output channels	

Pod Options for 16720A

- Option 011 TTL clock pod & lead set
- Option 013 3 state TTL/CMOS data pod & lead set
- Option 014 TTL data pod & lead set
- Option 015 2.5 V clock pod & lead set
- Option 016 2.5 V 3 state data pod & lead set
- Option 017 3.3 V clock pod & lead set
- Option 018 3.3 V 3 state data pod & lead set
- Option 021 ECL clock pod & lead set
- Option 022 ECL (terminated) data pod & lead set
- Option 023 ECL (unterminated) data pod & lead set
- Option 031 5 V PECL clock pod & lead set
- Option 032 5 V PECL data pod & lead set
- Option 033 3.3 V LVPECL clock pod & lead set
- Option 034 3.3 V LVPECL data pod & lead set
- Option 041 1.8 V clock pod & lead set
- Option 042 1.8 V 3 state data pod & lead set
- Option 051 LVDS clock pod & lead set
- Option 052 LVDS data pod & lead set

High-performance Digitizing Oscilloscope

	16534A	54800 Series Infinium with E5850A Time Correlation Fixture
Oscilloscope Type	Internal Module	External
Maximum Bandwidth	500 MHz	6 GHz
Maximum Sampling Rate	2 GSa/s	20 GSa/s
Maximum Memory Depth	32 K	32 M
Channels per Oscilloscope	2	2 and 4
Maximum Number of Channels on a Single Timebase and Trigger	8	4

B4600B
B4601B
B4605B
B4620B

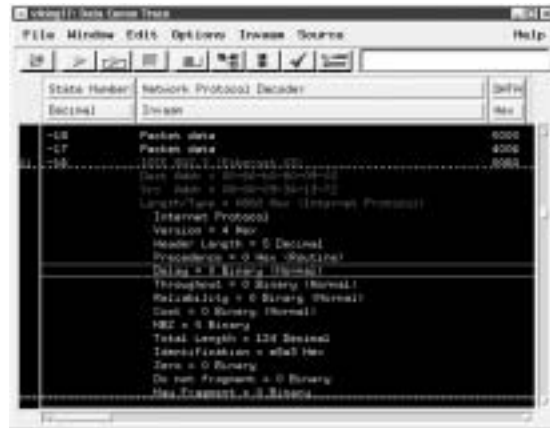
- Rapidly consolidate large amounts of data into displays that provide insight into your system's behavior
- Correlate a logic analyzer trace with the high-level source code that produced it
- Profile your target system's performance to identify the system bottlenecks and isolate areas needing optimization



Quickly Extract Valuable Information from your Trace Data

	B4600B System Performance Analysis Tool	B4601B Serial Analysis Tool	B4605B Tool Development Kit	B4620B Source Correlation Tool
Application	Optimizing target system performance	Solving serial communication problems	Customizing the trace display	Debugging real-time code at the source level
Tool Capabilities	<ul style="list-style-type: none"> • Generates statistical bar chart and histograms of the captured data • Shows amount of time spent in each targeted function or data location 	<ul style="list-style-type: none"> • Converts serial bit streams to parallel format for easy viewing and analysis • Supports serial data and protocols that use bit stuffing to maintain clock synchronization 	<ul style="list-style-type: none"> • Creates custom tools to analyze data using C programming language • Color-code specific states in a trace 	<ul style="list-style-type: none"> • Correlates the logic analyzer trace with the high-level source code that produced it • Provides ability to define the capture event by simply clicking on a line of source code

- Display logic-analyzer trace information at the protocol level
- Easily trigger on standard or custom protocol fields with powerful trigger macros
- Quickly debug systems with new interconnect standards, such as PCI-Express, RapidIO, and Serial ATA



- N4206A
- N421xA
- N4220A
- B4640B
- B4645B

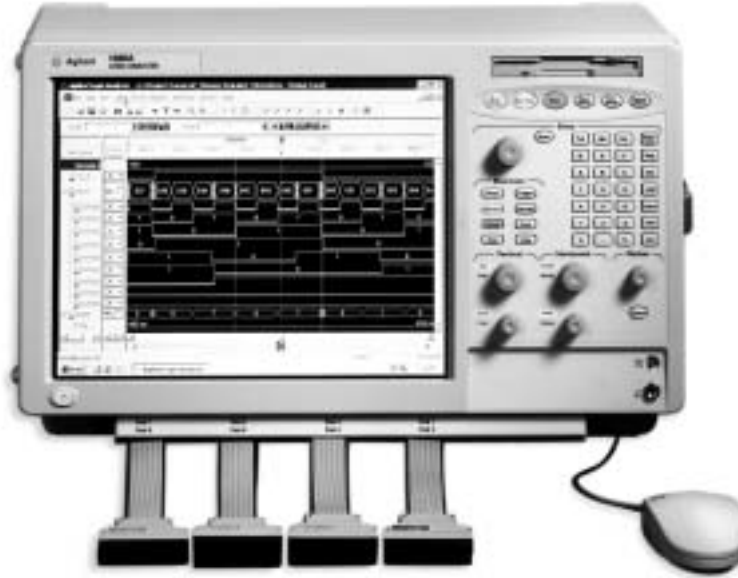
Speed up Debug by Triggering On and Viewing Protocol Data in a Standardized Form

Model Number and Description	N4220A PCI-Express Packet Analysis Probe	N4219A Serial ATA Packet Analysis Probe	N4217A InfiniBand Analysis Probe for InfiniBand 4x or 1x	N4215A Rapid IO Protocol Analysis Tool Set	N4214A POSPHY L4 (SPI-4.2) Protocol Analysis Tool Set	N4212A Gigabit Ethernet Protocol Analysis Tool Set	N4206A Protocol Analysis for InfiniBand 1x, 4x, 12x	B4645B MPEG-2 Protocol Analysis Tool Set	B4640B Data Communi- cations Tool Set
Bus/Protocol Support	PCI Express V1.0, updated as spec evolves	SATA-I and ATAPI, OOB signaling (real time) to 1.5 GHz	InfiniBand x1, x4 links up to 2.5 GHz	Rapid IO (8 and 16 bit parallel)	POS PHY L4 (PPP, ATM, Ethernet)	TBI (Gbit Ethernet)	InfiniBand x1, x4 and x12	MPEG-2	Utopia L1-3 (ATM), POSPHY L1-3 (PPP), MII/GMII (Ethernet), FlexBus
Packet Trigger	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
Additional Capabilities	Real time 8 B/10 B, disparity error. Data descrambling	CRC/Disparity checking, data descrambling, 10 B capture mode	VCRC/ICRC check, real 8 B/10 B, disparity error	CRC/Control word checking, Real-time Idle filter	Real-time Idle filter	Packet CRC check, 8 B/10 B disparity check	VCRC, ICRC, 8 B/10 B, disparity error	Packet length check, packet CRC check	—

- Meet your application and budget needs by selecting from a variety of configurations that range from 34 to 136 channels
- Capture your signal in real time with 800-MHz timing analysis and 200-MHz state analysis
- Gain broader insight into system behavior with up to 4 M deep memory
- Save time using the familiar Windows interface with efficient single-screen operation (1680 series)

Faster Insight with Intuitive Logic Analysis

Agilent Technologies' standalone logic analyzers offer reliability and accuracy comparable to our modular logic analysis systems. They are fixed configurations with small footprints and excellent price for performance. These products are ideally suited for individuals and teams working on hardware/software debug, parametric and mixed-signal testing and complex debugging with deep memory. A robust product line enables you to select the model that meets your needs and fits your budget.



Selection Guide for Agilent Standalone Logic Analyzers

	1680A/1680AD	1681A/1681AD	1682A/1682AD	1683A/1683AD	1670G	1671G	1672G	1673G
Channels	136	102	68	34	136	102	68	34
Maximum State Clock	200 MHz				150 MHz			
Maximum State Data Rate	200 Mb/s				150 Mb/s			
Maximum Timing Sampling Rate (half/full channels)	800 MHz (1.25 ns)/400 MHz (2.5 ns)				500 MHz (2 ns)/250 MHz (4 ns)			
Maximum Transitional Timing Rate	200 MHz				N/A			
Maximum Memory Depth (*full/half channels)	168xA series: State –256 K, Timing* –1 M/512 K, Transitional –1 M 168xAD series: State –1 M, Timing* –4 M/2 M, Transitional –1 M				128 K/64 K – standard* 512 K/256 K – option 001* 4 M/2 M – option 002*			
Setup/Hold Time	2.5 ns window adjustable from 4.5/–2 ns to –2.0/4.5 ns in 100 ps increments per channel				3.5/0 ns to 0/3.5 ns adjustable in 500 ps increments			
Triggering	Up to 16 sequence levels with 16 patterns terms, 15 range terms				Up to 12 sequence levels with 10 patterns terms, 2 range terms			
I/O and Storage	2 IEEE 1394 ports, 10/100 Base-T, parallel port, 20 GB hard disk, 1.44 MB flexible disk drive, 24 x CD-Rom drive, DIN mouse and keyboard ports, external SVGA display ports, Trigger In & Trigger Out BNCs				Ethernet LAN, GPIB, Parallel and RS-232 ports, 2 GB hard disk, 1.44 MB flexible disk drive, DIN mouse and keyboard ports, Trigger In & Trigger Out BNCs			
Input Resistance	100 kΩ, ±2%				100 kΩ, ±2%			
Parasitic Tip Capacitance	1.5 pF				1.5 pF			
Display	12.1" (diagonal) color flat panel				8.4" (diagonal) color flat panel			
Additional Capabilities	Time-correlation to external 54800 Series Infiniium oscilloscope, email on trigger, offline analysis, remote programmatic control via COM				2 channel, 500 MHz integrated oscilloscope (option 003) OR 32 channel, 100/200 MHz, 256 K deep integrated Pattern Generator (option 004), remote programmability			

- Achieve complete mobility with the compact size and a connection to a laptop PC
- Capture your signals in real time with 800-MHz timing analysis and 200-MHz state analysis
- Meet your application and budget needs by selecting from a variety of configurations that range from 34 to 136 channels
- Gain broader insight into system behavior with up to 4 M deep memory
- Stay within your budget by controlling the logic analyzer with a connection to your existing PC

Intuitive Usability and Ultimate Portability at a Breakthrough Price

Agilent Technologies' PC-hosted logic analyzers have fixed configurations with small footprints and the best price for performance in the industry. They also offer superb reliability and accuracy. Their compact size and ability to connect to a laptop PC makes them an ideal solution for use at remote sites. They're also ideal for individuals and teams working on hardware/software debug, parametric and mixed-signal testing and complex debugging with deep memory.

1690A/
1690AD
1691A/
1691AD
1692A/
1692AD
1693A/
1693AD
E9340A/
LOGICWAVE



Selection Guide for Agilent PC-Hosted Logic Analyzers

	1690A/1690AD	1691A/1691AD	1692A/1692AD	1693A/1693AD	E9340A/LOGICWAVE
Channels	136	102	68	34	34
Maximum State Clock	200 MHz				100 MHz
Maximum State Data Rate	200 Mb/s				100 Mb/s
Maximum Timing Sampling Rate (half/full channels)	800 MHz (1.25 ns)/400 MHz (2.5 ns)				250 MHz (4 ns)
Maximum Transitional Timing	200 MHz				N/A
Maximum Memory Depth (*full/half channels)	169xA series: State –256 K, Timing* –1 M/512 K, Transitional –1 M 169xAD series: State –1 M, Timing* –4 M/2 M, Transitional –1 M				128 K
Setup/Hold Time	2.5 ns window adjustable from 4.5/–2 ns to –2.0/4.5 ns in 100 ps increments per channel				4.0/0 ns fixed
Triggering	Up to 16 sequence levels with 16 pattern terms, 15 range terms				Up to 3 sequence levels “what you draw is what you capture” visual timing trigger events
I/O Ports	IEEE 1394 port, includes desktop IEEE 1394m PCI card & cable, laptop IEEE 1394 cable and accessory pouch, Trigger In/Out BNCs				Enhanced Parallel, Trigger In/Out BNCs
User Interface	Window 2000 on Pentium or better PC				Window 95/NT/2000 on Pentium or better PC
Probing	100 kΩ, ±2%, 1.5 pF				100 kΩ, ±2%, 1.5 pF
Additional Capabilities	Time-correlation to external 54800 Series Infiniium oscilloscope, email on trigger, offline analysis, remote programmatic control via COM				N/A

- Quickly and reliably connect to your device under test
- Get control over your microprocessor's internal and external data
- Select from comprehensive coverage of industry-standard processors and buses
- Display process mnemonics or bus cycle decode



Save Time Analyzing your Unique Design with a Turnkey Logic Analyzer Setup

Agilent Technologies and our partners provide an extensive range of quality tools that offer non-intrusive, full-speed, real-time analysis and processor execution control to accelerate your debugging process.

Agilent and Third-Party Bus/Protocol Support

AGP2X, AGP4X, AGP8X
 CAN
 CSIX
 DDR, DDR166, DDR233
 Fibre Channel
 Firewire (IEEE 1394)
 Gigabit Ethernet (TBI)
 GMII, Hyper Transport, I²C
 InfiniBand x1, x4, x12, ISA, JTAG (IEEE 1149.1, 1149.5), MPEG-2,
 PC 100/133
 ISA, JTAG (IEEE 1149.1, 1149.5), MPEG-2, PC 100/133, PCI CardBus,
 PCI-EIO
 PCI-Express, PCI Mezzanine, PCI/EXT-32/64, POS-PHY, RAMBUS,
 RapidIO, RS-232, RS-449, SCSI, Ultra SCSI, SCSI LVD, Serial ATA,
 SIMM, DIMM
 SPI-9.2
 USB 1.1, USB 2.0, Utopia, VME 64
 VXI

6

Agilent and Third-Party Processor Support

Device Manufacturer /Architecture/Name	Emulation Probes	Emulation Modules	Trace Port Analyzers	Inverse Assembly/Probing Support
Actel				ACT 1280
Altera				EPM5192-P
AMD				29xxx, 186CC 186/188 EM/ES
Analog Devices				ADSP 21xx
ARM7/9TDMI	—	—		ARM7, ARM7-Thumb, ARM9, ARM9-Thumb
ARM7/9-ETM			—	
GTE				65816
IBM PPC 4xx	—	—	—	PowerPC 403/405/601/603/740/750/750Cxe
IBM PPC 6xx	—	—		
IBM PPC 7xx	—	—		
IDT				R3041/51/52/81/82, R4000, R4400 PC, R4600/4700, R4640/50, R5000, R32364, R36100, RC32332/4/55, RC64474/4574, RC64475/4575
Intel Pentium, Pentium w/MMX Intel Pentium Pro, II, III, & Celeron				8080, 8085, 8031/51, 8086/8, 80x86, 80200, 80860XR, 80960, Celeron Pentium, Pentium II, Pentium III, Pentium Pro, Pentium II Xeon, Pentium III Xeon, Pentium 4, Pentium 4 Xeon, Strong ARM-110, IXP1200
Motorola PPC 6xx	—	—		68000/08/10, 680x, 68HC11, 68HC12, 68020, 68030, 68040, 68060, 68340, 68302, PowerPC 555/565, 601/603, MPC740/745/750/755, MPC 7400/10/40/50, MPC 801/823/850/855/860/862, MPC 8240/55/60/64/65/66, 860 ESAR, M* CORE, DSP 56xxx, 88xxx
Motorola PPC 7xx	—	—		
Motorola MPC 8xx	—	—		
Motorola MPC 74xx	—	—		
Motorola MPC 82xx	—	—		
Motorola M CORE	—	—		
National				NS32016, HPC16003/4/64
NEC				7810/11, V25, V830, VR4100, VR4111, VR4200, VR4300, R5000, R5432, R5464
NKK				NR46xx, NR4700
PACE				P1750
Performance				R4000/4400PC
QED				5230/31, 5260/61, 5270/71, 7000
Rockwell				6502
Siemens				80C165/166/167, 80C5xx, R4000/4400PC
Texas Instruments				320Cxx, 320C20x, 320C24x, 34010, 370CXX, 320C62XX, 470R1X
TI OMAP			—	
Xilinx			—	XC4xxx
Zilog				Z80, Z180, Z8001/2

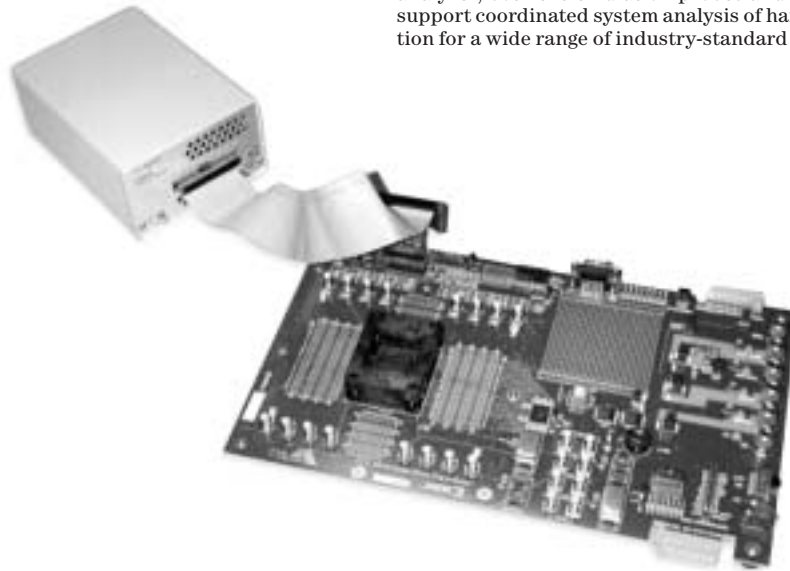
*For specific product configurations, please refer to the datasheet Processor and Bus Support for Agilent Technologies Logic Analyzers, p/n 5966-4365E.

- Control your processor with break, run, reset and single step capabilities
- Download code and modify register/memory values
- Perform efficient debug using a minimal amount of debug pins
- Trace analysis up to 200 MHz, integrated with industry-standard debuggers
- Couple your Xilinx Chip Scope ILA tools with deep external trace and advanced triggering tools

Add Processor Execution (run) Control and Real-Time Trace Capture to Best-in-Class Debuggers

Agilent Technologies' emulation probes utilize a processor's debug port to provide a convenient way to download code, modify memory and registers, and control program execution. Trace port analyzers provide real-time trace information in addition to the standard emulation functionality. When integrated with a 16700-series logic analyzer, both the emulation probes and trace port analyzers can support coordinated system analysis of hardware/software interaction for a wide range of industry-standard embedded processors.

E5900B
E5901B
E5904B



Selection Guide for Agilent Trace Port Analyzers and Emulation

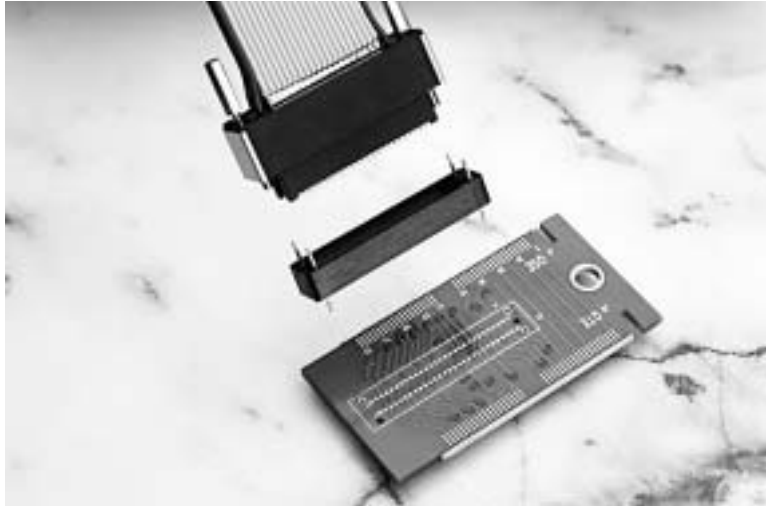
Processor Family	Emulation Probes	Emulation Modules	Trace Port Analyzers
	Link to the processor's debug port for a convenient way to download code, modify memory and registers, and control program execution	Add the same emulation capability of an emulation probe as part of an integrated solution built around your 16700 series logic analyzer	Provides emulation and real-time execution trace information; can be integrated with the 16700 series for coordinated system analysis
ARM 7,9 Thumb	E5900B-300	E5901B-300	
ARM 7,9 - ETME			E5904B-300
IBM PPC4xx: 401 (all), 403 (all), 405 (all), NPE405H, HPE405L, 440A4, 440GP	E5900B-060	E5901B-060	E5904B-060
IBM PPC6xx: 603, 603e – rev 1, 3, 4, 5, 603ev – rev 2, 12, 603e2, 603P, 603ec, 603R	E5900B-060	E5901B-060	
IBM PPC7xx: 740, 740P, 750, 750CSe, 750CX, 750P, 750M	E5900B-070	E5901B-070	
MIPS: MIPS32-4Kc, MIPS32-4Km, MIPS32-4Kp, MIPS64-5Kc	E5900B-200	E5901B-200	
Motorola MPC6xx: 603, 603e – rev 1, 3, 4, 5, 603ev – rev 2, 12, 603e2, 603P, 603ec, 603R	E5900B-060	E5901B-060	
Motorola MPC7xx: 740, 740P, 750, 750CXe, 750CX, 750P, 750M, 755	E5900B-070	E5901B-070	
Motorola MPC74xx: 7441, 7451, 7455	E5900B-110	E5901B-110	
Motorola MPC8xx: 801, 821, 823, 850, 855, 857, 860, 862 families	E5900B-080	E5901B-080	
Motorola MPC82xx: 8240, 8241, 8245, 8250A, 8255, 8255A, 8260, 8260A, 8264A, 8265A, 8266A	E5900B-100	E5901B-100	
Motorola M-Core: M2107	E5900B-090	E5901B-090	
TI OMAP 1510			E5904B-310
Xilinx FPGA			E5904B-500

E5378A
E5379A
E5380A
E5381A
E5382A
E5387A
E5390A

- Easily connect with reliable, electrically and mechanically unobtrusive probing solutions
- Achieve low loading (0.7 pF), an easy connection and a small footprint with soft touch connectorless probes
- Save time making bus- and processor-specific measurements with application-specific analysis probes

Flexibility and Choice in Creating Quality Connections to your Target System

Probing is the key to effective and efficient use of logic analyzers. Agilent Technologies offers a wide variety of probing accessories that support general-purpose and application-specific measurement needs. We provide reliable, electrically and mechanically unobtrusive probes that make it easy to connect your Agilent logic analyzer to your system under test.



Selection Guide for Agilent Logic Analyzer Probing Solutions

	E5390A	E5387A	E5378A	E5379A	E5382A	E5381A	E5380A
Probe Type	Soft touch connectorless probe, High-density probe with isolation network located at probe tip		High-density probe with isolation network located at probe tip for 100-pin Samtec connectors		General purpose flying-lead set, Isolation network located at probe tip		High-density probe with isolation network located at probe tip for 38-pin Mictor connectors
Application	Quick connection to many channels in a small footprint		Quick connection to many channels in a small footprint		Flexible connection to individual signals		Quick connection to many channels in a small footprint
Used with...	Logic analyzers with 90-pin cable connectors: 16753/54/55/56A and 16760A						
Number of Channels	34 (32 data, 2 clock)	17 (16 data, 1 clock)	34 (32 data, 2 clock)	17 (16 data, 1 clock)	17 (16 data, 1 clock)	17 (16 data, 1 clock)	34 (32 data, 2 clock)
Supported Signal Types	Differential Clock Single-ended Data	Differential Clock Differential or Single-ended Data	Differential Clock Single-ended Data	Differential Clock Differential or Single-ended Data	Differential Clock Single-ended Data	Differential Clock Differential Data	Single-ended Clock Single-ended Data
Maximum Data Rate	>1.5 Gb/s		1.5 Gb/s		1.5 Gb/s		600 Mb/s
Minimum Signal Amplitude	250 mV p-p	$V_{max} - V_{min} \geq 200 \text{ mV}$	250 mV p-p	$V_{max} - V_{min} \geq 200 \text{ mV}$	200 mV p-p	$V_{max} - V_{min} \geq 200 \text{ mV}$	300 mV p-p
Connection to Target System	Requires soft touch footprint and retention module designed into target system ¹		Requires 100-pin Samtec footprint and connector designed into target system ¹		Work with a wide assortment of accessories to connect to individual leads		Requires 38-pin Mictor connector designed into target system ¹
Input Capacitance	0.7 pF	0.7 pF	1.5 pF	1.5 pF	1.3 pF	0.9 pF	3 pF

¹ For more information on specific solutions, refer to Probing Solutions for Agilent Logic Analyzers at p/n 5968-4632E.

- Completely characterize the single-ended, differential-mode, common-mode and mode-conversion behavior of your device
- Powerful signal-integrity analysis tools include time-domain reflectometry (TDR), time-domain transmission (TDT), frequency-domain and eye-diagram analysis
- RLCG parameter extraction allows creation of accurate transmission-line models for use in simulation programs such as HSPICE



Confidence Based on Accurate Model Extraction and Complete Characterization

The Agilent N1900A series physical-layer test system (PLTS) is the premier signal-integrity solution for designing and validating high-speed digital interconnects. PLTS combines frequency-domain, time-domain and eye-diagram analysis to provide a comprehensive view of device performance. Measurement-based model extraction provides the most accurate models of components, such as printed circuit boards, connectors, backplanes, IC packages, cables and flexible interconnects. Now you can validate interconnect performance of high-bit-rate standards, such as 40-Gb, 10-Gb, PCI Express, SATA, InfiniBand and LVDS.

The PLTS utilizes a four-port vector network analyzer system, an external PC and innovative software analysis tools. This enables the most accurate and comprehensive solution for complete characterization of your high-speed interconnects. With a single setup to your device under test (DUT), you can measure all transmission and reflection terms in both frequency and time domain in all possible modes of operation, including single-ended, differential, common and mixed modes.

N1930A
N1947A
N1948A
N1951A
N1953A
N1957A
N4430B

Selection Guide for Agilent N1900A Series Physical-Layer Test Systems

Product	N1957A	N1953A	N1951A	N1948A	N1947A	N1930A	N4430B
Description	E8364A PNA and N4421A Test Set 4-Port/ 4-Receiver	E8362A PNA and N4419A Test Set 4-Port/ 4-Receiver	E8720ES VNA and N4418A Test Set 4-Port/3 or 4-Receiver	E8358A PNA and N4417A Test Set 4-Port/ 4-Receiver	E8803A PNA and N4417A Test Set 4-Port/ 3-Receiver	Physical-layer test system software that controls the system and provides advanced data analysis tools	Fast, single-connection electronic SOLT calibration
Frequency Range	45 MHz to 50 GHz	45 MHz to 20 GHz	50 MHz to 20 GHz	300 kHz to 9 GHz	300 kHz to 9 GHz		30 kHz to 9 GHz
Rise Time	14 pS	35 pS	35 pS	80 pS	80 pS		

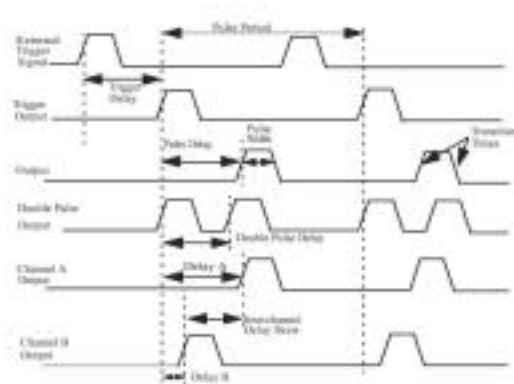
Leading pulse-, Clock and Data Signals for Everyday Testing in Digital Design and Manufacturing

A Pulse/Pattern Generator enables the easy generation of the digital pulse or data pattern that is required in everyday testing in digital design and manufacturing. It provides the flexibility and control over all relevant timing and level parameters.

The pulse generation capability is offered in each model of the Pulse/Pattern Generator family, covering a frequency range from 1 mHz up to 3.35 GHz and an output amplitude range from 50 mV up to 100 V.

The ability to create user defined bit pattern, standard compliant data and PRBS make the Agilent Pulse/Pattern Generators the ideal source for stimulated eye diagram measurement, cross-talk measurements, compliance tests or stress tests for receivers.

Whether your application calls for specific data patterns and packages, multi level patterns or standard compliant pseudo random data streams (PRBS) – the portfolio of Pulse/Pattern Generators provides the performance you need.



	8114A	8133A	81101A	81104A with 81105A	81110A with 81111A	81110A with 81112A	81130A with 81131A	81130A with 81132A	81133A	81134A	E8311A	E8312A
Variable Width	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Variable Delay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Remotely Programmable	GPIOB	GPIOB	GPIOB	GPIOB	GPIOB	GPIOB	GPIOB	GPIOB	GPIOB, LAN, USB	GPIOB, LAN, USB	GPIOB	GPIOB
Analogue Channel Add				✓	✓						✓	
Digital Channel Add							✓	✓				
Glitch-free Timing Changes (patented)			✓	✓	✓	✓			(✓)	(✓)	✓	✓
Multi Level Signals				✓	✓						✓	✓
Bursts	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Triggerable	✓		✓	✓	✓	✓					✓	✓
2 nd Channel can be Added		✓		✓	✓	✓	✓	✓		Incl.	Incl.	Incl.
Pattern Memory		32 bit		16 kbit/c hnl	16 kbit/c hnl	16 kbit/c hnl	64 kbit/c hnl	64 kbit/c hnl	8 kbit/c chnl	8 kbit/c chnl	16 kbit/c hnl	16 kbit/c hnl
PRBS (2 ⁿ - 1)		n = 23		n = 7, 8...14	n = 7, 8...14	n = 7, 8...14	n = 7, 8...15	n = 7, 8...15	n = 5, 6...32	n = 5, 6...32	n = 7, 8...14	n = 7, 8...14
Segment Looping Feature							4 segments; 1 looping level	1 segment; 1 looping level				
Multi Level Data Signals				✓	✓	✓			(✓)	(✓)	✓	
Differential Outputs		✓				✓	✓	✓	✓	✓		✓

The Agilent **81101A 50 MHz Pulse Generator** is the instrument of choice for cost efficient pulse and clock generation providing flexibility and full control over timing parameters.

- 1 channel
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 5 ns to 200 ns
- Internal and external clocking
- 1 mHz to 50 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs



Flexible pulse generation.....



The Agilent **81104A 80 MHz Pulse/Pattern Generator** provides the same pulse generation capability as the 81101A with an enhanced frequency range. Even greater flexibility is provided by the modular output channel concept: one or two **81105A output channels** can be configured in the 81104A mainframe. The instrument can be upgraded with the 2nd output channel later.

The 81104A also offers the feature to add the channels (analog channel add) for multi level signals. In addition to pulse generation, the 81104A also offer the capability to set up complex bit patterns, pseudo random binary sequences.

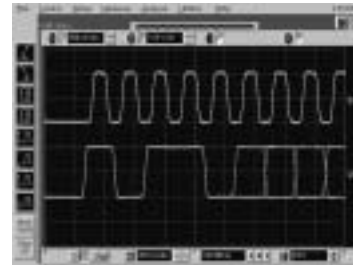
- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns to 200 ms
- Internal and external clocking
- 1 mHz to 80 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Complex data patterns
- Pseudo random data streams (PRBS)



Complex data patterns, multi level signals, variable transition times.....

The Agilent **81110A 165 MHz Pulse/Pattern Generator** with one or two **81111A output channels** provides the same features and functionality as the 81104A. with an enhanced frequency range up to 165 MHz.

- 1 or 2 channels
- Up to 20 Vpp (into 50 Ohm)
- Variable transition times between 3 ns to 200 ms
- Internal and external clocking
- 1 mHz to 80 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Single ended outputs
- Analog channel addition
- Complex data patterns
- Pseudo random data streams (PRBS)



The Agilent **81110A 330 MHz Pulse/Pattern Generator** with one or two **81112A output channels** provides similar features compared to the 81111A output channels.

The 81112A output channel provides an enhanced frequency range and differential outputs and faster fixed transition times.

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 mHz to 330 MHz repetition rate
- Glitch-free timing changes
- Triggerable or internal PLL
- Differential outputs
- Complex data patterns
- Pseudo random data streams (PRBS)



From the versatility of Agilent Technologies' 81110A comes the convenience of VXI with the E8311A and E8312A Pulse/Pattern Generators. These exercise the same specifications as the 81111A and 81112A modules with the same programmability and pattern and data sequence capabilities in a *plug&play* VXI form (C-size, 1 slot) – compatibility that makes the transition from lab to production quick and simple.

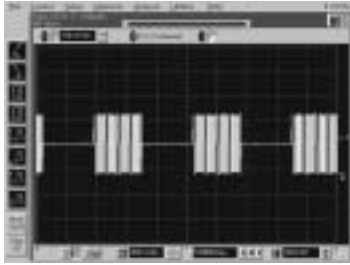
8114A
8133A
81101A
81104A with 81105A
81110A with 81111A
81110A with 81112A
81130A with 81131A
81130A with 81132A
81133A
81134A
E8311A
E8312A

8114A
8133A
81101A
81104A with
81105A
81110A with
81111A
81110A with
81112A
81130A with
81131A
81130A with
81132A
81133A
81134A
E8311A
E8312A



The Agilent **81130A 400 MHz Pulse/Pattern Generator** with one or two **81131A output channels** satisfies higher timing and precision demands. In addition enhanced data generation and pattern segment looping features are provided.

- 1 or 2 channels
- Up to 3.8 Vpp (into 50 Ohm)
- Selectable transition times 800 ps or 1.6 ns
- Internal and external clocking
- 1 kHz to 400 MHz repetition rate
- Precision timing
- Single ended outputs
- EXOR channel addition
- Complex data patterns and pattern segment looping
- Pseudo random data streams (PRBS)



For eye diagram measurements or receiver response tests data packets for testing high speed bus standard like USB 2.0, PCI Express, SATA can be set up with the pattern editor, segment looping features and hardware generated PRBS.



The Agilent **81130A 660 MHz Pulse/Pattern Generator** with one or two **81132A output channels** provides similar features compared to the 81131A output channels providing an enhanced frequency range.

- 1 or 2 channels
- Up to 2.5 Vpp (into 50 Ohm)
- Fixed transition times 500 ps typ.
- Internal and external clocking
- 1 kHz to 660 MHz repetition rate
- Precision timing
- Differential outputs
- EXOR channel addition
- Complex data patterns and pattern segment looping e.g. for USB 2.0 pre-compliance testing
- Pseudo random data streams (PRBS)

81133A and 81134A 3.35 GHz Pulse/Pattern Generators

When timing is crucial and high performance is required, the Agilent Technologies' 81133A and 81134A provide the fast rise times and low jitter that are required for in depth analyzes and performance characterizations of your devices.

Data Patterns can easily be set up or pre-defined and hardware generated pseudo random data streams (PRBS) can be selected.

- 1 channel (81133A) or 2 channels (81134A)
- 50 mV up to 2 Vpp amplitude (into 50 Ohm)
- <90 ps transition times (adjustable between 70 ps – 120 ps typ.)
- 15 MHz to 3.35 GHz repetition rate
- 1.5 ps typ. RMS jitter
- Differential Outputs
- Complex data patterns e.g. for PCI Express, SATA
- Pseudo random data streams (PRBS)



The ability to add a desired amount of jitter to your pulse, clock and data signals also enables you to perform stress tests and jitter tolerance tests.

- Delay Modulation: -250 ps to 250 ps (up to 500 ps total jitter)
- Modulation Frequency: 0 – 200 MHz
- Additional variable crossover between 30% – 70% typ.



Perform stress tests by modifying the amount and shape of jitter by using the Delay Control Input.



8114A 100 V 2 A Pulse Generator

For tests on devices that require higher voltages or currents, Agilent Technologies' 8114A is the alternative that can offer the following:

- 1 channel
- Up to 100 Vpp (into 50 Ohm) or 2 A
- Clean, reliable pulses with variable pulse width and 7 ns transition time
- External Synchronization and gating
- 15 MHz repetition rate and a counted burst mode
- Load compensation
- Optional variable pulse baseline (25 V)
- Device protection to avoid accidental damage

8133A 3 GHz Timing Generator

For applications that require highest timing precision the 8133A provides clock and pulse signals with typical RMS jitter of less than 1 ps.

- 1 or 2 channels
- Up to 3 Vpp (into 50 Ohm)
- 1 ps typ RMS jitter
- 3 GHz repetition rate

- 8114A
- 8133A
- 81101A
- 81104A with 81105A
- 81110A with 81111A
- 81110A with 81112A
- 81130A with 81131A
- 81130A with 81132A
- 81133A
- 81134A
- E8311A
- E8312A

Key Specifications of All Models at a Glance

Mainframes	E8311A	E8312A	8133A	8114A	81101A	81104A	81110A	81130A	81133A	81134A	
Channel Model	N/A	N/A	0 pt. 001, 002, 003 or 004	N/A	N/A	81105A	81111A	81112A	81131A	81132A	N/A
Nr. of Channels	2 single ended	2 differential	1 or 2 differential	1 single ended	1 single ended	1 or 2 single ended	1 or 2 single ended	1 or 2 differential	1 or 2 differential	1 differential	2 differential
Frequency Range	1 MHz – 330 MHz	1 MHz – 330 MHz	33 MHz – 3 GHz	1 Hz – 15 MHz	1 MHz – 50 MHz	1 MHz – 80 MHz	1 MHz – 165 MHz	1 MHz – 330 MHz	1 kHz – 400 MHz	1 kHz – 660 MHz	15 MHz – 3.35 GHz
Data Pattern	16 kbit/channel user defined; PRBS 2 ⁿ – 1, n = 7, 8, ... 14 RZ, NRZ, DNRZ		(4)	N/A	N/A	16 kbit/channel user defined; PRBS 2 ⁿ – 1, n = 7, 8, ... 14 RZ, NRZ, DNRZ		65504 bit/channel user defined; PRBS 2 ⁿ – 1, n = 7, 8, ... 15 RZ, NRZ, DNRZ		8 kbit/channel user defined; PRBS 2 ⁿ – 1, n = 5, 6, 7, ... 15, 23, 31 RZ, NRZ, DNRZ, R1	
Variable Delay Range	0.00 ns to 999.5 s		(5)	0.00 ns to 999 ms	0.00 ns – 999.5 s	0.00 ns to 999.5 s	0.00 ns to 999.5 s	0.00 ns to 3.00 μs		–5 ns to 230 ns	
Period RMS-Jitter	0.001% + 15 ps ³		<5 ps (<1 ps typ.)	0.03% + 25 ps ²	0.01% + 15 ps ³	0.01% + 15 ps ³	0.001% + 15 ps ³	0.001% + 15 ps		<4 ps (1.5 ps typ)	
Amplitude Range	100 mV to 20.0 V ¹	100 mV to 3.8 V	300 mV to 3.0 V	1.00 V to 100 V ¹	100 mV to 20.0 V ¹	100 mV to 20.0 V ¹	100 mV to 20.0 V ¹	100 mV to 3.8 V	100 mV to 3.8 V	100 mV to 2.5 V	50 mV to 2.0 V
Transition Time Range (10/90)	2.00 ns to 200 ms	800 ps or 1.6 ns selectable	<100 ps fixed (<60 ps typ.)	<7ns fixed	5.00 ns to 200 ms	3.00 ns to 200 ms	2.00 ns to 200 ms	800 ps or 1.6 ns selectable	800 ps or 1.6 ns selectable	500 ps typ. fixed	<90 ps fixed (in normal mode). Three settings for 60 pss – 70 ps, 70 pss – 80 ps and 80 ps – 120 ps typ.

¹Depends on selected source impedance (all other values apply for 50 Ω source impedance into 50 Ω load).

²0.05% + 25 ps in the 50 ns to 100 ns range.

³0.01% + 15 ps without internal PLL as clock source.

⁴Option 002 adds a 2nd channel providing 32 bit memory pattern and PRBS of 2ⁿ – 1.

⁵Please refer to detailed product information 5980-1414E.

Transition-Time Converters

These converters have been designed to convert the transition times of instruments with fixed, fast transition times, to slower, fixed transition-times (150 ps, 250 ps, 500 ps, 1 ns, 2 ns); hence reducing the signal bandwidth. All transition-times are between 10% and 90% of amplitude. Typical Characteristics:

- Converter models: 15435A, 15432B, 15433B, 15434B, 15438A
- Output Transition Time 150 ps, 250 ps, 500 ps, 1000 ps, 2000 ps
- 3 dB point 2.1 GHz, 1.3 GHz, 640 MHz, 370 MHz, 190 MHz
- Input Voltage <10 Vp-p
- Insertion Loss <0.2 dB
- Overshoot and Ringing <3%

For Further Detailed Technical Information about Agilent's Pulse/Pattern Generators please Refer to the Following Literature:

- Agilent Technologies 81133A and 81134A 3.35 GHz Pulse/Pattern Generators 5988-5549EN
- Agilent Technologies 81100A Family of Pulse/Pattern Generators 5980-1215E
- Agilent Technologies 8133A 3 GHz Pulse Generators 5980-1214E
- Agilent Technologies 8114A 100 V 2A Pulse Generator 5980-1213E

Ordering Information

Main Products

Mainframe	Output Channels and Hardware Options	Description
81101A		50 MHz Pulse Generator
81104A	81105A (1 or 2)	80 MHz Pulse/Pattern Generator 80 MHz Output Channel for 81104A
81110A	81111A (1 or 2) 81112A (1 or 2)	165/330 MHz Pulse/Pattern Generator 165 MHz Output Channel for 81110A 330 MHz Output Channel for 81110A
81130A	81131A 81132A	400/660 MHz Pulse/Pattern Generator 400 MHz Output Channel for 81130A 660 MHz Output Channel for 81130A
81133A		3.35 GHz 1chnl Pulse/Pattern Generator
81134A		3.35 GHz 2chnl Pulse/Pattern Generator
8114A	8114A-001	15 MHz 100V Pulse Generator Variable Base Line
8133A	004 (standard instrument) 8133A-001 8133A-002 8133A-003	3 GHz Timing Generator Variable width AND delay for chnl 1 2 nd chnl Data 2 nd chnl Pulse
E8311A	(included)	165 MHz VXI Pulse/Pattern Generator
E8312A	(included)	330 MHz VXI Pulse/Pattern Generator

Options and Accessories

	81101A, 81104A and 81110A	81130A	81133A and 81134A	8114A	8133A	E8311A and E8312A
0B1 English Manual Set (standard with every order)	•	•	Incl.	•	•	Incl.
AB0 Taiwan – Chinese Quick Start Guide	•	•				
AB1 Korean Quick Start Guide	•	•				
AB2 Chinese Quick Start Guide	•	•				
ABD German Quick Start Guide					•	
ABE Spanish Quick Start Guide					•	
ABF French Quick Start Guide	•	•			•	
ABJ Japanese Quick Start Guide	•	•	Incl.	•	•	
ABZ Italian Quick Start Guide					•	
0B0 Do not include any manuals	•	•		•	•	
0BV Service Documentation, component level				•	•	
0BW Service Documentation, assembly level	•	•		•	•	
UK6 Commercial Cal Certificate with Test Data	•	•	•	•	•	•
1BP Mii std 45662A calibration w/test data				•	•	
1CM Rackmount kit	•	•		•	•	
1CN Handle Kit	•	•		•	•	
1CP Rackmount and Handle Kit	•	•	•	•	•	
1CR Rack Slide Kit	•	•	PN1494-0059	•		
UN2 Rear Panel Connectors	•			•		
Recommended cable kit (SMA)	15442A	15442A	N4871A	15442A	N4871A	15442A

- flexible real-time stimulus and response system
- modular, scalable BER test solution for parallel, serial and mixed applications from 1 kbit/s up to 2.7 Gbit/s
- PRBS, PRWS and user-defined data for stimulus and analysis
- PC-controlled system with powerful GUI and programming interface
- single-ended, low voltage and differential input and output signals for ECL, LVDS and PECL



The Agilent 81200 data generator/analyzer platform is the right choice for you if you are an engineer in R&D or manufacturing performing functional and parametric tests on digital subsystems, ICs, or boards.

The 81200 is a flexible and scalable platform offering up to 240 channels (at 333 Mbit/s) and a frequency range of 1 kbit/s to 2.7 Gbit/s. It is freely configurable to fit your application needs either as a stand alone data generator or a platform with any number of generator and analyzer channels. Alternatively, the modules can be integrated into other standard VXI test platform.

With up to 8 Mbit memory depth per channel and full control of the pulse parameters for each individual channel, you can really stress your DUT. The 81200 is the ideal tool throughout the design verification process from first turn-on through operational check and characterization of design margins, to detailed analysis of critical parts of your design.

Specifications

Selection Guide Table for the 81200 Data Generator/Analyzer Platform

Use the Agilent 81200's modularity to configure a solution that matches your needs and measurement task. The modularity means that you can meet your budget goals today, safe in the knowledge that when you need to grow, your test system can grow with you.

Description

E4849C: Mainframe
E4848B: Expander Frame

Key Features

E4849C: Embedded 2-slot VXI PC (option 012) or IEEE-1394 PC-link to VXI (option 013)
E4848B: 12 slots free

Required Clock Module

E4805B: Max frequency 2.7 GHz

Agilent 81200 Platform Data Generator Front-ends and Modules

Description

E4846A: Dual Channel Data Generator Front-end
E4838A: Data Generator Front-end
E4864A: Data Generator Front-end
E4862A: Data Generator Front-end

Key Features

E4846A: Low data-rates down to 1 kbit/s
E4838A: Differential output, variable transition time
E4864A: Increased memory (4 MBit)
E4862A: Deep memory (8 Mbit)

Maximum Data Rate

E4846A: 200 Mbit/s
E4838A: 675 Mbit/s
E4864A: 1.6 Gbit/s
E4862A: 2.7 Gbit/s

Data Format

E4846A: NRZ, DNRZ
E4838A: RZ, R1, NRZ, DNRZ
E4864A: NRZ, DNRZ
E4862A: NRZ, DNRZ

Transition Time

E4846A: 20 – 80% ECL: 1.2 ns typ.
E4838A: 10 – 90% ECL: 0.5 – 4.5 ns
E4864A: 20 – 80% ECL: 110 ps typ.
E4862A: 20 – 80% ECL: 110 ps typ.

Required Data Module

E4841A: Holds up to 4 front-ends
E4832A: Holds up to 4 front-ends
E4861A: Holds up to 2 front-ends

Data Pattern

- Segments: user-defined memory, Pause, PRBS/PRWS
- PRBS/PRWS: $2^n - 1$, $n = 7, 8, \dots, 15, 23, 31$
- Errored PRBS/PRWS
- 5 Loop levels
- Export/Import function

Agilent 81200 Platform Data Analyzer Front-ends and Modules

Description

E4847A: Dual Channel Data Analyzer Front-end
E4835A: Two Data Analyzer Front-ends
E4865A: Data Analyzer Front-end
E4863A: Data Analyzer Front-end

Key Features

E4847A: 2 single-ended inputs
E4835A: Single input per front-end, differential or single-ended
E4865A: Single input, differential or single-ended
E4863A: Single input, differential or single-ended

Maximum Data Rate

E4847A: 333 Mbit/s
E4835A: 675 Mbit/s
E4865A: 1.65 Gbit/s
E4863A: 2.7 Gbit/s

81200
E4849C
E4848B
E4805A
E4832A
E4841A
E4861A
E4838A
E4846A
E4862A
E4864A
E4835A
E4847A
E4863A
E4865A

81200
E4849C
E4848B
E4805A
E4832A

Typical Impedance
E4847A: 50 Ohm/10 kOhm
E4835A: 50 Ohm
E4865A: 50 Ohm
E4863A: 50 Ohm

E4841A
E4861A
E4838A
E4846A
E4862A
E4864A
E4835A
E4847A
E4863A
E4865A

Input Sensitivity
E4847A: 200 mV typ.
E4835A: Differential 50 mV typ., single-ended 100 mV typ.
E4865A: 50 mV typ.
E4863A: 50 mV typ.

Required Data Module
E4841A: Holds up to 4 front-ends
E4832A: Holds up to 4 front-ends
E4861A: Holds up to 2 front-ends

Accessories

See Ordering Information

Key Literature & Web Link

Agilent 81200 Data Generator/Analyzer Platform, data-sheet (5965-3415E)
Agilent 81200 Data Generator/Analyzer Platform, brochure (5980-0488E)
Agilent E4839A Test Fixture (5965-3417E)

www.agilent.com/find/81200_overview

Ordering Information

E4849C 81200 Data Generator and Analyzer – mainframe included
E4849C-ATO 81200 Data Generator and Analyzer – mainframe included
E4848B-ATO Expander frame for 81200
E4849C-002 MXI expander interface
E4849C-OC-CONTRL Controller
E4849C-013 IEEE 1394 PC link to VXI (Firewire)
E4803A-FG 2-slot embedded VXI-bus PC
E4805B-ATO 2.7 GHz Central Clock Module
E4805B-UK6 Commercial calibration certificate with test data
E4849C-OC-CHANL Data Generator-/Analyzer-Channels
E4849C-OC-200MB 1 kHz – 200 Mbit/s
E4846A-FG Dual 200 Mbit/s generator
E4847A-FG Dual 200 Msa/s analyzers
E4841A-ATO 200 MHz Generator/analyzer module
E4841A-UK6 Commercial calibration certificate with test data

E4849C-OC-675MB 1 kHz – 675 MHz
E4838A-FG 333kHz – 675 MHz Data Generator Front End
E4835A-FG Two 333 kHz – 675 MHz Data Analyzer Front Ends
E4832A-ATO 675 MHz Module for 4*E4838A, 2*E4835 or 2*E4838+1*E4835
E4832A-UK6 Commercial calibration certificate with test data
E4849C-OC-2XGB 334 MHz – 2.7 Gbit/s
E4862A-ATO 334 MHz – 2.7 Gbit/s Generator front end
E4862A-UK6 Commercial calibration certificate with test data
E4863A-ATO 334 MHz – 2.7 Gsa/s Analyzer front end
E4863A-UK6 Commercial calibration certificate with test data
E4861A-ATO 2.75 Gbit/s Module for 2 front ends
E4861A-UK6 Commercial calibration certificate with test data
E4865A-ATO 1.65 G Analyzer Front-end
E4865A-UK6 Commercial Calibration
E4864A-ATO 1.65 G Generator Front-end
E4864A-UK6 Commercial Calibration
81250A-152 Expander Frame with IEEE 1394 connection – for Firewire controller only
E4849C-OC-ACCESS Accessories
15433B-FG 500 ps transition converter
15434B-FG 1 NS transition converter
15438A-FG 2 NS transition converter
15440A-FG Adapter kit: 4* SMA(m) adapters
15441A-FG Cable kit 10* SMA(m) to SCL-connector
15442A-FG Cable kit 4* SMA(m) to SMA(m)
15443A-FG Matched cable pair
15444A-FG PC accessories (keyboard,mouse, 17' monitor)
15445A-FG External CD-ROM
15446A-FG 8-Line trigger input for TTL signals
15447A-FG Deskew probe
E4849C-AX4 Rack Flange Kit for one frame
E4849C-OC-TSTFXT Test Fixture
E4839A-ATO Test fixture for the 812XX family
15448A-FG Pogo cables kit: 4* SMA(m) and 2 Pogo adapter
15449A-FG DUT board 50 Ohm impedance
E4849C-OC-DOC Documentation
E4849C-OB1 Manual set
E4849C-OB0 Do not include Manual set
E4849C-OC-ADLDOC Additional Documentation
E4849C-ABJ Japanese manual
R-51B Return-to-Agilent warranty and service plan (months)
R1380A-101 Productivity assistance
E4849C-RMKT Agilent Refurbished Product

- Complete family of professional PCI/PCI-X system test equipment
- PCI/PCI-X test solutions for the entire design cycle
- 33/66 MHz PCI Exerciser and Analyzer
- 133 MHz PCI-X Exerciser and Analyzer (Mode 1 and Mode 2)
- Full 32/64 bit solutions including protocol check for 64-bit commands
- CompactPCI test solutions, including hot swap functionality



PCI Server during system validation with the Agilent E2928A

PCI/PCI-X Series Exerciser & Analyzer

The Agilent E2920 PCI/PCI-X Series of Verification Tools is a family of test tools designed to provide an early and extensive insight into PCI/PCI-X-based designs, revealing and solving design problems sooner throughout the entire development process, from initial bring-up of devices and systems, through to system validation.

The tools supplied with the E2920 PCI/PCI-X Series not only help you get your new designs to market faster, but also give you the confidence of knowing your product will perform in any conceivable situation.

For more information visit our web site:
www.agilent.com/find/pci_overview

Evaluate: Getting Your Design Off to a Good Start

In the early stages of your PCI/PCI-X based prototype evaluation, you need to analyze the behavior of your system, device or firmware and detect the cause of any errors or problems as early as possible during the bring-up and debugging. The PCI/PCI-X Analyzer features a PCI/PCI-X state logic analyzer, real-time protocol and timing checkers, real-time performance measures and a PCI/PCI-X optimized trigger, giving you a fast overview of your system status.

PCI/PCI-X bus traffic from the state waveform level up to data transfer level can be captured and analyzed, allowing the observation of traffic at a level meaningful to the problem. The identification and triggering of protocol violations is possible at any time.

For more information visit our web site:
www.agilent.com/find/pci_evaluate

Optimize: Overcoming the First Hurdles

Optimizing a PCI or PCI-X design means applying your expertise to the analysis of traffic and of bus performance and then applying what you find to help improve your devices. The PCI/PCI-X Performance Optimizer is a powerful tool, which provides you with an in-depth real-time and post processing performance analysis, giving hints for performance optimization. The PCI/PCI-X Exerciser plays an active role in the analysis of complex PCI/PCI-X scenarios by letting you set up worst case traffic patterns quickly and allowing errors to be easily reproduced for deeper investigation. Identifying bottlenecks and true performance potential helps you optimize your design.

For more information visit our web site:
www.agilent.com/find/pci_optimize

Validate: Ensuring Reliability in the Long Run

Validating your PCI/PCI-X device means ensuring its reliability in the long run. The E2920 PCI/PCI-X Series use the PCI/PCI-X bus as the “standard” interface to validate a system. Variable levels of background traffic can be generated and typical peripheral traffic patterns emulated to stress arbitration, memory controller, bridges and system interrupts. The System Validation Package (Opt 310) provides a set of tests for testing particular sub-systems. The C-Application Programming Interface (C-API) available with the Protocol Permutator and Randomizer (PPR)(Opt 320) enables full range testing. Automatic protocol permutations within user-defined constraints, enable optimum test coverage of PCI/PCI-X behavior of a device or system, in the minimum amount of time.

For more information visit our web site:
www.agilent.com/find/pci_validate

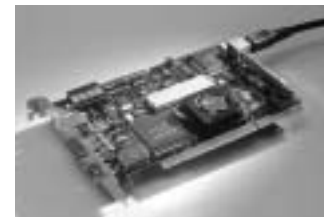
System Description

The PCI/PCI-X Exerciser and Analyzer is delivered as a single, short card, which requires plugging into the system that needs to be tested. Plugging other PCI/PCI-X devices into the system-under-test enables these devices to also be tested.

The E2920 PCI/PCI-X Exerciser and Analyzer can either be externally controlled by a RS-232, a 4 MB fast host interface, USB (E2929B), USB 2.0 (E2930A), or through the system-under-test via PCI/PCI-X.



Compact PCI Exerciser/Analyzer Card



PCI-X Exerciser/Analyzer Card

Key Literature

- E2930A Technical Specifications, p/n 5988-8678EN
- E2920 Verification Tools, PCI/PCI-X Series, Color Brochure, p/n 5968-9694E
- E2925B, E2926B, Technical Specifications, p/n 5968-3501E
- E2928A, Technical Specifications, p/n 5968-3506E
- E2922B, Technical Specifications, p/n 5968-9577E
- E2929B, Technical Specifications, p/n 5968-8984E
- E2940A, Technical Specifications, p/n 5968-1915E
- System Validation Package, Technical Overview, p/n 5968-3500E

For customer reference stories/application notes and latest ordering information, please visit our web site: www.agilent.com/find/pci_overview

Software/Graphical User Interfaces

The PCI/PCI-X Analyzer Graphical User Interface is a comprehensive Windows graphical user interface for the PCI/PCI-X exerciser and analyzer’s on-board logic analyzer. It allows the analysis of bus traffic quickly and easily:

- Easy setup of trigger sequences and storage qualification for the on-board PCI/PCI-X state logic analyzer
- Real-time PCI/PCI-X protocol checker
- State Waveform Lister displays waveform trace of all PCI/PCI-X signals, sideband I/O and internal bus state signals
- Bus Cycle Lister disassembles bus traffic at state level, with comprehensive error reporting including cross references to PCI/PCI-X specification
- Bus Transaction Lister summarizes bus transfer at address and data level

The PCI/PCI-X Exerciser Graphical User Interface (comes with #300) is a comprehensive Windows graphical user interface, which controls the PCI/PCI-X exerciser and analyzer’s programmable PCI/PCI-X master and target:

- Configuration Space Editor to set up the configuration space
- Master Transaction Editor to set up master transactions and protocol behavior and requester/completer for PCI-X
- Target Attribute Editor to set up protocol behavior for the target
- Data Memory Editor to view/modify the on-board memory content

E2925B
 E2928A
 E2929B
 E2940A
 E2930A

E2925B
E2928A
E2929B
E2940A
E2930A

PCI/PCI-X Exerciser and Analyzer Comparison Table

	E2940A	E2925B	E2928A	E2929B	E2930A
Data-Path Width	32/64 bit	32 bit	32/64 bit	32/64 bit	32/64 bit
Addressing	32/64 bit DAC	32 bit	32 bit/64 bit DAC	32 bit/64 bit DAC	32 bit/64 bit DAC
PCI Clock Range	0...66 MHz Analyzer 0...33 MHz Exerciser	0...33 MHz	0...66 MHz	0...133 MHz	0...133 MHz (200 MT/S)
State PCI Logic Analyzer Trace Memory	64 K on-board/ 4 M (E2995A)	64 K on board/ 4 M (E2995A)	64 K on board/ 4 M (E2995A)	#100, 2 M on board	4 M on board
Mechanical	Compact PCI card	PCI short card	PCI short card	PCI-X short card	PCI-X short card
Fast Back to Back (master)	Yes	Yes	No	N/A	N/A
Target Decode Speed	Fast/Medium/Slow	Fast/Medium/Slow	Fast ¹ /Medium/Slow	Fast/Medium/Slow	Fast/Medium/Slow
LOCK Control	Lock/Hide/Unlock	Lock/Hide/Unlock	No lock control	No lock control	No lock control
Programmable Clock Delay Between Transactions	0 to 2,000,000	0 to 2,000,000	0 to 2,000,000	1 to 65,536	1 to 65,536
Real-Time Counter Size	64 bit	64 bit	64 bit	64 bit	64 bit
Signal Levels	3.3/5 V	3.3/5 V	3.3/5 V	3.3 V	3.3/1.5 V
Temperature Range	-40°C to 70°C	-40°C to 70°C	-40°C to 70°C	-40°C to 70°C	0°C to 50°C
Trigger I/O	12	12	12	4	4
Data Memory	512 KB	512 KB	512 KB	1 MB	4 MB
Real-Time Checked Protocol Rules	53	53	53	53	over 64
Control Interfaces	RS 232, fast host interface, PCI	RS 232, fast host interface, PCI	RS 232, fast host interface, PCI	RS 232, fast host interface, USB, PCI-X	USB 2.0
PCI Compatibility	PCI 2.1	PCI 2.1	PCI 2.1	PCI-X 1.0	PCI-X 2.0

¹ Fast, decode speed up to 66 MHz.

6

The **PCI/PCI-X Performance Optimizer** (comes with #200) is a comprehensive Windows graphical user interface using the exerciser and analyzer capabilities to help engineers optimize performance (not available for the E2930A). It features:

- Performance analysis with real-time counters and in-depth post processing
- Hierarchical data representation for fast problem detection and in-depth root cause analysis with report generation
- Numerable ready-to-go tests: data transfer rate, data efficiency, bus usage, retry rate

The **System Validation Package** (comes with #310), which is a ready-to-use software package running on Windows to perform system stress test during system validation. It automatically sets-up tests to stress the computers data paths from:

- CPU and Exerciser to system memory
- Exerciser to system memory
- CPU to Exerciser memory space
- CPU to Exerciser I/O space
- Peer to peer traffic
- Master to target traffic

C-API and PCI/PCI-X Protocol Permutator & Randomizer Library (comes with #320), which provides automatic PCI/PCI-X protocol permutations within user-programmed constraints. It features:

- Reduced and predictable test time, as use of the system CPU is not required
- PCI/PCI-X master and target support
- Comprehensive reports of performed protocol variations

The following accessories are available for the **E2920 Verification Tools, PCI/PCI-X Series:**

Agilent Products	E2940A	E2925B	E2928A	E2929B	E2930A
E2991A External Power Supply		X	X	X	X
E2993A External Agilent Logic Analyzer Adapter		X	X		
FS2104 Future Plus Logic Analyzer Adapter				X	
E2994A General Purpose Logic Analyzer Adapter		X	X		
E2995A 155 x 4 M Trace Memory		X	X		
E2996A 155 x 4 M Trace Memory	X				
System Test Library	X	X	X	X	

In addition, the E2922B PCI-X Master Target Card is available for larger labs with multiple test benches.

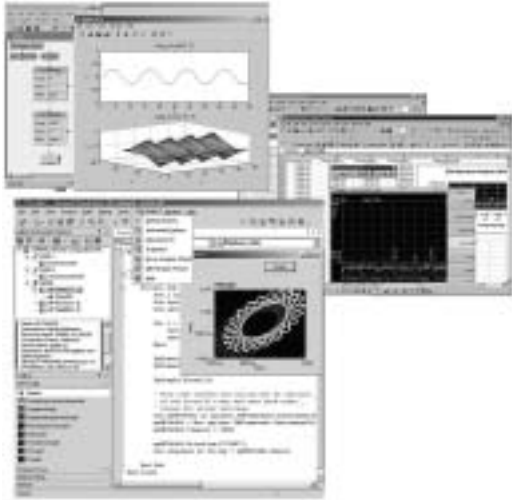
Test and Measurement Software
and Connectivity 312

GPIB Cards and Converters 317

Agilent Developer Network –
ADN 318

Software and Connectivity

- Choose from a complete set of software tools, from no-programming IntuiLink to a full test development environment
- Choose a graphical or an open, standards-based Microsoft development environment
- Obtain industry-standard I/O libraries and broad, multi-vendor driver support for ease of use and compatibility with a wide range of hardware and software



Software and Connectivity Tools for all Measurement Automation Needs, Whether Simple or Complex

If you need to connect your test equipment to a PC and automate your measurements – whether your test code needs are simple or complex – this set of software tools has what you need.

For simple, fast, no-programming connections to transfer instrument data directly into Excel or Word, there's IntuiLink. For easy graphical programming to make measurements, there's VEE.

For development of test system software using Microsoft Visual Studio .NET, there's T&M Programmers Toolkit.

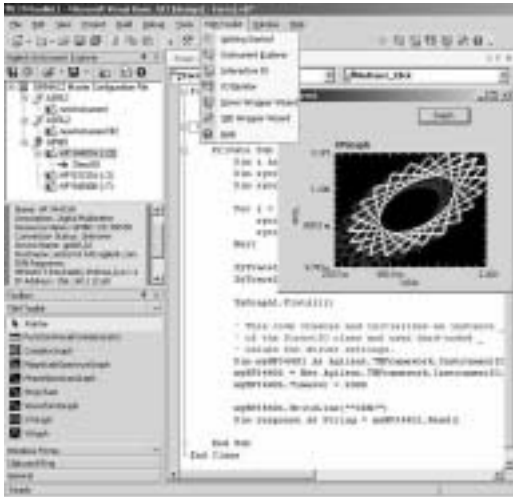
7

Selection Guide for Test & Measurement Software

Product	Description	Used In	Features at a Glance	Best For
T&M Programmers Toolkit	Test code development program integrated into Visual Studio .NET	<ul style="list-style-type: none"> • Design characterization • Design validation • Manufacturing 	<ul style="list-style-type: none"> • Instrument ID and communication • Test code debugging • Data collection and analysis 	Writing more complex or reusable programs from Microsoft's Visual Studio .NET environment
VEE	Graphical instrument programming environment	<ul style="list-style-type: none"> • Data acquisition • Design • Low volume manufacturing test 	<ul style="list-style-type: none"> • Easy test system control • MATLAB analysis & visualization • Full support of ActiveX 	Creating quick programs to acquire instrument data
IntuiLink	Toolbar add-ins for MS Word and Excel	<ul style="list-style-type: none"> • Early stages of design 	No-programming connection to acquire instrument data into Excel, Word	Simple data acquisition needs
Test Developers Bundle	Cost-effective bundle of T&M Programmers Toolkit, VEE with six months support and product updates	<ul style="list-style-type: none"> • Design • Design validation • Manufacturing 	<ul style="list-style-type: none"> • Combined features of Toolkit, VEE and Agilent Software Support 	Best overall value

To help ensure your success, the T&M Programmers Toolkit and VEE now come standard with support and product updates.

Agilent Technologies embraces open, computer standards by seamlessly supporting computer-standard connections such as LAN and USB, driving T&M standard I/O programming, and integrating fully with Microsoft applications and development environments.



As an extension of the powerful built-in functionality available in the .NET Framework, the T&M Toolkit simplifies programmatic access to your instruments and speeds your programming.

Test & Measurement Programmers Toolkit for Visual Studio .NET

Agilent's T&M Programmers Toolkit brings the benefits of Microsoft's Visual Studio .NET to test and measurement engineers. Visual Studio .NET is Microsoft's latest version of its Visual Studio development environment. The Toolkit extends the Visual Studio .NET platform with integrated, easy-to-use software tools and components, such as project wizards, class libraries, and 2D graph controls, to save you time and make it easier to write code for automating measurement tasks and displaying data.

The T&M Toolkit offers many of the test and measurement productivity advantages historically associated with standalone proprietary T&M environments. It is completely integrated into Visual Studio .NET to give you easy access to the productivity and flexibility that Microsoft has built into that environment.

The T&M Toolkit lets you easily pull legacy or current code and drivers forward into this open, standard environment. The Toolkit also lets you quickly identify and debug I/O issues during development. And to make sure you get up to speed quickly, a fully integrated, online help system shortens your programming learning curve. Using the Toolkit, you can connect to your test instruments and accomplish your instrument programming tasks in a fraction of the time it formerly took.

Why Visual Studio .NET is so Powerful

Visual Studio .NET, Microsoft's latest version of its Visual Studio development toolset, provides an integrated development environment for programmers working with a variety of languages, including C#, C++ and Visual Basic. It offers several advantages that help you get your job done faster:

- **Language independence** – Visual Studio .NET lets you write in virtually any programming language, without worrying about integration issues
- **Freedom from mundane programming tasks** – Visual Studio .NET has a huge support library (.NET Framework), which means you write less “support” code, giving you more time to spend on test and-measurement-specific code
- **Easy code reuse** – Visual Studio .NET gives you the ability to easily reuse code across projects and across programming languages

Best of all, since Visual Studio .NET is an industry-standard development environment, your T&M Programmers Toolkit programming expertise will be valuable in any work environment. Eliminate your worries about getting stuck in an obsolete proprietary environment.

As a proud partner with Microsoft in their Visual Studio Integration Program Agilent is able to gain access to tools to enable us to tightly integrate to their environment, allowing Agilent to focus on what we do best – bring the power of instrumentation to your desktop or laptop.

Standard Versus Proprietary Languages

There are some distinct advantages to working in a standard language instead of a proprietary language. The skills you develop in a standard language are more portable and give you more flexibility for moving into different work environments. Because more people use standard languages, managers can draw from a larger pool of developers and protect their investment in their intellectual property. The larger developer pool also means you have more places to turn when you need questions answered. Visual Studio .NET is an industry-standard development environment that gives you these advantages. Moving to the open .NET environment allows you to leverage the huge investment Microsoft has made in this platform and also lets you take advantage of the add-ons being built by numerous companies.

Features

T&M Programmers Toolkit has a variety of features designed to make it easy for you to communicate with and configure your test instruments and test systems, and to acquire, analyze and display data. And a fully integrated, online help system lowers your programming learning curve. The Toolkit makes it easy for you to:

Get started

- **Project Wizards** – Provides instrument and system control program building blocks, so you don't have to start from scratch when you write instrument control applications

Configure the Interface, Communicate with Instruments and Acquire data

- **Multi-Vendor Support** – with the ability to use almost a thousand drivers representing the most popular instruments from 70 different vendors. Toolkit can control any standard instrument and many vendor's PC plug-in cards
- **Instrument Explorer** – helps you quickly configure your test system by finding instruments on your PC or network and helps you easily manage instruments and drivers. Choose either DirectIO, VXI *plug&play*, IVI-COM or an IVI-C driver and then drag and drop the instrument icon into your work window to generate code to connect with the instrument. See Figure 1



Figure 1. Drag and drop capability saves you programming time and effort. Just drop an instrument icon into your work window to generate code to talk to the instrument.

Analyze and Display Data

- **Simple Access to Math and Analysis APIs** – provides math routines such as Digital Signal Processing functions (FFT, Bartlett, Hanning, Hamming windowing), Bessel functions, Statistical function (RMS, Stand Deviation, Binomial), regression functions (Lin, Log, Exp and curve fitting routines) as well as a complex number class and an engineering formatter
- **Graph Displays** – enabling visualizing, scaling and tracking data from measurement and data stores. Display results with XY, Y, Waveform, Complex, Magnitude, Spectrum, Phase Spectrum graphs or a Strip Chart

Visual Studio .NET

Debug Instrument Control Applications

- **IOMonitor** – helps you debug instrument control applications by capturing and displaying instrument communication details from several I/O layers. Or save the file for later analysis

Integrate with Other Environments

- **VEE Connect Wizard** – provides an easy way for you to call your Agilent VEE Pro user functions from a Visual Studio .NET project

Get Help when you Need it

- **Integrated Help System** – provides easily accessible assistance, fully integrated with the Microsoft help system, including sample code you can cut and paste directly into your work environment

Create Runtime Executables

- **Free Runtime Distribution with Purchase** – Unlike many proprietary environments, you can create runtime executables for use on other computers. These can be distributed without paying any additional fees. These executables can be run on Windows 98, 2000, NT 4.0, XP Pro and XP Home

Worldwide Service and Support

With The T&M Toolkit, you have access to Agilent's worldwide resources for start-up assistance, training classes, and update services. As part of the purchase of any Toolkit product you will receive 6 months of support and updates included, free of charge. If you would like additional consulting services Agilent offers those too.

Try T&M Toolkit, Completely Risk Free

We believe that the T&M Toolkit will simplify your instrument connection and control tasks. But there is no reason to take our word for it. Download your FREE copy of the T&M Toolkit* or see an online demo today at <http://www.agilent.com/find/toolkit>. And if you purchase after the evaluation period, you have our exclusive money-back guarantee. If you are not fully satisfied for any reason, you can return it within 90 days for a full refund, no questions asked.

*You must have Visual Studio .NET installed to use the evaluation version of the Agilent T&M Programmers Toolkit.

Minimum System Requirements

T&M Toolkit requires Visual Studio .NET, for a complete list of minimum system requirements please visit <http://www.agilent.com/find/toolkit>

Ordering Information

To order the Test & Measurement Toolkit – refer to **product W1140A**.

Product Description	Notes
T&M Programmers Toolkit for Visual Studio .NET	Includes the T&M Toolkit product and 6 months of support and product updates
Test Developers Bundle with VEE, Toolkit	A cost effective way to get all of Agilent's test development software. Includes VEE, T&M Toolkit for Visual Studio .NET and 6 months of support and product updates

For additional information on these and other SW products – please visit <http://www.agilent.com/find/connectivity>

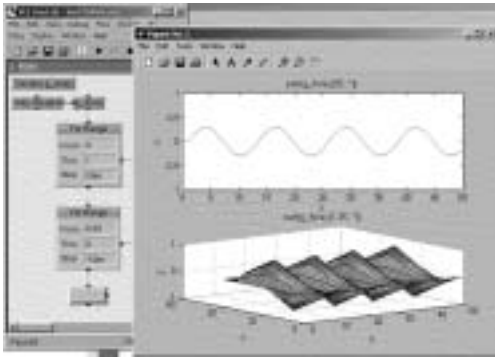
Faculty version of Toolkit – qty. 50 licenses For approved faculty members only	Includes 3 sets of media and manuals with the license to copy up to 50 licenses, no support
--	---

Available Options

Description	Notes
Support	Additional support purchased at any time
82357A USB/GPIB Interface	Buy the connectivity hardware with your software and receive a discounted price
82350B GPIB Interface	
E5810A LAN/GPIB Gateway	

For additional information on these and other connectivity products – please visit <http://www.agilent.com/find/gpib>

For the additional ordering and for pricing assistance please refer to <http://www.agilent.com/find/connectivity>



Agilent VEE Graphical Programming Environment

As an alternative to The T&M Toolkit, Agilent VEE is another software solution for research and design environments demanding fast test program creation with a mix of GPIB and PC card instruments. Full support of ActiveX means you can customize programs within VEE and automate reporting or spreadsheets with Microsoft Word or Excel. In addition, with embedded MATLAB Scripts, you can easily perform numerical analysis, graphics, and signal processing tasks. Multimedia tutorials and example programs will help you get up to speed quickly.

Graphical Programming Environment

VEE is an award-winning, uniquely productive, graphical programming environment. To create a program, you choose high-level graphical objects from the menu and connect them with wires (no more low-level icons to represent each textual line of code). The wire connections help specify functionality and sequence in intuitive block diagrams. You program at a higher, task-oriented level using built-in scientific and engineering routines. VEE jumpstarts your programming effort, and maximizes the 2-D programming space for faster measurement analysis results.

Self-Documenting

VEE is a self-documenting program that illustrates the connections between individual objects and the wires that join them to create a program. Where appropriate, many objects (such as MATLAB objects) include powerful textual code within the object itself. Objects can include graphs, displays, advanced math, and signal processing.

Works with Standards

As an open graphical environment, VEE works with leading products across all market segments. It supports leading applications such as Microsoft Excel and Word, The MathWorks MATLAB, Microsoft Internet Explorer, and Netscape Navigator. It supports popular programming languages including Visual Basic, C, and Visual C++. It works with manufacturing equipment via ActiveX, including surface mount machines and robots. Furthermore, Agilent VEE can be used as a standalone solution or it can deliver measurement analysis results from custom in-house solutions. It becomes part of your environment without changing the way you do business. VEE works with standard instrument interfaces including; GPIB, RS-232, LAN and many PC plug-in interfaces.

Features

Agilent VEE has a variety of features designed to simplify your connection, control and collection of instrument data so that you can spend more time focusing on your tasks – creating better tests, faster – instead of worrying about instrument control issues.

Get started

- **Multimedia Tutorials** – to give you an overview and help get you up to speed quickly
- **Welcome Window** – upon startup automatically loads the VEE example directory and MATLAB demos so you can immediately see how you can use the power of MATLAB to your application programs
- **Context-Sensitive Tips and Help** – easy and accessible help along the way

Traditional Chinese URL www.agilent.com.tw/find/products

Connect To and Control Instruments

- **Program the Properties of Instruments** – quickly, easily, graphically through the powerful DirectIO capability or one of the almost thousand VXI *plug&play* drivers available
- **Take any Measurement and Control any Instrument from any Vendor** – with the ability to use almost a thousand drivers representing the most popular instruments from 70 different vendors. Agilent VEE can control any standard instrument and many vendor's PC plug-in cards
- **Automatically Converts 16 Different Data Types** – without extra programming so you get the relevant data in the format you expect
- **Create Runtime Executables** – easily with embedded I/O configuration, and distribute the programs, at no extra charge
- **Verify Instrument Addresses** – and other parameters automatically at runtime
- **Troubleshoot** – instrument timeouts and other errors automatically

Program Instruments

- **Create a User Interface for Programs** – you don't have to create a front panel for your VEE program, but if you want to create a user interface without access to your code, you simply add the objects and UserFunctions to your front panel. automatically create a runtime executable directly from the menu
- **Quickly Analyze Code Sections** – to save development time when finetuning your programs
- **Runtime Executable Creation** – automatically directly from the menu
- **Unlimited Runtime** – with VEE, you can distribute your runtime programs at no extra charge

Analyze and Visualize Data

The power of MATLAB Script and the Signal Processing Toolkit embedded within VEE, (from The Mathworks) delivers analysis and visualization capabilities in a single graphical environment.

- **Numeric and Symbolic Computation** – including linear algebra and matrix computation, Fourier and statistical analysis, differential equation solving, matrix manipulation, trigonometric and other math operations
- **Engineering and Scientific Graphics** – 2-D and 3-D displays; triangular and grided data; waterfall diagrams; quiver, ribbon, scatter, bar, pie, and stem plots
- **Signal Processing Functions** – including signal and linear system models, analog filter design, FIR and IIR digital filter design, spectrum estimation, and time-series modeling

Worldwide Service and Support

With Agilent VEE, you have access to Agilent's worldwide resources for start-up assistance, training classes, and update services. As part of the purchase of any VEE product you will receive 6 months of support and updates included, free of charge. If you would like additional consulting services Agilent offers those too. There are currently over 30 companies available in North America, Europe, Middle East and Asia to help you develop your Agilent VEE solution. Please refer to the Agilent VEE web site for a complete list. Join the Agilent VEE electronic users group. Sign up through the Agilent VEE web site and get assistance on using the Agilent VEE from experts around the world: www.agilent.com/find/vee

Minimum System Requirements

For a complete list of minimum system requirements please visit <http://www.agilent.com/find/VEE>

Try VEE, Completely Risk Free

Agilent VEE is a powerful programming environment. Go to <http://www.agilent.com/find/vee> to download your free, fully working copy of VEE. And if you purchase after the evaluation period, you have our exclusive money-back guarantee. If you are not fully satisfied for any reason, you can return it within 90 days for a full refund, no questions asked.

Simplified Chinese URL www.agilent.com.cn/find/products

VEE
IntuiLink

Ordering Information

To order VEE – refer to **product W1140A**.

Product Description	Notes
VEE Pro Software	Includes VEE product and 6 months of support and product updates
Test Developers Bundle with VEE, Toolkit	A cost effective way to get all of Agilent's test development software. Includes VEE, T&M Toolkit for Visual Studio .NET and 6 months of support and product updates

For additional information on these and other SW products – please visit <http://www.agilent.com/find/connectivity>

Faculty version VEE – qty. 50	Includes 3 sets of media and manuals with the license to copy up to 50 licenses, no support
For approved faculty members only	

Available Options

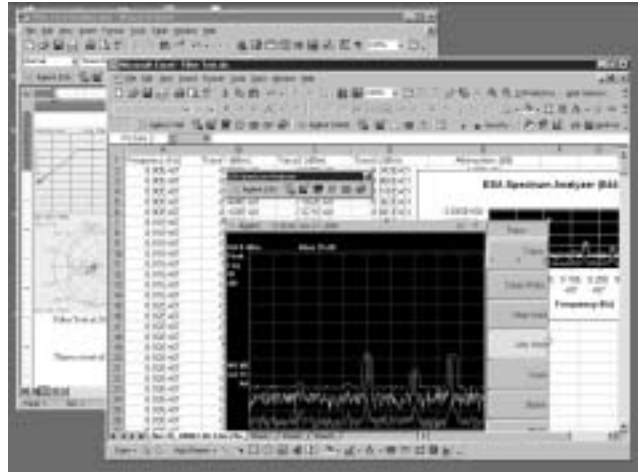
Description	Notes
Support	Additional support purchased at any time
82357A USB/GPIB Interface	Buy the connectivity hardware with your software and receive a discounted price
82350B GPIB Interface	
E5810A LAN/GPIB Gateway	

For additional information on these and other connectivity products – please visit <http://www.agilent.com/find/gpib>

Available Upgrade Products

Description	Notes
Upgrade from VEE 5 and earlier	Buy the connectivity hardware with your software and receive a discounted price
Upgrade from VEE 6 and later	
Upgrade from VEE 6 OneLab to VEE Pro	

For the additional ordering and for pricing assistance please refer to <http://www.agilent.com/find/connectivity>



Agilent IntuiLink is a free connectivity software solution that links test and measurement instrument data to PC applications. IntuiLink consists of two key elements:

- PC Application toolbar: allows easy transfer of measurement data and images from instruments into PC Applications (Microsoft® Word and Excel) with little or no programming
 - Active X/COM programming objects to simplify automating test
- To download IntuiLink toolbars and drivers, go to www.agilent.com/find/IntuiLink

IntuiLink is bundled free with many Agilent leading instruments, including oscilloscopes, multimeters, counters, spectrum analyzers, network analyzers, signal generators, power supplies, power meters, and function generators ensuring simplicity and consistency among this wide range of products.

Features

- Quickly get instrument data and images into Microsoft Office applications (Word, Excel) and technical development applications with little or no programming
- Use familiar applications to quickly visualize, analyze, manipulate, document and print instrument data and images
- Insert key measurements directly into a document or spreadsheet
- Easily save instrument state settings, and retrieve them later to quickly reproduce difficult measurement set-ups
- Create and send waveform data directly to a source
- Automate tests using ActiveX/COM programming objects (drivers)
- For complete details, go to www.agilent.com/find/IntuiLink and click on the Data Sheet
- Agilent Web Remote Control Software – Web-enabled instrument control gives you remote access to instruments across the Web using popular Web browsers. Web-enabled support is available today on Agilent 16700 Logic Analyzer, 8714 Network Analyzer, Infiniium Oscilloscopes, ESA and PSA Series Spectrum Analyzers, and the 33220A Function Generator

- Easy access and control of GPIB instruments
- Support of industry standards – IEEE 488, USB or Ethernet
- VISA I/O Libraries provide backwards compatibility
- High throughput solutions up to 900 KB/s
- Bundles combine the hardware and software to quickly and easily automate your tests



Simplified Connectivity for Test and Measurement Instruments, over GPIB, USB and LAN

Directly connect your test-and-measurement instruments to your PC or network in several different ways. For the fastest and easiest connections, Agilent converters let you take advantage of USB and LAN – the standard I/O already available in your computer.

The USB/GPIB interface offers a direct connection from the USB port on your laptop or desktop PC to GPIB instruments from any vendor. There are no switches to set or PC cards to install.

For benchtop or system applications, the LAN/GPIB gateway provides remote access and control of GPIB instruments via 10BASE-T or 100BASE-Tx networks; enabling resource sharing, global project communications and remote access to instruments. Or if you prefer, the High Performance GPIB card plugs into the backplane of your computer and provides high system throughput.

The Agilent connectivity solutions offer a direct connection to your PC using standard interfaces – GPIB, USB, or LAN. The interface includes hardware and Agilent VISA/SICL IO Libraries software. The VISA software provides an industry-standard method to connect-to and control your instrumentation.

82357A
E5810A
82350B
82341C

Selection Guide Table for GPIB Cards and Converters

	GPIB Converters		GPIB Plug-in Cards	
	82357A	E5810A	82350B	82341C
Description	USB/GPIB Interface connects to USB port on computer	LAN/GPIB Gateway provides remote access and control of GPIB instruments	PCI High-Performance GPIB Card	ISA High-Performance GPIB Card
Operating System	Windows® 98 (SE)/Me/2000/XP	Windows® 98 (SE)/Me/NT/2000/XP	Windows® 98 Me/NT/2000/XP	Windows® 95/98/NT/2000
IO Libraries	VISA/SICL	VISA/SICL	VISA/SICL	VISA/SICL
Interface	USB 1.1	10BASE-T/100BASE-Tx	IEEE 488, 5 V PCI	IEEE 488, ISA
Max Speed	750 KB/s (with large block transfers)	N/A	900 KB/s	750 KB/s

Note: With the standard IO Libraries, these GPIB Cards and Converters work with many of the standard languages and applications.

Accessories

GPIB Interconnection Cables

Cables for interconnecting GPIB devices are available in six lengths. The connector block at both ends of the cable has a plug on one side and a matching receptacle on the other so that several cables may be conveniently daisy-chained, thus simplifying system interconnection. Lock screws securely mount each connector block to a GPIB instrument or to another connector block.

10833 cables feature an improved shielding design to help reduce RFI levels in systems. This series of cables has significantly lower radiated emissions than previous GPIB cables.

GPIB Cables

- 10833A GPIB Cable, 1 m (3.3 ft)
- 10833B GPIB Cable, 2 m (6.6 ft)
- 10833C GPIB Cable, 4 m (13.2 ft)
- 10833D GPIB Cable, 0.5 m (1.6 ft)
- 10833F GPIB Cable, 6 m (18.5 ft)
- 10833G GPIB Cable, 8 m (26 ft)
- 10834A Adapter

ADN

- One-stop access for connectivity information: code samples, white papers, application notes and more
- Downloads for instrument drivers and I/O Libraries
- More than 700 instrument and software manuals
- Peer-to-peer discussion forums



Cut the Time Required for Successful Instrument-PC Connectivity

Have you ever spent too much time getting your PC and test equipment to communicate; searched endlessly for drivers on the web; wished you could find the instrument manual you need; or needed help solving your connectivity problem?

The Agilent Developer Network is the one-stop resource to support your connectivity needs. You can download drivers, I/O, example code and user manuals. Focus on your tasks, not on your connections – join ADN today!

All you have to do is register for a free membership in ADN. ADN provides Web access to a wealth of connectivity resources:

- My ADN – My ADN lets you customize ADN so it works best for you
- Downloads – Simple access to instrument drivers, I/O libraries, IntuiLink connectivity software, and software demos for Agilent T&M Programmers Toolkit for Visual Studio .NET, Agilent VEE, and other test and measurement software. This includes full development access to Agilent I/O libraries including the VISA standard libraries and tools for Visual Basic 6
- Knowledge library – Select from an assortment of articles and white papers on connectivity, drivers, I/O, and more. Get application notes, sample code and use contributed applications that suit your needs
- Discussion forums – Engage your peers in the ADN discussion forums on connectivity and programming issues. Forums will change and grow with participant needs
- T&M Software Product Manuals – Access to T&M software manuals in PDF format
- Instrument Manuals – Access to over 700 instrument manuals in PDF format

EDA Software	320
RF Design Environment	323
RF Design Environment Bundles	325

Overview

Agilent EEsof Electronic Design Automation (EDA) business grew from an internal need to improve the design process for its RF and microwave instrumentation.

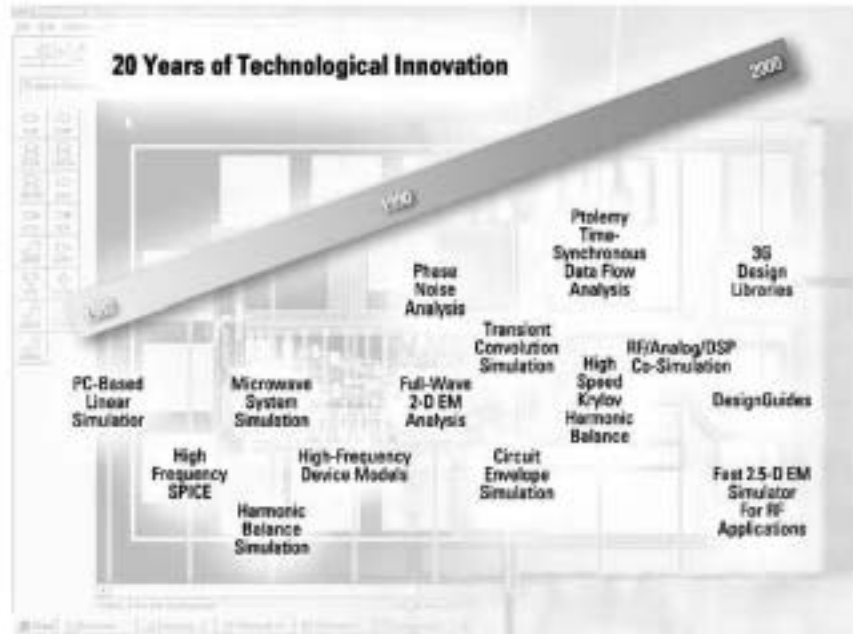
For more than 20 years, Agilent has led the development of new high-frequency EDA technologies such as Harmonic Balance and Circuit Envelope simulators, RF/Analog/DSP co-simulation, and behavioral models. It is technology that has proven its robustness and lasting value over time.

Today, just as Agilent engineers continue to use these EDA tools when inventing new products, you can trust that Agilent EEsof EDA supplies the breadth of technology to give you confidence in all your high-frequency designs.

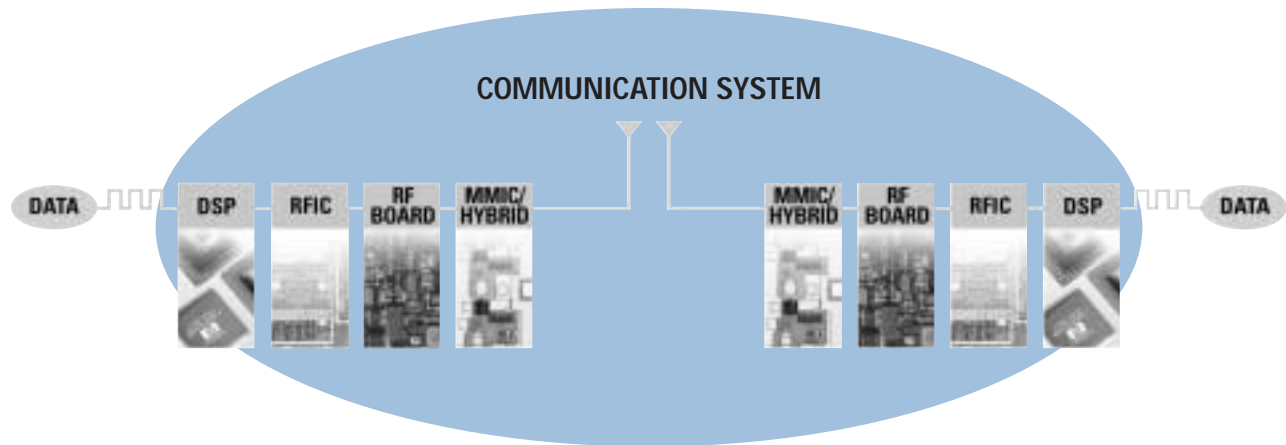
World-Class Products for the Entire Development Process

Agilent EEsof EDA offers three main platforms, each with a wide range of affordable configurations.

- **Advanced Design System (ADS)**
A powerful EDA software platform, offers industry leading simulation technologies to RF and Microwave designers
- **Device Modeling Systems**
Based upon IC-CAP parameter extraction and device modeling software, provide a complete toolset for developing accurate device models
- **Agilent RF Design Environment (RFDE)**
Integrates Agilent's leading RF simulation technologies into the Cadence industry-standard analog/mixed signal design flow framework for large-scale RF/mixed-signal IC design



Speeding Optimized Designs from Concept to Implementation



A Unified Environment for Communications Signal Path Design: Powerful tools for system, RFIC, MMIC, RF board, hybrid and baseband/DSP design in one integrated environment.

- Quickly explore design options and tradeoffs from RF to baseband/DSP
- Ease the design process with proven RF, microwave, RFIC and baseband/DSP design tools that combine leading-edge technology with built-in application expertise
- Meet the most demanding design challenges with application-focused design suites
- Save development time with comprehensive design and verification environments and integrated test links to signal generators, network analyzers and other Agilent instruments

The Agilent Advanced Design System (ADS) helps designers meet the multi-dimensional challenge of mixed-signal design, from RF to digital to baseband. When equipped with Agilent's broad range of high-performance design tools, project teams can quickly explore a host of ideas and then simulate the electrical and physical characteristics of the most promising design candidates. ADS offers complete design integration for products ranging from mobile phones and pagers to wireless networks and radar systems.

Boost Productivity with Integrated Design Tools

ADS is a powerful suite of electronic design automation (EDA) software that can simulate the entire communications signal path. It integrates a wide variety of proven RF, mixed-signal and electromagnetic design tools into a single, flexible environment. Seamless integration minimizes the need for data or design transfer, and ADS works with other EDA frameworks for full compatibility within your overall design process.

Use ADS and its highly integrated links and support as a basis for your design verification solution. ADS can be used for virtual prototyping, debugging, or as an aid in manufacturing test.

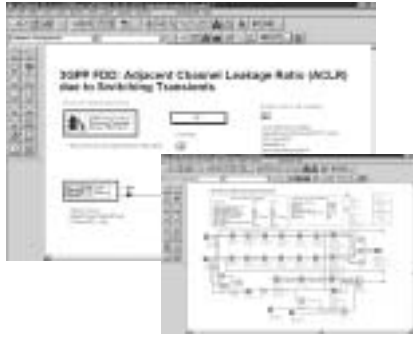
To enhance engineering productivity and shorten time-to-market, ADS software offers a high level of design automation and applications intelligence. This proven software environment is easily extensible: you can customize ADS by adding design suites focused on your particular application needs (see page 322). All suites share a common database, user interface and display. ADS and the six design suites run on PCs and workstations, with complete file compatibility between platforms and across networks.

Optimize System Performance and Resolve Design Conflicts

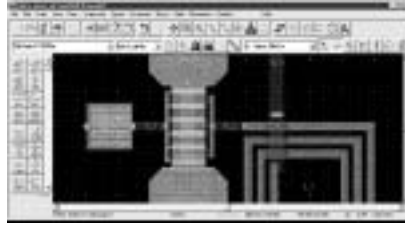
With RF mixed-signal co-simulation, you can examine RF and mixed-signal interactions and make architectural tradeoffs. For instance, you can explore alternatives and decide whether to implement a particular filter in the baseband stage or in the RF section. ADS lets you choose either a baseband design flow or an analog/RF track. You can build the physical design for the RF portions in ADS, then choose to integrate with other third-party EDA frameworks.

Meet the Unique Challenges of your Application

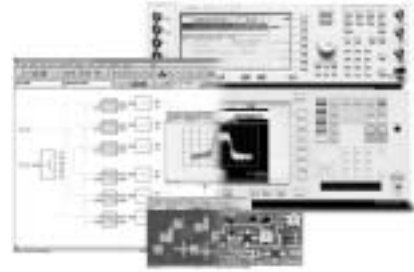
Customize ADS for demanding applications and design flows from RF chips and boards to microwave circuits and baseband/DSP elements. All suites share a common database, user interface and data display.



Simulating top-level ACLR due to switching transients in 3GPP system user equipment.



MMIC and RFIC front-to-back design solutions are supported by all major foundries.



Verification of real-world signals through connected solutions.

Design Suite	Designer	Version	Designer Premier
Communication System Designer Provides a unified environment from system concept to implementation.	Validates RF system designs. RF simulator and linear/nonlinear RF block models predict the performance of complete RF systems.	Offers RF and floating-point DSP modeling and design to simulate critical specifications such as BER and EVM. Allows bi-directional co-simulation with MATLAB®. Expandable to include HDL co-simulation.	Adds fixed-point analysis, HDL co-simulation, verification via the Adaptive Waveform Comparator, and propagation models for GSM, CDMA, TDMA and other standards.
DSP Designer The ability to verify DSP algorithms in conjunction with mixed systems helps you isolate and avoid RF/analog/DSP integration problems.	Uses the Agilent Ptolemy fixed-point simulator and libraries for system-level DSP algorithm development.	Integrates the analysis and simulation of RF, DSP and analog systems to determine RF/DSP design tradeoffs. Expandable floating- and fixed-point capabilities.	Helps analyze interaction between DSP content and the rest of the communications system. Co-simulate and generate HDL codes for analysis, and validate more levels of system abstraction.
RFIC Designer Realize the most demanding RFIC designs through leading-edge simulation and optimization. RFIC Designer links to third-party EDA solutions and libraries and is supported by major silicon foundries around the world.	N/A	Provides an integrated time-, frequency- and modulation-domain simulation environment for schematics containing a combination of models for devices, behavioral blocks, layout parasitics, and off-chip components.	Adds user-defined element modeling, statistical design, RF system models and convolution simulation.
RF Board Designer Confidently design RF boards to specification by accurately predicting, optimizing and rendering PCB designs for manufacturing. The results are fewer board turns, lower development costs and shorter time-to-market.	Base simulator capability for linear circuits. Includes accurate models, libraries and unique Agilent EEsof tools.	Provides an integrated environment for design and verification of RF board components. Designers and design teams benefit from leading-edge simulator technology, advanced modeling, a physical design environment and yield-optimization tools.	Adds RF system models and Circuit Envelope for analysis of complex modulated signals. Provides end-to-end architecture, design and implementation capabilities.
Microwave Circuit Designer A complete solution for developing high-frequency designs, including MMICs and hybrids, with optimized performance and manufacturing yield.	Combines high-frequency simulation and optimization with accurate models, libraries and physical design tools.	A powerful solution for microwave component designers. Adds an integrated physical design environment and yield-optimization and maximization tools.	Offers expanded capabilities for micro-wave system designers. Additions include RF system-level analysis, simulation of complex digitally modulated RF signals, and tools to create custom models.
MMIC Designer A complete front-to-back MMIC design in a single integrated design flow.	N/A	Offers a front-to-back design solution with synchronized schematic/layout, Data Display, Harmonic Balance, Linear, Electromagnetic simulators, and GDSII file translator. MMIC Designer Pro also includes Electromagnetic simulators with Optimization and Visualization.	Adds to MMIC Designer Pro: Advanced Model Composer, Passive DesignGuide, full Statistical Design, DRC, plus DXF and Gerber file translators.
	Precision Modeling System	RF Modeling System	Pulsed Modeling System
Precision, RF and Pulsed Modeling Systems Complete, single-source systems configured for specific frequency ranges and applications to accurately measure nonlinear devices.	A complete measurement system for high-frequency active devices. Includes an Agilent 8510C network analyzer for ac measurements up to 20 GHz (optionally 26.5 GHz, 50 GHz or 100 GHz).	Designed for modeling at frequencies below 3 GHz (optionally to 6 GHz) using the Agilent 8753 or PNA network analyzers.	Improves device characterization and modeling by incorporating thermal effects on device performance.

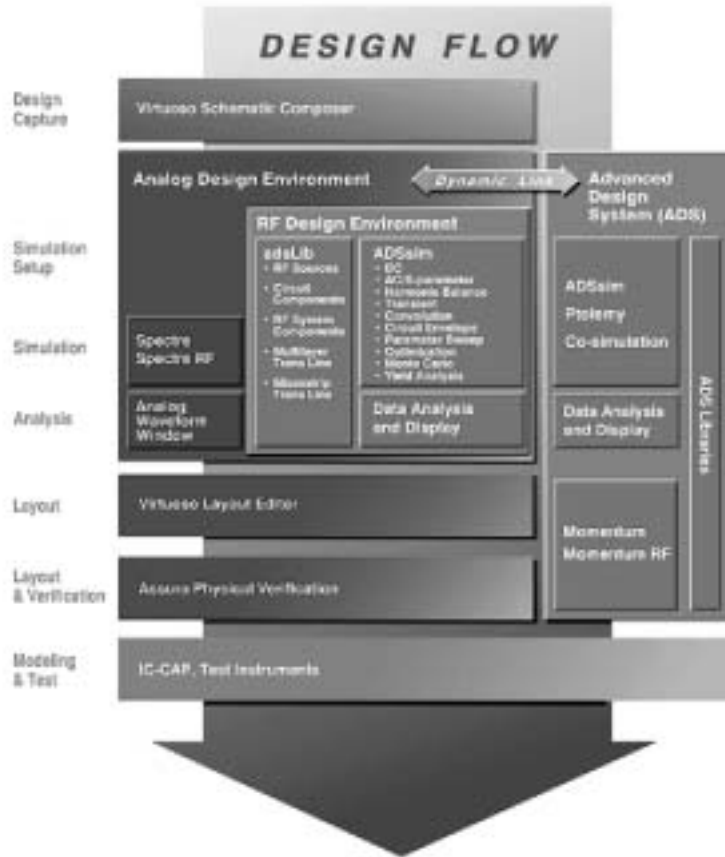
Complete RF/Mixed-Signal IC Design Flow

RFDE is part of a comprehensive RF/MS IC design flow, from design capture to prototype test. Designs initially are created in Cadence Virtuoso Schematic Composer. A schematic test bench is then created with RFDE, using sources and other components from adsLib. Advanced simulation options, including optimization, parameter sweeps, pre-configured measurements, and statistical analysis are available when the simulator is chosen. Simulation results are viewed using Agilent's rich set of data display capabilities. After the IC layout is complete, extracted parasitics can be re-simulated and analyzed within RFDE.

Additional parasitic and passive layout component modeling is performed using the ADS Momentum and MomentumRF simulators. Co-simulation with the Agilent Ptolemy system simulator (accessed through RFIC Dynamic Link) is used to verify that overall system behavior matches specification. Final prototype measurements, and additional circuit and device modeling, are performed with Agilent test equipment and IC-CAP software.

Training, Support, and Service – When and Where You Need It

Support for RFDE is provided through Agilent's world-class, global technical support organization. Agilent's experienced application and technical support engineers are dedicated to addressing the special challenges of high frequency design. Product, application, training, and support information is also available 24 hours a day from Agilent EEs of EDA's up-to-date and comprehensive web site, www.agilent.com/find/eesof



RF Design Environment Bundles

	RFDE Wireless Pro	RFDE Wireline Pro	RFDE Premier
RFDE Integration			
Cadence Analog Design Environment Integration	•	•	•
Dynamic Link to ADS	•	•	•
Simulation Capabilities (ADSsim)			
Data Analysis and Display	•	•	•
Parameter Sweep	•	•	•
Parameter Optimization	•	•	•
Monte Carlo/Yield Analysis	•	•	•
DC Analysis	•	•	•
AC Analysis	•	•	•
S-Parameter Analysis	•	•	•
Small-Signal Noise Analysis	•	•	•
Transient Analysis	•	•	•
Transient Analysis with Convolution		•	•
Harmonic Balance Analysis	•		•
Transient Assisted Harmonic Balance Analysis	•		•
Nonlinear Noise Analysis	•		•
Phase Noise Analysis	•		•
Circuit Envelope Analysis			•
Library Components (ADSlib)			
Frequency-domain sources	•	•	•
Time-domain sources	•	•	•
Modulated sources	•	•	•
Noise sources	•	•	•
Voltage/Current controlled sources	•	•	•
Lumped components	•	•	•
Transistor components	•	•	•
Data Items (S-parameter files)	•	•	•
Microstrip T-Lines	•	•	•
Multilayer T-Lines	•	•	•
Passive RF components (bond wires, transformers)		•	•
Filter components			•
Amplifier components			•
Mixer components			•
PLL components			•

RFDE Premier + adds the following ADS licenses:

- ADS Project Design Environment
- Ptolemy Simulator (RF/baseband co-simulation)
- Antenna & Propagation Models (use with Ptolemy)
- Momentum Simulator (for modeling of passive layout structures)
- Momentum Visualization
- Momentum Optimization
- ADS Layout (for setting up Momentum simulations)
- GDSII Translator (for importing layout elements from Cadence into ADS Layout)

RFDE and ADS can be used together with the Dynamic Link capability, which is included in each of the RFDE seats.

Works with Cadence versions 4.4.5 and 4.4.6
Available on HP-UX, Sun and IBM platforms:

- HP-UX 11.0x
- Solaris 2.6, 2.7 and 2.8
- IBM AIX 5.2

Designed for use with the following Cadence Products:

- Virtuoso Schematic Composer
- Analog Design Environment

Electronic Functional Test System	328
Phase Noise Test System	333
Satellite Payload Test Solutions	334
VXIbus Products	335
Cabinets & Cabinet Accessories	345

Electronic Functional Test System

328

TS-5400 Series II Automotive Electronics Functional Test System

E8786A
E8780A
E8770A

- A scalable platform; one platform for testing the entire range of ECMs and smart sensors
- Lowers test deployment costs by up to 33%
- Buy “just enough test” now to meet current test requirements
- Integrated system is solution-ready and ready-to-go
- Includes a Test Executive with over 200 automotive routines



Accelerates Test Deployment, Meets your Time-to-Market Window and Full Scalability

As electronic control modules become more prevalent, ranging in complexity from simple- to high-pin-count, automotive electronics manufacturers like yourself are looking for a test platform that's fully equipped to handle competitive challenges – from rising production volumes to time-to-market pressures. You need to meet demands for quality at a competitive price, as well as the demands of the competitive automotive marketplace. Our next generation test platform, the Agilent Technologies TS-5400 Series II, is designed to help you meet those challenges. This platform not only accelerates test system deployment, it ensures test development doesn't stand in the way of delivering ECMs on time and on budget. Featuring true scalability, they're sure to put your manufacturing line and your bottom line on the fast track.

Key Literature & Web Link

<http://www.agilent.com/find/ts-5400>

Ordering Information

E8770A TS-5400 Series II; Small Pin Count

E8780A TS-5400 Series II; Medium Pin Count

E8786A TS-5400 Series II; Highest Performance

Contact Agilent Technologies to configure a customized test system.

- Provides equipment-to-DUT connectivity for test systems
- Custom RF/MW signal routing and conditioning per customer requirements
- Allows calibrated, repeatable test-system measurements
- Built upon Agilent's expertise with RF/MW switches, cabling, and signal-conditioning components
- Modular design allows easy access to internal components
- Switch-driver accessories available with flexible interfacing



A switch matrix provides automatic routing of signals between test equipment and the device under test (DUT) in an RF or microwave ATE system. The switch matrix decreases total measurement time, since multiple measurements are made automatically, with a minimum number of manual connections to the DUT. Also, devices such as couplers, attenuators, amplifiers, and filters can be easily included in the matrix to provide signal conditioning.

The Agilent 8760 series switch-matrix family provides low-loss, high-isolation connections that allow accurate, repeatable measurements. The Agilent 8760 series matrices are rack-mount boxes with size, weight, connector type, and location designed to customer specifications. Matrix design considerations include the following:

- Long switch life and high switching repeatability
- Signal paths with low loss and high isolation
- Low SWR for optimum external-connector match
- Factory signal-path characterization for test-system calibration

Specifications

Switch-matrix design is based upon customer requirements for the following specifications:

- Electrical specifications
 - Frequency bandwidth
 - Power
 - VSWR
 - Insertion loss
 - Isolation
- Mechanical-design considerations
 - Enclosure/size/weight
 - Environmental considerations
 - Design for serviceability
 - Software Interface
 - Switch drivers
- Additional capabilities specified by customer

Accessories

Switch-matrix switch drivers – 87130A, 70611A, 11713A, 3488A, 84940A

Key Literature & Web Link

Web information at www.agilent.com – search for switch matrix
Switch-matrix brochure 5966-0990E

Ordering Information

Contact Agilent Technologies for proposal and quotation



Buying or Building, Agilent can Help You Streamline Test System Development

9

- System Components
- Complete Systems
- Software...I/O...Power...Switching... Stimulus...Response

The majority of instruments that Agilent builds are used with a computer, and we are committed to maintaining our test automation leadership role. Whether you are building your own test system or need to have one built for you, we have software tools, measurement solutions and test expertise to help you...

- Shorten development time
- Increase system speed
- Reduce system cost
- Increase system accuracy

To keep you on the leading edge of test automation, here are some examples of the system innovations permeating Agilent's new system components:

- **IVI drivers save steps in writing test code**
- **Personality modules make it easy to upgrade instruments** or keep up with changing standards
- **New instruments have modern, standard computer-industry I/O (LAN and USB), in addition to GP-IB.** Computer-standard I/O will mean longer distances, good noise immunity and rapid growth in I/O bandwidth. And with LAN or USB, you won't have to open the computer or install a separate communications card
- **System-ready products give you high quality measurements and sources optimized for the system environment,** just what you would expect from a test and measurement leader.
- **Agilent works in the software environment that you do.** Our solutions are compatible with the most popular environments, whether it is graphical (VEE or LabView), spreadsheet (Excel) or textual (Visual Basic, C).

Want a Custom Solution?

For manufacturers in multiple industries worldwide, Agilent system-based solutions mean low-risk implementation and deployment, and the assurance of meeting your business objectives with greater confidence backed by Agilent's expertise and credibility.

It's Your Choice

- Our design or yours
- World-class measurement science
- System-ready products
- Computer industry standards

Together we can work to streamline test system development, make better measurements and reduce test costs.

For more information, go to www.agilent.com/find/testsys

- Flexible, customized tools to meet your specific testing requirements
- Product-specific support services
- Education and training tailored to product/application
- Worldwide test knowledge, installation and support



Automotive-Electronic Functional Test/DOCSIS Test Solutions

For automotive-electronics manufacturers facing time-to-market pressures, the TS-5400 series II platform accelerates functional test deployment, ensuring test development does not stand in the way of getting your automotive-electronics control modules to market. Current users report a time improvement of up to 50 percent in deploying functional test systems.

Agilent DOCSIS test solutions assist in R&D, design verification, pre-certification and manufacturing. These test solutions include the DOCSIS design verification test system (E1371B), the DOCSIS protocol analyzer (E7333A) and DOCSIS test services.

TS5400
E1371B
E7333A

Selection Guide for Automotive Functional Test

	Automotive	DOCSIS	
Model	TS-5400	E1371B	E7333A
Product	Automotive Functional Test system	DOCSIS Design Verification Test System	DOCSIS Protocol Analyzer
Industry	Automotive	CM, Set Top and CMTS Vendors	CM, Set Top and CMTS product development, PHY and MAC conformance testing, field troubleshooting, manufacturing test
Application	Functional ECM Electronic Test	Design Verification/Pre-certification	
Features	<ul style="list-style-type: none"> • Integrated software, hardware and cabling • Test executive with over 200 automotive routines • Test code, enterprise connectivity, operator user interfaces • Scalable, flexible 	<ul style="list-style-type: none"> • System design based on DOCSIS ATP, PICS, RFI and Agilent Test Technology • Automatic DUT testing for PHY and MAC performance • DOCSIS protocol analyzer with US triggering • Euro-DOCSIS testing option available 	<ul style="list-style-type: none"> • Flexible upstream and downstream DOCSIS Protocol Analysis • DOCSIS Physical Layer Monitoring • MPEG Stream Analysis/ Protocol Timing Analysis

N1891A
Z2090A
E5500
Series

- Satellite payload testing results in faster satellite integration time
- Converter test systems speed development of frequency converter modules, assemblies and ODUs
- Switch matrices rout signals between test equipment and DUTs
- End-to-end solutions include: hardware, software, integration and consulting services



Agilent RF and Microwave Test Systems: Low Risk, High Confidence

Agilent RF and microwave functional parametric test solutions include satellite payload test and converter test systems, phase-noise measurement solutions and test-solution building blocks, such as matrices for RF/MW signal conditioning and routing. Customers can benefit from Agilent's extensive test-system and switch-matrix experience through standard solutions or via modifications for individual test needs.

For manufacturers in multiple industries worldwide, Agilent system-based solutions provide the lowest risk implementation and deployment and provide assurance of meeting your business objectives with greater confidence backed by Agilent's expertise and credibility.

Selection Guide for RF and Microwave Functional Test

9

Model	N1891A	Z2090A	E5500 Series	
Product	Digital Communication Measurement System	Component Test System	Phase Noise Measurement System	Custom Switch Matrices
Industry	Satellite	Aerospace Defense/Communications	RF frequency based applications including Wireless Communication and Aerospace/Defense	Multiple Industries
Application	Communications Payload Test	Transmit/Receive Module Test, Transceiver Module Test	Characterizations of crystal oscillators, VCOs, synthesizers, amplifiers	Custom designed, Application-specific
Features	<ul style="list-style-type: none"> • Test digital-transparent and analog payloads • Expandable for testing digital-regenerative payloads • Single setup for testing multiple transponders • Test suite includes two-tone and multi-tone parametric and distortion measurements • Standard Ku-band operation with VHF and Ka-band frequency coverage available 	<ul style="list-style-type: none"> • Frequency Coverage to 50 GHz with up to 6 RF Test Ports • Measurements include: S-Parameters (CW, Pulsed), Spectral Analysis, Noise Figure, Pulse Profiling • High-speed measurements with Digital Receiver • Fast test-plan development • Scalable system architecture 	<ul style="list-style-type: none"> • 50 kHz to 110 GHz solutions available • CW and pulsed carrier noise measurements • Benchtop and ATE configured solutions available 	<ul style="list-style-type: none"> • DC to 50 GHz • Automatic routing of stimulus and response signals • Agilent coaxial switches and semi-rigid cables for top performance

- 50 kHz to 26.5 GHz with expanded carrier frequencies to 110 GHz
- Quick and easy integration into ATE test systems
- Ability to test a wide range of devices
- Measure AM noise directly



The E5500 series solutions use the power of a flexible software program to automate phase noise carrier measurements. The E5500 B series includes the 70420A phase noise test set, a Pentium PC running Windows 2000, a PC digitizer, an RF spectrum analyzer, selected low noise frequency downconverters and measurement software.

Specifications

E5501A: 50 kHz to 1.6 GHz	E5501B: 50 kHz to 1.6 GHz
E5503A: 50 kHz to 18 GHz	E5502B: 50 kHz to 6 GHz
E5504A: 50 kHz to 26.5 GHz	E5503B: 50 kHz to 18 GHz
	E5504B: 50 kHz to 26.5 GHz

E5501A
E5503A
E5504A
E5501B
E5502B
E5503B
E5504B

Frequency Offset Range:

E5500 A series: 0.01 to 4 MHz
E5500 B series: 0.01 Hz to 100 MHz

System Noise Response:

-180 dBc/Hz typically (>10 kHz offsets)

System Spurious Response:

-120 dBc typically

E5500 A-series Optional Capabilities:

Extend offset range to 8, 10 and 100 MHz
Add RF reference source
Add high power input capability (includes uWave phase and AM detectors)
Extended carrier frequency to 110 GHz

E5500 B-series Optional Capabilities:

Add SCPI remote programming client
Add RF reference source
Add high power input capability (includes uWave phase and AM detectors)
Extended carrier frequency to 110 GHz

Key Literature & Web Link

www.agilent.com go "phase noise"
E5500 series product overview 5965-7590E
E5500 series configuration guide 5965-7589E

Ordering Information

See the E5500 series configuration guide 5965-7589E

N1891A
85121A

- Test Ku band Analog Bent Pipe payloads, expandable to test digital transparent and digital regenerative payloads
- UHF and Ka band Frequency coverage available
- Exceptional reliability
- Optimized architecture for fast throughput
- Consistent results achieved through the integration of advanced measurement science, specialized subsystems, and standard equipment
- Worldwide support and training
- Tailored to your specific test requirements



9

There are many challenges facing satellite payload manufacturers: ever increasing transponder counts, technology transitions from analog bent pipe to digital transparent and fully digital regenerative. The demand for faster throughput and test system flexibility have never been greater. The Agilent N1891A series Digital Communications Measurement System (DCMS) addresses all of these concerns and rises to a new level of performance.

Our Payload Test Heritage and Future

The Agilent 85121A Payload test system has been the industry's most popular commercially available Payload Test System (PTS) for nearly 10 years, becoming the industry's de facto commercial payload test solution. Agilent's new N1891A is poised to set the new standard. The DCMS represents a completely new architecture that supports the implementation of innovative new measurement and calibration methods to dramatically reduce measurement and calibration time.

Hardware innovations such as Agilent's exclusive dual tracking down converter allow the system to make measurements that were virtually impossible to make previously. The fundamental system architecture is designed around a modular functionality approach. For example an entry level version of the DCMS configured to test traditional analog bent pipe payloads can be expanded to cover digital payloads, providing investment protection.

Convenience and Flexibility

Testing digital transparent and digital regenerative communication payloads used to mean more than one system. Not any more. The N1891A provides the convenience and flexibility to handle what may have taken two or more systems to accomplish in the past. This unified approach minimizes the integration time of the system into your test environment and provides a level of data integrity not possible with multiple test system approaches.

Hardware Architecture

The DCMS hardware architecture supports both Digital Signal Processing (DSP) and non-DSP payload testing using a common core set of high-performance test instruments. It is expandable to measure signals from baseband to Ka-band, and has a port expansion feature that allows the DCMS to be configured for testing units of varying size and complexity. The hardware has been designed to allow the core component to operate at a fixed frequency range. The frequency range of the core equipment is 1 to 18 GHz. Agilent provides additional external equipment to extend the core frequency range up to 31 GHz.

Measurement Architecture

The DCMS measurement architecture includes multitone stimulus for high-throughput testing of digital transparent processors as well as single and two-tone stimulus for testing bent-pipe payloads. In addition, this architecture allows for expansion to complex digital stimulus for testing the regenerative processors of the future. The measurement architecture is designed to support various standard and tailored measurement suites. The standard suites are available for both analog and digital transparent repeater test.

All measurements are corrected to allow the reference plane to be configured by the user. This allows the system to be used in different test environments.

Software Architecture

The DCMS software architecture provides an RF measurement subsystem with a consistent, well-defined interface. In effect, the DCMS serves as a measurement server to the external environment, accepting commands from an external sequence controller and returning measurement results for post-test processing. The software is designed to support both remote and local control. Remote control is achieved by sending messages through the external LAN interface.

Measurements

The N1891A comes with an extensive library of fully documented measurements, the following are a small subset of the available measurements:

Traditional Bent-Pipe:

- Output Power
- Gain Transfer
- Spurious
- Noise Figure
- Frequency Conversion

Digital Transparent:

- Real Beam Weights
- Channelization
- Noise Power Ratio (NPR)
- Phase Linearity

Digital Regenerative:

- BERT
- Wide bandwidth real time measurements

Key Literature & Web Link

5988-7037EN, www.agilent.com/find/sat-pts

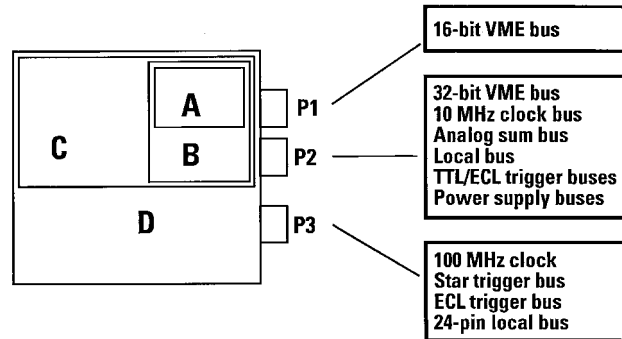
Ordering Information

Each N1891A is configured to meet the specific needs of each application. Please contact your Agilent representative for a quotation.

Korean URL www.agilent.co.kr/find/products



VXIbus Connectors



VXIbus Introduction

In 1987, a consortium led by several major test and measurement manufacturers, including Hewlett-Packard, introduced VXIbus, a new standard modular instrument architecture. VXIbus was developed to meet the needs for portable applications, particularly for the military, and to provide an industry-standard instrument architecture with an interface speed significantly higher than that of the GPIB interface. The design of this new architecture allowed the integration of VXIbus products into traditional GPIB test systems and for standalone applications. Today, the VXIbus Consortium continues to refine the VXIbus standard and Agilent Technologies has replaced HP as an active member.

Since the inception of VXIbus, other standards have been developed, which reduce users' dependence on any one vendor. This lowers the risks and provides maximum investment protection in hardware and software purchases and system development. Agilent's VXIbus products support the industry-accepted *VXIplug&play* instrument drivers¹. One set of these standard drivers for the MS Windows environment, for example, is supported by any of several popular software packages: Agilent VEE, Microsoft C/C++, Visual Basic, Borland C/C++, and NI Lab Windows. Other supported environments are Windows 95/NT, HP-UX, and SUN-OS.

Compact size, high throughput, and flexibility best characterize VXIbus. Today you can use VXIbus products to build a variety of test systems from portable testers for field use and remote data acquisition applications to high-performance data acquisition and functional test systems. While some systems are entirely VXIbus products, many users are integrating VXIbus along with traditional GPIB instruments. Today VXIbus manufacturers and numerous third-party integrators now are offering dedicated measurement solutions using the VXIbus platform. Agilent offers several integrated products based on VXIbus.

The pages which follow give a brief overview of the VXIbus Standard and a list of VXIbus products offered. For additional configuration and product ordering information, separate documents are available. For a free Agilent VXIbus Products Catalog, please visit our web site: www.agilent.com/find/vxi

The VXIbus Architecture

VXIbus is defined around the highly popular VMEbus architecture known for its excellent computer backplane. High-speed data rates of 40 MB/s along with the necessary communication protocols make it ideal for building instrument systems for high throughputs. VXIbus incorporates the ease-of-use features of intelligent GPIB instruments (for example, ASCII-level programming) into its message-based devices. It also takes advantage of the high-throughput capability of VMEbus devices which are programmed and communicate directly in binary.

Although VMEbus is an excellent computer backplane, it is not adequate for instrumentation without further standardization. The VXIbus Consortium fully defined the operating environment for instrumentation modules. All VXIbus mainframes must state how much power and cooling they provide. And all VXIbus modules must state how much power and cooling they require. Also, there are strict limits on how much conducted and radiated interference is allowed between modules. These parameters allow you to easily configure a workable system.

VXIbus systems provide backplane management and resource management functions. Slot 0, a unique physical location in every VXIbus mainframe, handles the backplane by providing clock signals, data movement arbitration, and more. The Resource Manager program configures the modules for proper operation whenever the system is powered on.

Mechanical and Electrical

The VXIbus specification defines a scalable family of four module sizes. The two smaller sizes, A and B, are the defined VMEbus module sizes, and are true VMEbus modules in every sense of the word. The two larger sizes, C and D, are additional sizes to allow higher performance instrumentation. Increased module spacing in the C- and D-size systems makes it possible to fully shield sensitive circuits for high-performance measurements. VXIbus is a scalable architecture, and allows smaller module sizes to fit into larger mainframes.

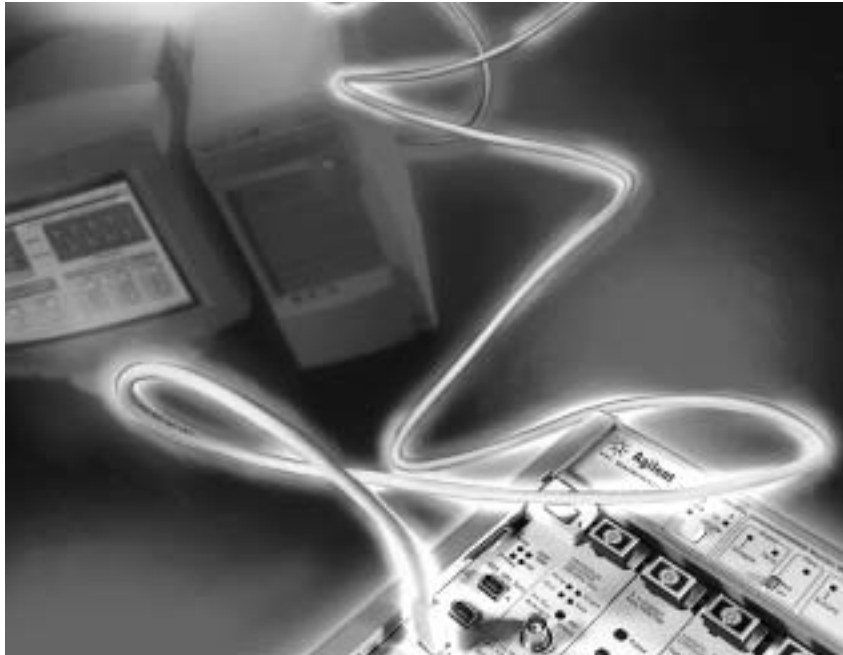
VXIbus provides other resources for instrumentation. These include additional power supply voltages for powering analog and ECL circuits, and implementation buses for measurement synchronization and triggering. Included are an analog summing bus and a set of local bus lines for private module-to-module communication. Additionally, stringent EMC and noise requirements are specified to maintain an interference-free environment for sensitive instrumentation.

VXIbus specifies three 96-pin DIN connectors: P1, P2, and P3. The P1 connector, the only mandatory connector in VMEbus or VXIbus, carries the data transfer bus (up to 24 bits addressing and 16 bits data), the interrupt buses, and some power. The optional P2 connector, available to all card sizes except A-size, expands the data transfer bus and provides the additional resources as shown with particular pin assignments. The local bus indicated is a powerful feature provided by VXIbus. This flexible daisy-chain bus structure allows for adjacent modules to conduct private, high-speed communication.

Power and Cooling

VXIbus specifies a set of guidelines to ensure adequate cooling. Every vendor's mainframe specifications sheet provides cooling specifications for worst-case module configuration. Available airflow as a function of the maximum allowable pressure differential across any module is specified. This is matched against the specified airflow and pressure parameters specified for each module.

¹ HP (now Agilent) joined the *VXIplug&play* Alliance in 1994 and has contributed to the definition of its industry-standard instrument drivers now provided by numerous VXI manufacturers.



The E8491B PC to VXI Link provides IEEE-1394 (FireWire) interface capability to your VXI test system.

Values of peak dc current and peak-to-peak dynamic current are specified for each module. The system integrator can match the total module current loading to the capacity of the mainframe. The dynamic current specification assures ripple-free noise on the mainframe's power supply lines.

Communications

A more standardized set of communication protocols is defined for VXIbus systems to handle autoconfiguration, resource management, and device communication. The Resource Manager, a message-based commander, takes care of the configuration tasks. It sets up the shared address space, manages the system self-test, creates the commander-servant hierarchies, and then releases the system for operation fully configured.

A message-based device, which communicates directly in SCPI (ASCII), is commonly the most intelligent VXIbus device. Typically it uses a microprocessor and is more costly than a register-based device, but is easier to integrate into a VXIbus system. Most message-based devices provide moderate throughput performance in a VXIbus system.

The most basic level of communication is that handled through register-level (binary-level) reads and writes to the registers of the register-based device (in some instances, direct-register access is provided on a message-based device to improve throughput performance). The register-based device is often controlled by an intelligent message-based device, its commander (command module or embedded controller). The commander interprets SCPI (ASCII) instrument commands converting them into binary for communication to the register-based device.

An IEEE-488-to-VXIbus interface is also defined in the VXIbus specification allowing for easy integration of VXIbus and GPIB products into one system. Agilent's Command Module (E1406A), for example, provides the GPIB connection for interfacing to an external GPIB controller. For high-throughput systems, an industry-standard interface, IEEE-1394 (FireWire), is provided in the E8491B PC link to VXI.

Summary

The benefits of industry-standard VXIbus systems are these:

- Downsizing to save costly rack space
- High-performance, high-throughput measurement capability
- Reduced time and cost for system development
- Reduced dependency on proprietary architectures

The following pages provide a listing of Agilent's VXI products. For product details and specifications, please refer to Agilent's VXIbus Products Catalog. To obtain a copy, please visit our web site: www.agilent.com/find/vxi



The E6432A VXI Microwave Synthesizer delivers CW signals with low phase noise and excellent spectral purity.



The E8408A is Agilent's smallest footprint, lowest-priced C-size mainframe.

75000 VXI Products Information

Model No.	Description
Mainframes	
E8408A	4-Slot, C-Size VXI Mainframe with options to add GPIB Command Module or IEEE-1394 Slot-0 Interface
E8401A	Low-cost, Medium Power C-Size VXI Mainframe, 13-Slot
E8403A	High Power, C-Size VXI Mainframe, 13-Slot, standard monitoring
E8404A	High Power, Enhanced Monitoring C-Size VXI Mainframe, 13-Slot
E1401B	High-Power Mainframe, C-Size, 13-Slot; racking options available
E1421B	Mainframe, C-Size, 6-Slot; racking options
E1300B/01B	Mainframes, B-Size, 7-Slot; built-in 68000 processor and IEEE-488 and RS-232 interfaces; Options: dc power, memory, mass storage, IBASIC
Controllers	
E1406A	Command Module, C-1, message-based commander, SCPI translator for register-based modules; optional expanded memory available
E4208D	SCSI Disk, C-1, 4 GB hard drive, 1.44 MB, 3.5-inch floppy
Interface	
E8491B	IEEE-1394 PC Link to VXI C-Size, Opt 001
Application Software	
E2120A	VEE Pro 6.1 for Windows, Graphical Programming Language
E2123A	VEE OneLab 6.1 for Windows, Graphical Programming Language
Measurement	
E1412A	6.5 Digit Multimeter, C-1, RB/MB, Vac/dc, lac/dc, 2/4-w ohms, frequency, period
E1411B	5 Digit Multimeter, C-1/B1, RB, Vdc/ac, 2/4-w Ω , temperature
E1430A	10 MSa/s A/D with DSP, C-1, RB 1-Ch., 23 b, 4 MHz bw, 24 digital filters, FIFO
E1437A	20 MSa/s Digitizer with DSP, C-1, MB/RB, 1-Ch., 23 b, 8 MHz bw, 24 digital filters, FIFO
E1438A	100 MSa/s Digitizer with DSP, C-1, RB, 1-Ch., 12 bit, 40 MHz BW, AAF, 17 dig. filters, FIFO
E1439A	95 MSa/s Digitizer with DSP, 70 MHz IF input, C-1, RB, 1-Ch., 12 bit, 36 MHz BW, AAF, 17 dig. filters, FIFO
SCMVX008	Digital Signal Processor, Dual 60 MHz, Tms 320, C40 DSP with 6 expansion slots
E3245A	12-channel mini-phone plug breakout box to 26-pin high density connector for SCMVX008
E1420B	High-Performance Universal Counter, C-1, MB, 2-Ch., 200 MHz/2 GHz
E1332A	4-Ch. Counter/Totalizer, B-1, RB, 4 MHz
E1333A	3-Ch. Universal Counter, B-1, RB, 1 GHz
E1416A	Power Meter, C-1, MB, 1-Ch., 110 GHz
E1485C	Digital Signal Processor, C-1, 40 MHz Motorola 96002 DSP with 4 expansion slots

Model No.	Description
Sources and Amplifiers	
E1445A	Arbitrary Function Generator, C-1, MB, 13 b, 40 Msa/s, 10.2 V p-p (50 Ω), sweep, waveforms: arb, sine, square, ramp; Optional waveform software available
E1328A	4-Ch. D/A Converter, B-1, RB, 16 b, 1.3 kSa/s, 10.92 V dc
E1418A	8/16-Ch D/A Converter, C-1, RB programmable isolation, ± 16 V, ± 20 mA, 16 bit 1 kHz update rate
E1441A	Arbitrary Waveform Generator
E8311A	C-1, 165 MHz/Pulse/Pattern Generator, 2 output channels, 10 Vpp (50 Ω into 50 Ω), 20 Vpp (1K Ω into 50 Ω), 16 kbit patterns, 5 ps timing resolution, 0.01% frequency accuracy, variable transition times (2 ns to 200 ms)
E8312A	C-1, 330 MHz/660 Mbit/s, Pulse/Pattern Generator, 2 output channels, 3.8 Vpp, 16 kbit patterns, 5 ps timing resolution, 0.01% frequency accuracy, 0.8 ns or 1.6 ns fixed transition times
Digital	
E1330B	Quad 8-bit Digital I/O, B-1, RB, 32-Ch., I or O, TTL, 325 kb/s
E1339A	72-Ch. Open-Collector Dig Out/Relay Driver
E1458A	96-Ch. Digital I/O, C-2, RB, 96-Ch., I or O, TTL
E1459A	64-Ch. Isolated Dig Input/Interrupt
E1452A	Pattern I/O Module, C-1, RB 32-Ch., Input or Output, TTL/CMOS, 20 M patterns/s
Switches – Relay Multiplexer	
E1343A	16-Ch., 3-w, B-1, RB, Reed, <10 μ V, 250 V, 10 MHz, 50 mA
E1344A	16-Ch., T/C, 3-w, B-1, RB, Reed, <10 μ V, 250 V, 10 MHz, 50 mA
E1345A	16-Ch., 3-w, B-1, RB, Reed, <4 μ V, 120 V, 10 MHz, 50 mA
E1346A	48-Ch., 1-w, B-1, RB, Reed, <50 μ V, 120 V, 10 MHz, 50 mA
E1347A	16-Ch., T/C, 3-w, B-1, RB, Reed, <4 μ V, 120 V, 10 MHz, 50 mA
E1351A	16-Ch., 2-w, B-1, RB, FET, <25 μ V, 16 V, 100 kHz, 1 mA
E1352A	32-Ch., 2-w, B-1, RB, FET, <25 μ V, 16 V, 100 kHz, 1 mA
E1353A	16-Ch., 1-w, B-1, RB, FET, <25 μ V, 16 V, 100 kHz, 1 mA
E1460A	64/32/128-Ch. 2/3/1-w, C-1, RB, Armature/L, <7 μ V, 60 V, 1 MHz, 1 A
E1476A	64-Ch. 3-w, 32-Ch. 4-w, C-1, RB, Reed, voltage, current, temperature (T/C)
E8460A	256-Ch. Reed Relay Multiplexer
E8462A	256-Ch. Armature Relay Multiplexer
Switches – RF Relay Multiplexer	
E1366A	Dual 1 x 4, 50 Ω , B-1, RB, Armature, <6 μ V, 42 V, 1.3 GHz, 1 A
E1367A	Dual 1 x 4, 75 Ω , B-1, RB, Armature, <6 μ V, 42 V, 1.3 GHz, 1 A
E1470A	60-Ch. Cascade RF Multiplexer, 60:1 to 20 3:1, 50 Ω , C-1, RB, Armature, <6 μ V, 30 V, 500 MHz (3:1), 450 mA (AC)
E1472A/73A	Six 1 x 4, 50 Ω , C-1, RB, Armature, <6 μ V, 42 V, 1.3 GHz, 1 A
E1474A/75A	Six 1 x 4, 75 Ω , C-1, RB, Armature, <6 μ V, 42 V, 1.3 GHz, 1 A
E8482A	Six 1 x 4, 50 Ω , C-1, Armature, 30 V, 3 GHz, 1 A
E8482B	Three 1 x 4, 50 Ω , C-1, Armature, 30 V, 3 GHz, 1 A

75000 VXI

Model No.	Description
Switches – Microwave	
E1368A	50 Ω, 3-Ch. Form C (SPDT), B-1, RB, Armature, 18 GHz
E1369A	Switch Driver, B-1, RB, drives switches up to 26.5 GHz
E1370A	Switch/Attenuator Driver, B-2, RB, drives switches up to 26.5 GHz
E8483A	Switch/Attenuator Driver, C-2, drives switches up to 26.5 GHz, attenuators up to 40 GHz

Switches – Matrix

E1361A	4 x 4, 2-w, B-1, RB, Armature, <14 μV, 250 V, 10 MHz, 1 A
E1465A	16 x 16, 2-w, C-1, RB, Armature/L, <5 μV, 200 V, 10 MHz, 1 A
E1466A	4 x 64, 2-w, C-1, RB, Armature/L, <5 μV, 200 V, 10 MHz, 1 A
E1467A	8 x 32, 2-w, C-1, RB, Armature/L, <5 μV, 200 V, 10 MHz, 1A
E1468A	8 x 8, 2-w, C-1, RB, Armature/L, <7 μV, 220 V, 10 MHz, 1 A
E1469A	4 x 16, 2-w, C-1, RB, Armature/L, <7 μV, 220 V, 10 MHz, 1A
E8481A	4 x 32, 2-w, C-1, RB, Reed, <50 μV, 42 V, 70 MHz, 3A

Model No.	Description
Switches – General Purpose	
E1364A	16-Ch., Form C (SPDT), B-1, RB, Armature, <7 μV, 250 V, 10 MHz, 1 A
E1463A	32-Ch. Form C (SPDT), C-1, RB, Armature, <7 μV, 125 V, 10 MHz, 5 A
E1442A	64-Ch., Form C/A (SPDT), C-1, RB, Armature, <70 μV, 150 V, 10 MHz, 1 A
E8480A	40-Ch., Form A (SPST), C-1, RB, Armature, <10 μV, 280 VAC, 10 MHz, 12 A

Special Purpose Modules

WJC9119S/M	High Frequency Tuner (down converter) C-2, RB, 32 MHz
-------------------	---

C-1 means C-size, 1 slot; B-2 means B-size, 2 slot; RB means Register-based; MB means Message-based, DIO means digital input/output.

Agilent's switch family provides you with long-lasting quality, reliability, and performance for your small, medium, or large test system. Agilent offers modular test systems with plug-in switch modules and dedicated instrumentation and fixturing.

VXIbus Modular Test Systems

The 75000 B- and C-size VXI test systems provide a modular architecture with numerous switches and instruments. These systems contain the most versatile switching solutions in the industry-standard VXI format. The C-size VXI system is the most popular architecture for high-performance, high-speed applications that require both switching and instrumentation. The B-size VXI system is ideal for applications requiring switching and some instrumentation.

- General purpose
- Matrix
- Multiplexers/scanners
- Microwave/RF
- Full line of instruments

3499 for Manufacturing Test and Desktop Switching

The Agilent 3499A/B/C switching/control systems are ideal for use in manufacturing test application where a high-speed, high density switching solution is needed. The 3499 family includes three mainframe (2 slots, 5 slots, and 9 slots) and 30 plug-in modules, making it cost-effective for any size application. The following modules are

available for the 3499A/B:

- 40/20/10-Channel Multiplexers (armature relays)
- 40-Channel Multiplexer (high-speed reed relays)
- 40/20/10-Channel General Purpose Relays (Form A and Form C)
- 4 x 8 and 4 x 4 Matrixes
- 32-bit and 16-bit Digital I/O
- 3.5 GHz, 1.3 GHz, and 300 MHz Dual 1 x 4 Multiplexers
- 1 GHz 1 x 9 RF Multiplexer
- Triple 1 x 2 18 GHz Microwave Multiplexers
- Dual 1 x 4 and 1 x 6 20 GHz Microwave Multiplexers
- Microwave Switch/Attenuator Drivers
- Quad 1 x 2, Dual 1 x 4, Single 1 x 8 Optical Multiplexers
- 4 x 4 Matrix + 16-bit Digital I/O
- 12-Channel General Purpose + 3-Channel High-Current + 16-bit Digital I/O
- 32-bit Isolated Digital I/O + Dual D/As
- 8-Channel 8 A General Purpose
- 10-Channel 1000 V Multiplexer

34970A for Low-Cost Switching

The 34970A Data Acquisition/Switch Unit is ideal for cost-sensitive applications with small- to mid-sized channel count requirements. The three-slot mainframe offers eight switch and control modules which cover a broad spectrum of capabilities.

- Low-frequency multiplexing to 300 V
- 2 GHz RF switching (both 50 and 75 ohms)
- Matrix switching/General Purpose/Form-C switching
- Digital IO/Analog output/Event counting

The Switch Module Selection Table on this page provides comparative information for each of the VXIbus switches.

Model #	Description	Size, Slots	Switching Type (L-latching)	Thermal Offset (per ch.)	Max. Volts (DC)	Bandwidth (~3 dB)	Current Rating	Closed Channel Resistance (Ω , initial)
Relay Multiplexers								
E1343A	16-Channel, 3-wire	B, 1	Reed relay	<10 μ V	250 V	10 MHz	50 mA	100 \pm 10%
E1344A	16-Channel T/C, 3-wire	B, 1	Reed relay	<10 μ V	250 V	10 MHz	50 mA	100 \pm 10%
E1345A	16-Channel, 3-wire	B, 1	Reed relay	<4 μ V	120 V	10 MHz	50 mA	100 \pm 10%
E1346A	48-Channel, 1-wire	B, 1	Reed relay	<50 μ V	120 V	10 MHz	50 mA	100 \pm 10%
E1347A	16-Channel T/C, 3-wire	B, 1	Reed relay	<4 μ V	120 V	10 MHz	50 mA	100 \pm 10%
E1351A	16-Channel, 3-wire	B, 1	FET	<25 μ V	16 V	100 kHz	1 mA	<3.1 k
E1352A	32-Channel, 1-wire	B, 1	FET	<25 μ V	16 V	500 kHz	1 mA	<3.1 k
E1353A	16-Channel T/C, 3-wire	B, 1	FET	<25 μ V	16 V	500 kHz	1 mA	<3.1 k
E1460A	64-Channel Relay Unit	C, 1	Armature, L	<7 μ V	220 V	3/10 MHz	0.3, 1 A	<1.5
E1476A	64-Channel, 3-wire	C, 1	Reed relay	<2 μ V	120 V	100 kHz	35 mA	100 \pm 5%
E8460A	256-Ch. Relay Multiplexer	C, 1	Reed relay	50 μ V	200 V	100 kHz	300 mA	<3
E8462A	256-Ch. Armature MUX	C, 1	Armature	3 μ V	250 V	—	2 A	<0.5
E2272A	Dual 8 x 1, MUX	M-Mod	DPST, L	<3 μ V	60 V	>10 MHz	2 A	0.2
RF Multiplexers								
E1366A	Dual 1 x 4, 50 Ω	B, 1	Armature	<6 μ V	42 V	1.3 GHz	1 A	<1
E1472A/73A	Six 1 x 4, 50 Ω	C, 1	Armature	<6 μ V	42 V	1.3 GHz	1 A	<1
E1367A	Dual 1 x 4, 75 Ω	B, 1	Armature	<6 μ V	42 V	1.3 GHz	1 A	<1
E1474A/75A	Six 1 x 4, 75 Ω	C, 1	Armature	<6 μ V	42 V	1.3 GHz	1 A	<1
E1470A	60-Channel RF Cascade Multiplexer	C, 1	Armature	—	30 V	500 MHz (1 x 3)	400 MA	<1.5 (typical)
E8482A	Six 1 x 4, 50 Ω	C, 1	Armature	<10 μ V	30 V	3 GHz	0.5 A	<1
E8482B	Three 1 x 4, 50 Ω	C, 1	Armature	<10 μ V	30 V	3 GHz	0.5 A	<1
Microwave Switches								
E1368A	50 Ω , 3-Ch. Form C (SPDT)	B, 1	Armature	—	—	18 GHz	—	—
E1369A	Switch Driver	B, 1	—	—	—	Up to 26.5 GHz	—	—
E1370A	Switch/Attenuator Driver	B, 2	—	—	—	Up to 26.5 GHz	—	—
E8483A	Switch/Attenuator Driver	C, 2	—	—	—	Up to 26.5 GHz	—	—
Matrix Switches								
E1361A	4 x 4, 2-wire	B, 1	Armature	<14 μ V	250 V	10 MHz	1 A	<1.5
E1465A/66A	16 x 16/4 x 64, 2-wire	C, 1	Armature, L	<5 μ V	200 V	10 MHz	1 A	<1.8
E1467A	8 x 32, 2-wire	C, 1	Armature, L	<5 μ V	200 V	10 MHz	1 A	<1.8
E1468A	8 x 8, 2-wire	C, 1	—	<7 μ V	220 V	10 MHz	1 A	<1.5
E1469A	4 x 16, 2-wire	C, 1	Armature, L	<7 μ V	220 V	10 MHz	1 A	<1.5
E8481A	4 x 32, 2-wire	C, 1	Reed	<50 μ V	42 V	70 MHz	0.5 A	<2
E2271A	4 x 4 Matrix	M-Mod	DPST, L	<3 μ V	60 V	>10 MHz	—	0.3
General Purpose Switches								
E1364A	16-Channel Form C (SPDT)	B, 1	Armature	<7 μ V	250 V	10 MHz	1 A	<1.5
E1442A	64-Ch. Form C/A (SPDT)	C, 1	Armature	<70 μ V	150 V	10 MHz	1 A	<1.5
E1463A	32-Channel Form C (SPDT)	C, 1	Armature	<7 μ V	125 V	10 MHz	5 A	<0.25
E8480A	40-Ch. High Power Form A (SPST)	C, 1	Armature	<10 μ V	280 V	10 MHz	12A	<0.1
E2270A	16-Ch. Form A Switch	M-Mod	SPST, L	<3 μ V	60 V	>10 MHz	2 A	<0.2
E2273A	8-Ch. Form C Switch	M-Mod	Armature	<20 μ V	60 V	>10 MHz	1 A	—

VXI Series
B/C-size
34970A
3499A/B/C

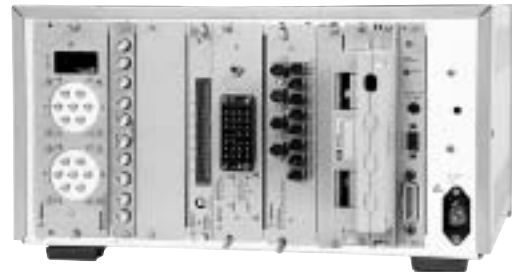
3499A
3499B
3499C

- Close/open 200 channels in parallel in 0.1 second
- 30 electronic and fiber-optical modules available
- Switching modules with built-in relay cycle counters

- DC to 26.5 GHz, 1 mA to 8 A, 1 mV to 1000 V
- Easy wiring with connection kits
- Multi-function modules for space saving



3499A/B front panels



3499C rear panels

3499A/B/C Switch/Control System

The Agilent 3499 family is a high speed, high density, switching solution for electronic/optical automated test (ATE) applications. It can scan at up to 300 channels per second, or open/close 200 channels in less than 0.1 second. The 3499A can accommodate up to 5 plug-in modules, routing up to 200 channels in a test system. The 3499B is a half-rack-width, 2-slot mainframe, switching up to 80 channels in ATE or desktop operations. The 3499C accommodates up to 9 plug-in modules for up to 360 electronic or up to 48 optical channels. The user can choose from 30 plug-in modules, to switch electronic signals from DC to 26 GHz, 1 mV to 1000 V, and 1 mA to 8 A, or to switch optical signals from 1270 to 1670 nm.

Both units have a concise user interface that is extremely useful for manual operation on the manufacturing floor or in desktop applications.



3499A/B rear panels

9

High Speed Switching

While traditional switching mainframes open/close relays in sequence, the Agilent 3499A/B/C use innovative parallel driving circuits to open/close switches simultaneously. The 3499A can drive as many as 50 channels in 25 ms. With fast reed relays, the N2266A multiplexer can scan at a speed up to 300 channel/second. The high-speed 3499A/B/C dramatically increase the test throughput of an automated test system.

Highly Reliable Switching

The switches are the linkage between the instruments and the DUT, and are the central parts of a test system. Reliability is the most important consideration when designing a switching system. If a low reliability switching system is chosen, it will be the weakest link in your test system, thus increasing your production down time. The design of the plug-in modules provides fail-safe protection circuitry and enough design margin to ensure high reliability.

High Density Switches

The Agilent 3499 family allows the user to select a cost-effective configuration for a specific application. High density switch modules reduce test system cost by condensing a large number of channels on a single module. The 3499A contains five slots that accommodate up to 200 switching channels for those large applications on the manufacturing floor. The 3499B contains two slots for switching up to 80 channels, a cost-effective solution for small manufacturing or desktop applications. The 3499C efficiently accommodates larger RF, microwave, and optical switch modules, or provides 9 slots for very large lower-frequency electronic switch systems. All three mainframes are designed for easy installation on a standard rack.

Ease of Maintenance

The built-in relay cycle counters on eleven newly-designed switching modules help you predict relay end-of-life, thereby avoiding costly production line down-time. The relay cycle counter automatically counts every individual relay closure and stores the number in the on-board memory. A simple command recalls the total number of cycles for individual relay, making preventative maintenance much simpler.

Ease of Wiring

The Agilent 3499 family provides two types of wiring connections to reduce the time and effort of wiring. Both the screw connection kits and pre-assembled cable assemblies are detachable from the switching modules, eliminating the need to rewire the connectors if a switching module is replaced. The cable assemblies provide D25 or D50 connectors for user connections of low-frequency signals. RF and microwave signals are connected directly to the face plates of the switch modules to assure high signal integrity.

Applications

The 3499A/B/C, with their diverse plug-in modules, are an ideal switching solution for automated test system applications. Typical applications include the production test system of cellular phones, base stations, antennas, pagers, printers, power supplies, optical, and electronic components. You will discover that the Agilent 3499 family is the preferred, highly reliable switching solution with its high density plug-in modules, high switching speed, ease of wiring, ease of maintenance, and low cost per channel.

Plug-in Module Description**40-Channel High Speed Multiplexer****N2266A**

The Agilent N2266A is a high speed multiplexer module for high throughput production test system applications, scan speed is up to 300 channel/second. It can be configured as a 1-wire 80-channel, a 2-wire 40-channel, or a 4-wire 20-channel multiplexer.

8-Channel 8 A General Purpose**N2267A**

The N2267A is a highly reliable GP module for high current, low resistance switching applications, such as AC/DC power supply test. It can also be used to switch AC (up to 250 V) or DC power supplies, current sources, and line powers.

10-Channel 1000 V Multiplexer**N2270A**

The N2270A is a highly reliable 2-wire multiplexer. It can be used to source voltage up to 1000 V to any of ten DUTs or to monitor voltage from different sources with a voltmeter. Applications include capacitor breakdown voltage test and high-resistance measurement of transformers, capacitors, relays, connectors, PCBs and cables.

Dual 1 x 4 RF (50 Ω 3.5 GHz) Multiplexer**N2268A**

The N2268A has two independent 1 x 4 multiplexers with SMA connectors, providing very low insertion loss, high isolation and excellent VSWR performance. The high isolation performance makes this module ideal for RF signal measurements with spectrum analyzers, network analyzers and GSM/CDMA test sets. Each group of four channels is isolated from the other and from the chassis to prevent ground loops. The typical applications include 1.8/1.9 GHz wireless communication device, *Bluetooth* transceiver and L1/L2 GPS receiver test.

32-Bit Isolated DIO+2 DACs**N2269A**

The N2269A multifunction module is a combination of two DACs, 16-bit digital input and 16-bit digital output. The optically isolated module is designed for industrial automation, it provides excellent signal integrity by eliminating ground noise.

40-Channel Multiplexer**N2260A**

The N2260A can be configured as 1-wire 80-channel, 2-wire 40-channel, dual 2-wire 20-channel, or a 4-wire 20-channel multiplexer for scanning or multiple-signal/instrument connection.

40-Channel General Purpose**N2261A**

The N2261A is ideal for creating isolated control between circuits, providing power control of DUTs, or control of stepping motors and solenoids.

4 x 8 Matrix**N2262A**

The N2262A provides the most flexible way to connect a group of test instruments to multiple test points on DUTs.

32-Bit Digital I/O**N2263A**

The N2263A, with its 32 TTL compatible digital bits, and 3 handshake lines, can be used to drive/control external devices, to monitor external status, or to communicate with other devices. It provides 3 modes (Static, Strobe, Handshake) for different I/O control applications.

12 + 3 GP + 16-Bit Digital I/O**N2264A**

The N2264A multi-function module is designed for applications that require general purpose relays and up to 3 high current relays (5 A maximum) within one module for rack space saving. The 3 high current relays are very useful in applications where a few low resistance channels are needed, such as in cellular phone or battery production test system. There are also 16 bits of Digital I/O on this module.

1 GHz 1 x 9 RF Multiplexer**N2272A**

The N2272A high-density RF module provides a 1 x 9 multiplexer for RF signals up to 1 GHz. Low insertion loss, high isolation, and excellent VSWR performance guarantee that the RF signals will not be degraded when routed from source to destination. To decrease signal degradation when multiple modules are cascaded, an auxiliary channel (with smaller insertion loss and lower VSWR) can be connected to the COM channel of the next N2272A module, creating larger RF multiplexers while maintaining excellent signal characteristics. The auxiliary channel can also be used as a standard channel. BNC connectors on the module's front panel provide ease of cabling.

20 GHz Dual 1 x 4 or 1 x 6 Microwave Multiplexers**N2276A/B**

The N2276A provides dual 1 x 6 or 1 x 4 microwave multiplexers with excellent insertion loss, isolation and VSWR performance. The modular N2276A fits your channel density needs, minimizing the redundant channels and offering very cost effective microwave switching with SMA connectors. The N2276A can also drive two external microwave attenuators (Agilent 84904/6/7/K/L). The N2276B is a microwave multiplexer/attenuator driver, deleting the microwave relays from the N2276A. The N2276B can drive any two 1 x 4 or 1 x 6 microwave relays (Agilent 87104A/B/C, 87106A/B/C) and/or two external microwave attenuators (Agilent 84904/6/7/K/L). Custom microwave switch configurations can be built with the N2276B and microwave relays, with relay drive power supplies and digital I/O relay control conveniently provided by the N2276B. Use the N2276A/B in testing mobile and cordless phones, mobile radios, cellular base station, broadband wireless communication transceivers, RFICs, and high-speed digital circuits.

Quad 1 x 2, Dual 1 x 4, Single 1 x 8 Optical Multiplexers**N2280A/N2281A/N2282A**

The N2280A (Quad 1 x 2), N2281A (Dual 1 x 4), and N2282A (1 x 8) optical modules bring the flexibility of modular switching to optical test applications. The optical switching modules, combined with other 3499 family electronic switching modules, provide a total switching solution in electro/optical test systems. With these optical switching modules, test engineers can set up an ATE system with just enough optical switching channels to fit the current application, and add more channels later as the application grows. The collimating lens optical relays minimize insertion loss, and improve switching repeatability and stability. These three modules are ideal for lightwave/optical component test and network monitoring. These modules are optically passive and operate independently of data rate, data format and optical signal direction; and are transparent to signaling formats. SC/APC connectors provide reliable and easy connections.

4 x 4 Matrix + 16-Bit Digital I/O**N2265A**

The N2265A is designed for applications that require 4 x 4 matrix and 16 bits digital I/O within one module for rack space saving.

10-Channel Multiplexer**44470A****20-Channel Multiplexer****44470D****10-Channel General Purpose****44471A****20-Channel General Purpose****44471D****Dual 1 x 4 RF Multiplexer****44472A****4 x 4 Matrix****44473A****16-Bit Digital I/O Module****44474A****Breadboard****44475A****7 Form-C Relay****44477A****18 GHz Microwave Switches****44476A****1.3 GHz 50 Ω RF Multiplexer****44478A****1.3 GHz 75 Ω RF Multiplexer****44478B****Microwave Relay Driver****44476B**

This module can drive two of the following Agilent 876xx coaxial switches.

Coaxial Switch	Ports	Max. Frequency
8762A, B, C, F	3	4 GHz to 26.5 GHz
8763A, B, C	4	4 GHz to 26.5 GHz
8764A, B, C	5	4 GHz to 26.5 GHz

Notes: The 8762F is for 75 Ω signal switching.

Please choose option 011 when ordering these coaxial switches for the coil voltage of 5 V DC. For details of Agilent 876xx specification, please refer to publication number 5964-9527E.

3499A
3499B
3499C

3499A/B/C Mainframe Specifications

Power Supply: 100 to 240 VAC universal input; 47 Hz to 440 Hz; 40 VA maximum (3499A/B); 65 VA maximum (3499C)
Operating Environment: 0°C to 55°C, <80% RH (0°C to 40°C)
Storage Environment: -40°C to +70°C
Size: 3499A: 89 mm H x 426 mm W x 348 mm D (3.5 in x 16.8 in x 13.7 in)
 3499B: 89 mm H x 213 mm W x 348 mm D (3.5 in x 8.4 in x 13.7 in)
 3499C: 222 mm H x 426 mm W x 354 mm D (8.75 in x 16.8 in x 13.9 in)
Net Weight: 3499A: 3.8 kg (8.4 lbs); 3499B: 2.5 kg (5.5 lbs); 3499C: 7.4 kg (16.4 lbs)
Safety: Conforms to CSA, UL-1244, IEC 1010 Cat I
RFI and ESD: CISPR 11, IEC 80 1/2/3/4
Slot Capacity: 3499A: 5 slots; 3499B: 2 slots; 3499C: 9/14 slots
Rear Panel Connectors: GPIB; RS-232; 8-pin Mini DIN
Trigger Source: External (9-pin Mini DIN); GPIB; RS-232
Built-in 4 digital I/O: Input: TTL compatible; Vout (H) ≤42 V
Warranty: 1 year

Key Literature

Agilent 3499 Switching Family Data Sheet, p/n 5988-6103EN
 Agilent 3499 Switching Family Product Overview, p/n 5988-6102EN

Plug-in Module Selection Table

Module	Description	Max. Voltage	Max. Current per Chan.	Initial Closed Channel Resistance	Thermal Offset per Chan.	Bandwidth	Connection Type	Relay Cycle Counter
Multiplexer Modules								
N2260A	40-Channel	200 V	1 A	<1 Ω	<3 μV	10 MHz	T or C	Yes
N2266A	40-Channel	200 V	0.5 A	<1 Ω	<50 μV	40 MHz	T or C	Yes
N2270A	10-Channel	1000 V	1 A	<1 Ω	<200 μV	5 MHz	Crimp & Insert	Yes
44470A	10-Channel	250 V	2 A	<1 Ω	<3 μV	10 MHz	T	
44470D	20-Channel	250 V	2 A	<1 Ω	<3 μV	10 MHz	T	
General-Purpose Relay Modules								
N2261A	40-Channel	200 V	1 A	<0.5 Ω	<3 μV	10 MHz	T or C	Yes
N2267A	8-Channel	250 V	8 A	<0.08 Ω	<3 μV	20 MHz	Crimp & Insert	Yes
44471A	10-Channel	250 V	2 A	<1 Ω	<3 μV	10 MHz	T	
44471D	20-Channel	250 V	1 A	<1 Ω	<3 μV	10 MHz	T	
44477A	7-Channel	250 V	2 A	<1 Ω	<3 μV	10 MHz	T	
Matrix Modules								
N2262A	4 x 8 matrix	200 V	1 A	<1 Ω	<3 μV	10 MHz	T or C	Yes
44473A	4 x 4 matrix	250 V	2 A	<1 Ω	<3 μV	10 MHz	T	
Digital I/O Modules								
N2263A	32-bit TTL	42 V	0.6 A	—	—	—	T or C	
44474A	16-bit TTL	30 V	0.125 A	—	—	—	T	
Multi-Function Modules								
N2264A	12 GP	200 V	1 A	<0.5 Ω	<3 μV	10 MHz	T or C	Yes
	3 GP	125 V	5 A	<0.1 Ω	<3 μV	10 MHz	T or C	Yes
	16-bit DIO	42 V	0.6 A	—	—	—	T or C	
N2265A	4 x 4 matrix	200 V	1 A	<1 Ω	<3 μV	10 MHz	T or C	Yes
	16-bit DIO	42 V	0.6 A	—	—	—	T or C	
N2269A	2 DAC	12 V	10 mA	—	—	—	T or C	
	32-bit DIO	TTL Compatible	—	—	—	—	T or C	

Notes: GP = General Purpose; DIO = Digital I/O; T = Terminal Block; C = Cable.

Fiber-Optical Multiplexer Modules (typical specs)

Modules	Description	Insertion Loss	Stability	Repeatability	Wavelength	Connector	Switching Time
N2280A	Quad 1 x 2	0.5 dB	±0.03 dB	±0.005 dB	1310/1550 nm	SC/APC	15 ms
N2281A	Dual 1 x 4	0.5 dB	±0.03 dB	±0.0065 dB	1310/1550 nm	SC/APC	20 ms
N2282A	Single 1 x 8	0.5 dB	±0.02 dB	±0.005/0.01 dB	1270/1670 nm	SC/APC	250 ms

RF & Microwave Modules

Modules	Description	Insertion Loss	Cross Talk	SWR	Bandwidth	Impedance	Connector
N2268A	Dual 1 x 4	<0.35 dB	<-64 dB	<1.20	3.5 GHz	50 Ω	SMA
N2272A	Single 1 x 9	<0.5 dB	<-75 dB	<1.20	1.0 GHz	50 Ω	BNC
N2276A	Dual 1 x 6	<0.36 dB	<-100 dB	<1.20	20 GHz	50 Ω	SMA
N2276B Relay driver can support 2 microwave switches. Technical specs depend on the mounted relays.							
44472A	Dual 1 x 4	<0.75 dB	<-85 dB	<1.12	300 MHz	50 Ω	BNC
44478A	Dual 1 x 4	<1.1 dB	<-70 dB	<1.35	1.3 GHz	50 Ω	BNC
44478B	Dual 1 x 4	<1.1 dB	<-70 dB	<1.35	1.3 GHz	75 Ω	BNC
44476A	Triple 1 x 2	<0.25 dB	<-90 dB	<1.15	18 GHz	50 Ω	SMA
44476B Relay driver can support 2 microwave switches. Technical specs depend on the mounted relays.							

Ordering Information

3499A 5-Slot Switch/Control Mainframe, includes hard copy manual and power cord. Plug-in modules are ordered separately.

3499A-0B0 Delete Hard Copy User's Manual

3499A-1CP Rack Mount Kit with Handles

3499A-1CM Rack Mount Kit

3499A-0B1 Add additional User's Manual

3499B 2-Slot Switch/Control Mainframe, includes hard copy manual and power cord. Plug-in modules are ordered separately.

3499B-0B0 Delete Hard Copy User's Manual

3499B-1CM Rack Mount Kit with half-rack filler panel

3499B-0B1 Add additional User's Manual

3499C 9/14-Slot Switch/Control Mainframe. User's manual is not included. Must order 3499C-0B1 for hardcopy of the User's Manual. Plug-in modules are ordered separately.

3499C-0B1 Hardcopy of User's Manual

Plug-in modules (* terminal block included)

N2260A 40-Channel Multiplexer Module*

N2261A 40-Channel General Purpose Relay Module*

N2262A 4 x 8 Matrix Module*

N2263A 32-bit Digital I/O Module*

N2264A 12 + 3 GP + 16-bit Digital I/O Module*

N2265A 4 x 4 Matrix + 16-bit Digital I/O Module*

N2266A 40-Channel High-speed Multiplexer Module*

N2267A 8-Channel 8 A General Purpose Relay Module*

N2268A Dual 1 x 4 RF (3.5 GHz) Multiplexer Module

N2269A 32-bit Optical Isolated DIO + 2 DACs Module

N2270A 10-Channel 1000 V Multiplexer Module*

N2272A 1 x 9 RF (1 GHz) Multiplexer Module

N2276A Dual Microwave Multiplexer Module

N2276A-204 Dual 1 x 4 Multiplexer

N2276A-206 Dual 1 x 6 Multiplexer

N2276B Microwave Multiplexer Driver Module

N2280A Quad Optical 1 x 2 Multiplexer Module, SC/APC

N2281A Dual Optical 1 x 4 Multiplexer Module, SC/APC

N2282A 1 x 8 Optical Multiplexer Module, SC/APC

44470A 10-Channel Relay Multiplexer Module*

44470D 20-Channel Relay Multiplexer Module*

44471A 10-Channel GP Relay Module*

44471D 20-Channel GP Relay Module*

44472A Dual 1 x 4 RF (300 MHz) Multiplexer Module (50 Ω)

44473A 4 x 4 Matrix Switch Module*

44474A 16-bit Digital I/O Module*

44475A Breadboard Module*

44476A Microwave Multiplexer Module

44476B Microwave Switch Driver Module

44477A 7-Channel Form-C Relay Module*

44478A Dual 1 x 4 RF (1.3 GHz) Multiplexer (50 Ω)

44478B Dual 1 x 4 RF (1.3 GHz) Multiplexer (75 Ω)

Accessories

N2289A Mini-DIN-to-D9 cable for built-in DIO in 3499A/B/C

N2290A Screw terminal block for N2260A and N2266A

N2291A Screw terminal block for N2261A

N2292A Screw terminal block for N2262A

N2293A Screw terminal block for N2263A

N2294A Screw terminal block for N2264A

N2295A Screw terminal block for N2265A

N2297A DIN96-to-Twin-D50 cable for N2260A – N2266A, N2269A

N2298A DIN96-to-D25 cable for N2262A

N2299A DIN96-to-Quad-D25 cable for N2260A – N2266A, N2269A

N2320A Crimp & Insert Connection Kit for N2270A

N2327A Crimp & Insert Connection Kit for N2267A

N2329A Screw Connection Kit for N2269A

44480A Connector Kit for 44470A

44480B Connector Kit for 44470D

3499A

3499B

3499C

35670A

- High resolution display
- Two or four channels (optional)
- Portable-fits under an airplane seat
- 1600 line frequency resolution
- 16-bit ADC/90 dB dynamic range (typical)
- 16 MB RAM Standard



35670A

35670A Dynamic Signal Analyzer

The 35670A lets you make laboratory-quality measurements in the field, on an automobile test track, flying above a city, or in the narrow confines of a submarine. Small enough to fit under an airplane seat, the 35670A is a two-, or four-channel (35670A-AY6), FFT-based spectrum/network analyzer. The standard instrument provides spectrum, network, time-domain, and amplitude-domain measurements from virtually dc to slightly over 100 kHz. Your ability to solve problems in the field is enhanced with the optional four-channel 35670A – measure noise at multiple locations inside vehicles, make triaxial vibration measurements, or gather data from several locations along a noise transmission path.

With the 35670A, you carry all your measurement and analysis tools in one package. Octave analysis (35670A-1D1) adds real-time measurements of 1/1, 1/3, or 1/12 octave spectra at frequencies up to 40 kHz. Computed order tracking (35670A-1D0) allows you to view spectra as a function of orders, or to view the amplitude of multiple orders as a function of RPM. Standard 16 MB of memory provides deep transient time capture or extra space for 2 MB of non-volatile memory. An arbitrary source (35670A-1D4) lets you test devices with real-life test signals. With Instrument BASIC (35670A-1C2), you can automate measurements or customize your instrument interface. Everything you need to troubleshoot vibration and noise problems in the field is in one instrument. (You can retrofit all options – buy only the functionality you need today and add more as your needs change.)

A deep transient time capture memory can record up to four channels of data plus a tachometer signal for playback in the narrow-band FFT, octave, order, correlation, or histogram instrument modes. Pre- and post-trigger delay functions let you capture the leading edge of one-time events or eliminate transmission delay in signals.

Real-Time Octave Analysis to 40 kHz (ANSI S1.11-1986)

Octave analysis (35670A-1D1) adds a real-time octave analyzer to your 35670A for analysis in 1/1-, 1/3-, or 1/12-octave bands. Four LEMO connectors with power for microphones are provided by the microphone adapter and power supply (35670A-UK4). The 1/1- and 1/3-octave band filters in the 35670A comply fully with ANSI S1.11-1986 (Order 3 Type 1-D), DIN 45651, and IEC 225-1966. An overall total power band and an A-weighted overall power band can be activated as needed. All three octave band modes and the overall power band can be A-weighted with an analog filter in full compliance with IEC 651-1979 Type 0. The overall power band can be redefined as a broadband impulse detector that complies with IEC 651-1979 Type 0. A fan-off mode eliminates instrument noise from measurements. A pink noise source allows you to evaluate electroacoustic devices.

View Spectra in the Order Domain (35670A-1D0)

View spectra as a function of orders or track up to five orders on four channels simultaneously with computed order tracking (35670A-1D0). Orders as high as 200 can be tracked. An order map can be displayed as a function of RPM or time, using the waterfall function. Waterfall markers let you view the track of any order.

Computed order tracking is ideal for troubleshooting rotating machinery. Run-up or run-down measurements can be displayed in bode or polar formats. Oscilloscope-quality orbit diagrams are another benefit. Because the data is resampled with changes in RPM, a single-loop orbit display is maintained as the shaft RPM is varied. With four channels (35670A-AY6), two orbits can be measured simultaneously—at both ends of a shaft, for instance. An RPM measurement readout, available in any instrument mode, aids in the interpretation of measurement data from rotating machinery.

Computed order tracking provides alias-protected measurements without expensive and cumbersome external ratio synthesizers and tracking filters. This new technique uses a digital tracking algorithm that follows rapid changes in shaft RPM without time delay and eliminates the phase noise normally associated with ratio synthesizer techniques. Accuracy is enhanced over traditional methods.

Swept-Sine or Broad Measurement Range (35670A-1D2)

The swept-sine instrument mode expands the network analysis range of the 35670A to 130 dB. Higher noise rejection and accuracy are obtained by auto-ranging the instrument during the sweep. Automatic sweep resolution reduces measurement time without sacrificing accuracy. Alternatively, sweep resolution can be set by the user.

Advanced Modeling and Analysis Cut Design Time

Prototype revisions are reduced by modeling design modifications using curve fit and synthesis functions (35670A-1D3). In a typical application, a model of the test device is created by curve fitting a frequency response measurement. Up to 20 poles and 20 zeros are used to describe the device; results can be output in pole/zero, pole/residue, or polynomial formats. The designer then transfers the circuit model to the synthesis function. Using synthesis, the model is modified by adding or deleting poles and zeros. The frequency response function of the modified model is then synthesized to test the design modification.

Automation Improves Productivity

Instrument BASIC (35670A-1C2) replaces the external computer in small test systems. Like the computer, it can be used to automate measurements, create a custom user interface, synthesize new information from raw data, or control other instruments and peripherals. An optional external keyboard plugs into the rear panel. The 35670A provides direct control of external disks, plotters, and printers via GPIB RS-232, or parallel interfaces, and is fully programmable via the GPIB.

35670A-100 software bundle

Bundles options 1D0 through 1D4 and UFC. 35% discount over the same options sold separately.

Key Literature

- 35670A RotoDynamics Measurement, p/n 5966-0518E
- 35670A Technical Data Sheet, p/n 5966-3064E
- 35670A Product Overview, p/n 5966-3063E
- DSA Accessory Catalog, p/n 5966-2340E

For more information, visit our web site:

<http://www.agilent.com/tmo/datasheets/English/35670A.html>

Ordering Information

- 35670A Dynamic Signal Analyzer
 - 35670A-AY6 Add 2 Input Channels
 - 35670A-1D0 Computed Order Tracking Measurements
 - 35670A-1D1 Real-Time Octave Measurements
 - 35670A-UK4 Microphone Adapter and Power Supply
 - 35670A-1D2 Swept-Sine Measurements
 - 35670A-1D3 Curve Fit/Synthesis
 - 35670A-1D4 Arbitrary Waveform Source
 - 35670A-1C2 Instrument BASIC
 - 35670A-100 Software Bundle

Accessories

- 35250A DC Power Cable (3 m)
- 35251A DC Power Cable w/Cigaretter Lighter Adapter



Standard Rack Cabinet (E3661B)



Standard Rack Cabinets: E3661B (32 EIA), E7590A (25 EIA), E3662B (41 EIA)

Rack Solution for Agilent Systems

Agilent Technologies offers 19-inch EIA (Electronics Industries Association) rack cabinets tailored to meet the needs of test and measurement instrumentation customers. Rack mounting is fast and easy with unique design features. A selection of options and accessories provides flexibility to meet the vast majority of racking applications.

Standard Rack Includes:

- Vented top for better cooling
- Solid base
- Leveling screws
- Retractable anti-tip foot
- 4 Concealed lifting hooks. Each hook can support 227 kg (500 lbs)
- One Agilent System II rail kit, including a pair of rails
- 3-Inch heavy duty casters
- Power distribution Unit (PDU) – must specify 110 V or 220 V
- Vented, swinging rear door with lock
- Easy to remove side panels, which can be lifted off
- Attractive quartz gray color

Shipping Features

All racks and accessories are shipped with basic assembly completed, as shown.

Agilent Rack Value

Agilent racks have been designed and engineered to save time and money for our customers:

- Package design – Designed for easy unloading from the pallet
- Pallet re-use – Racks are sent out with double pallets, as well as a ramp. Racks can be integrated on the pallet, which adds a convenient system for integrating the rack. The pallet has been tested up to 1000 pounds and can be used to ship an integrated system, saving you time and money
- Fully assembled rack – Customers receive Agilent racks fully assembled and ready for equipment installation saving time and money. Accessories can be ordered, and will be shipped ready to be integrated onto the rack
- Unique column and rail design – Equipment installation time is cut in half because of Agilent's unique column and support rail design. Our special cutouts in the columns, spaced at EIA intervals and rail hooks assure instruments are mounted easily in the right place the first time

Enhance Your Instrument Investment

Agilent racks are specifically designed for Agilent's test and measurement equipment, virtually ensuring a perfect fit. Agilent racks will also accommodate non-Agilent equipment making them suitable for the customer of a mixed instrument environment. Designed for today's competitive environment, five heights are offered to accommodate any system: 1.3 m, 1.6 m, and 2.0 m. All racks are deep enough to hold Agilent instruments of varying sizes.

Load a Rack in Less Time

The design of Agilent support rails can cut in half the time required to install equipment in a rack. The rails hang on discrete slots on the vertical mounting columns, corresponding to each EIA unit in the rack. Vertical adjustment between instruments is minimized by selecting the proper rail. Rails are available for Agilent System II instruments and for flat bottom instrument chassis. The system was specifically designed to minimize the time required to install instruments.

Rack Systems Fast and Easily

Racks are shipped with all basic materials assembled. No time is lost preparing a rack with basic assembly. Accessories, kits and supplementary small parts are shipped separately, as ordered, and are ready for immediate configuration. More than just a way of storing instruments, the racks reflect Agilent's reputation for quality and design. A sturdy frame provides structural integrity, which allows lightweight, easy-to-lift off side panels that allow for installation and easy access to equipment and cables. Rails are placed into keyed slots in the vertical columns, resulting in quick and accurate positioning.

Use Vertical Space Efficiently

Vertical space within a rack is measured in industry-standard EIA units, where 1 EIA unit = 1.75 inches (44.5 mm). Equipment height is also specified in EIA units. System configuration is made easier by counting EIA units from the base of the rack. A seamless fit of instrument and rail is ensured.

Manage Power Requirements

A power management system must be ordered. Option AW3 (110 V) or option AW5 (220 V). It is vertically mounted behind the rack rear column and supplies power to the cabinet. An illuminated master switch, which is conveniently located on the front of the rack, provides easy access to turn the power on and off.

E3661B
E3662B
E7590A

Protect from Heat Buildup

It is important for racks to efficiently dispose of heat. Instruments increasingly generate more heat, and in a compact rackmounted system the heat buildup can be detrimental to the system. System-generated heat is removed by natural convection through a ventilation path incorporated in the roof of the racks. The vented rear door also helps reduce the heat captured within the rack. For greater heat dissipation, an optional easy to install top-mounted extractor fan is available.

Secure Instruments During Test

Both the rear door and the optional Plexiglas front door can be locked to secure against disruption of tests or unauthorized removal of system components. The symmetrical rear door design allows it to be mounted for opening to either left or right, useful for multi-bay configurations.

Move Racks Easily

Each rack is provided with four 3-inch diameter, smooth-rolling, heavy-duty casters to facilitate moving racks over short distances. Four lifting hooks conveniently concealed in the top of the rack allow for transport, even when fully loaded. Each hook can support 227 kg (500 lbs) to easily handle the maximum recommended gross weight for a loaded rack of 816 kg (1800 lbs).

Enhance Stability

A front mounted retractable anti-tip stabilizer that can be extended into place with ease is standard on all racks. It provides temporary anti-tip capability for slide mounted products when they are in their extended position. Use the optional anti-tip ballast kit when permanent anti-tip capability is desired.

Improve Cable Management

Agilent racks, including the 1.3 m, 1.6 m and 2.0 m, have an additional 100 mm of internal space that is available at the rear of the rack. This convenient space is available for the installation of power distribution units (PDUs) and as a convenient location for cables, which are routed out the bottom of the rack. The added rear space also enhances air flow.

Ventilation

Agilent standard racks include a vented top cap and 100 mm additional internal rear space enhancing air flow.

Material

Frame/columns: 13 Ga. cold rolled steel.
Side Panels: 18 Ga. cold rolled steel.

Rack Dimensions, Weight and Load Ratings

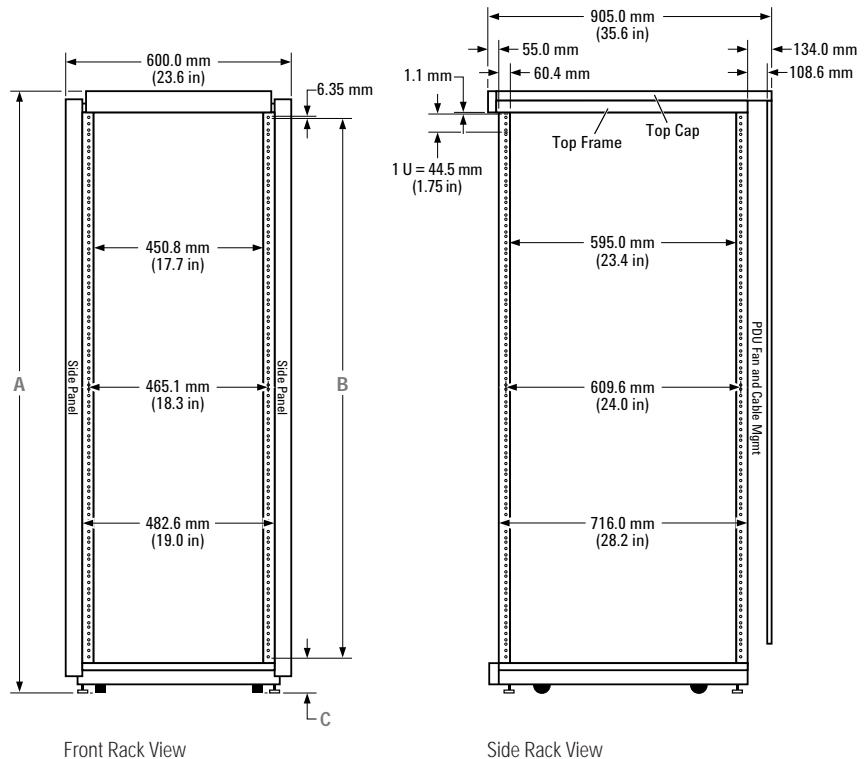
Prod. No.	Dim	Height	Width	Depth	Weight	Load Capacity	EIA Units
E7590A	Exterior A	1320 mm (51.9 in)	600 mm (23.6 in)	905 mm (35.6 in)	89 kg (196 lbs) empty	816 kg (1800 lbs)	25
	Interior* B	1111.25 mm (43.8 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			
E3661B	Exterior A	1620 mm (63.8 in)	600 mm (23.6 in)	905 mm (35.6 in)	100 kg (221 lbs) empty	816 kg (1800 lbs)	32
	Interior* B	1422.5 mm (56.0 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			
E3662B	Exterior A	2020 mm (79.5 in)	600 mm (23.6 in)	905 mm (35.6 in)	116 kg (255 lbs) empty	816 kg (1800 lbs)	41
	Interior* B	1822.5 mm (71.8 in)	450.8 mm (17.8 in)	851 mm (33.5 in)			

*Interior = EIA units = Rackmountable space.

Front to rear column hole spacing: 610 mm (24 in)

9

Prod. No.	Dim	Height
E7590A	A	1,320 mm (51.9 in)
	B	1,111.25 mm (43.75 in)
	C	120.81 mm (4.76 in)
E3661B	A	1,620 mm (63.8 in)
	B	1,422.4 mm (56.0 in)
	C	131.83 mm (5.19 in)
E3662B	A	2,020 mm (79.5 in)
	B	1,822.45 mm (71.75 in)
	C	131.83 mm (5.19 in)



Rack Specifications

Casters Rating 318 kg (700 lb) each, 816 kg (1,800 lb) total
Casters have a point contact, convex cross section

Lift Hook Rating 227 kg (500 lb) each
Total system and cabinet weight is a maximum 816 kg (1,800 lbs), static. Lift cabinet using all four (4) hooks.

Material

Frame/columns: 13 Ga. cold rolled steel
Side Panels: 18 Ga. cold rolled steel

Ventilation

Vented top cap
100 mm additional internal rear space to enhance air flow

Ordering Information

Agilent racks can be ordered at: www.agilent.com
A complete catalog of Agilent racks and accessories is located at:
www.agilent.com/find/enclosures

E3661B
E3662B
E7590A

Power Distribution Units (PDUs)

The power distribution unit is a convenient way to supply power to everything mounted in the rack. The PDU is mounted vertically behind the rear column and does not reduce vertical mounting space in the rack.

A lighted master power switch is supplied with the PDU. The switch provides rapid system shutdown in case of emergency or turns off power conveniently. The switch controls a relay in 1 or 2 PDUs and uses low voltage signal lines for safety and to minimize electrical noise.

- Circuit breakers are provided on both hot (live) and neutral lines
- All PDUs are single phase
- A maximum of two PDUs can be installed in a rack
- The top receptacle of all PDUs is configured as IEC-320 and is intended for the extractor fan. It can be used for other purposes if no fan is installed
- Different power cords and sizes are offered. Select the one that is appropriate for your location and rack solution

PDUs must be Specified as Option:

- AW3 for 100 – 120 V North American configuration, or
- AW5 for 200 – 240 V International configuration.

Additional PDUs can be Ordered as Follows:

PDUs for 1.3 m Racks

Prod. No.	Voltage	Region
E4451A	100 – 120 V	North America
E4453A	200 – 240 V	International

PDUs for 1.6 m and 2.0 m Racks

Prod. No.	Voltage	Region
E4455A	100 – 120 V	North America
E4457B	200 – 240 V	International

Monitor Rackmount Kit

Product Number: J1519BC

- Quartz gray
- The monitor rackmount kit can accommodate 14 – 19 inch monitors. The kit consists of a shelf, all required mounting hardware, and cosmetic panels around the monitor
- EIA units required: 11 EIA U

Keyboard and Mouse Rackmount Kits

Select a fixed or retractable keyboard and mouse kit appropriate for your needs. Keyboard and mouse are not included.

Retractable Keyboard

Product Number: J1518AC

- Quartz gray
- Keyboard security is available by using a front door on the rack cabinet
- EIA units required: 2 EIA U
- Includes all mounting hardware

Fixed Keyboard

Product Number: E7714AC

- Quartz gray
- Mounts on the outside of the front columns
- EIA units required: 1 EIA U
- All mounting hardware is included

Note: Cannot be used with a front door.

Rackmount Adapter Kits

Modules of less than 1 MW can be rackmounted using these kits.

- Individual 1/4 MW or 1/2 MW modules use the kits shown below directly
- Combinations of 1/4 MW or 1/2 MW (of equal depth) are first joined side-by-side with the Lock Link Kit (5061-9694), then the rackmount adapter kit is applied
- For combinations of instruments adding to 1 MW, use regular rackmount flange kit

Kits include attaching screws and front-panel rackmounting screws. Hole patterns conform to EIA and IEC standards.

Rack Adapter Kits

Instrument Module Height	Mounts 1/4 mw Module	Mounts 1/2 mw Module (or 2 ea. 1/4 mw modules)	Mounts 3/4 mw Module (3 ea. 1/4 mw or 1/4 + 1/2 mw side by side)
		Mounts 1/4 MW	or 2 each 1/4 MW or 1/4 and 1/2 MW
88.1 mm (3 1/2 in)	5063-9239	5063-9240	5063-9241
132.6 mm (5 1/4 in)	—	5063-9243	—
177.0 mm (7 in)	—	5063-9245	—

Support Shelf, Slides and Filler Panels

These shelves are available for instruments less than 1 MW

- Submodules of differing heights, widths, and depths (up to 20 inches deep) can be rackmounted using these support shelves. Any combination of 1/4 MW and 1/2 MW will fit side-by-side up to 1 MW
- Shelves support up to 50 pounds
- Special filler panels are available to close up vacant spaces either on top of a short module or side-by-side
- The slide kit is required. It provides ready access to internal shelf areas and is required for installation of the support shelf. Slide kit includes brackets and mounting hardware

Drawers

Keep manuals or spare cables close to where they are needed. Two drawer sizes are available.

- Sliding rails and mounting hardware are included
- Quartz gray



Testmobile Scope Cart (1180C)



Testmobile System Cart (1181B)

1180C
1181B

Testmobile Carts

Agilent Testmobile Carts add protection and mobility to test instruments and systems. The convenience of mobility makes instruments readily available when needed. The cart effectively extends the amount of lab bench space. Ergonomic cart and accessory design makes test equipment accessible to the operator, whether seated or standing at the test area. Additionally, several operators can cost effectively share expensive equipment that has been mounted on a Testmobile Cart.

Competitively priced Agilent testmobile carts are offered in cart capacities to provide optimum instrument test configuration:

- Scope cart, 59 kg (130 lb)
- System cart, 227 kg (500 lb).

A variety of easy-to-mount accessories are available for customized solutions.

Add Mobility to Your Instruments

Agilent Testmobile Carts provide convenient mobility of test equipment, PCs, or workstations to make them readily available when needed. This capability effectively extends the amount of lab bench space available. Mar-resistant, heavy-duty 5-inch hard rubber casters make moving instruments easy. All casters swivel, which lets the cart move right up to the workbench.

Bring the Equipment to the Test

Rather than bringing the test to the equipment, Agilent Testmobile Carts bring the equipment to the test, to save time and get right to the task. Testmobile Carts provide a convenient way to move everything from a small oscilloscope to a complete test system to the work to be tested.

Share Expensive Instruments

Agilent Testmobile Carts allow several operators in a work group to cost-effectively share expensive equipment. In the case of a small test system, all instruments can be conveniently combined in one place through the sufficient space, load capacity, and rackmount capability of the Testmobile System Cart.

Protect Your Investment

Unlike general-purpose cart design, Agilent Testmobile Carts have a nylon strap and steel buckle that secure instruments to the cart, and instrument feet fit securely in slots in both upper tilt tray and lower fixed tray. Expensive instruments are prevented from sliding or tipping off the cart. Locking brakes on rear wheels provide added safety and convenience.

Use Instruments with Ease

The ergonomically designed tilt tray adjusts 30-plus degrees for viewing and using instruments in comfort whether seated or standing. Lifting and carrying heavy instruments is no longer necessary with the mobility provided by Agilent Testmobile Carts.

Key Features

Agilent's Testmobile Carts offer the following attractive features:

- Ergonomic design. Test equipment is operator-accessible whether seated or standing
- Heavy-duty casters make moving instruments easy
- Includes a nylon strap and steel buckles to secure instruments to the cart
- Tilt tray adjusts 30-plus degrees for viewing comfort

Enhance Instrument Output

Agilent Testmobile System and Instrument Carts can be customized with a range of easy-to-mount accessories that enhance instrument input and output:

- Work surface and anti-static mat that provide a secure, static free work area in front of the instrument
- Plotter/printer stand, which can be set up either 305 mm or 381 mm (12 in or 15 in) high, enables hardcopy output on the spot
- Storage drawer (3.5 inch or 5.25 inch) for a convenient place to store probes, cables, and manuals
- Angle rails for supporting rack mounted instruments
- Attractive quartz gray color

Testmobile Cart Selection Criteria

A key criterion for cart selection is instrument depth. For instruments with a depth up to 17 inches, select the Agilent 1180C Testmobile Scope Cart. The Agilent 1181B Testmobile System Cart should be used for instruments up to 24 inches. Static drag chain is supplied on the 1181B.

1180C Testmobile Scope Cart

- Tilt tray load capacity = 29.5 kg (65 lb)
- Total load capacity = 59 kg (130 lb)
- Tilt tray = 457 mm W x 457 mm D (18 in x 18 in)

1181B Testmobile System Cart

- Tilt tray load capacity = 90.7 kg (200 lb)
- Total load capacity = 226.8 kg (500 lb)
- Tilt tray = 559 mm W x 660 mm D (22 in x 26 in)
- Rackmount any 19-inch EIA instrument up to 24 inches deep beneath the tilt tray in EIA columns
- 12 EIA units available for rack mounting
- Includes one set of 5957-8476 angle rails to support rack-mounted instruments

1180C
1181B

Specifications

	1180C Scope Cart	1181B System Cart
Capabilities		
Tilt tray load	29.5 kg (65 lb)	90.7 kg (200 lb)
Total load	59.0 kg (130 lb)	226.8 kg (500 lb)
Cart net weight	18.1 kg (40 lb)	39.0 kg (86 lb)
Dimensions		
Tilt tray size (w x d)	457 x 457 mm (18 x 18 in)	559 x 660 mm (22 x 26 in)
Height	721 mm (28.4 in)	721 mm (28.4 in)
Width	475 mm (18.7 in)	566 mm (22.3 in)
Depth	508 mm (20.0 in)	737 mm (29.0 in)
Vertical rack space*	N/A	533 mm (21.0 in – 12 EIA units)
Maximum Instrument Depth	432 mm (17.0 in)	635 mm (25.0 in)
Casters	101 mm (4 in) diameter	127 mm (5 in) diameter

* Vertical rack space is reduced the more the tilt tray is angled.

Parts List

Rack Cabinets

Standard Racks

E7590A	1.3 m Rack Cabinet, Quartz Gray (25 EIA U)
E3661B	1.6 m Rack Cabinet, Quartz Gray (32 EIA U)
E3662B	2.0 m Rack Cabinet, Quartz Gray (41 EIA U)

Rack Accessories

Power Distribution Units (PDUs)

For 1.3 m Racks

E4451A	100/120 V PDU (North America)
E4453A	200/240 V (International)

For 1.6 m and 2.0 m Racks

E4455A	100/120 V PDU (North America)
E4457B	200/240 V (International)

PDU Installation Kits: Not needed for factory-installed PDUs.

E7685A	PDU brackets and forehead bezel replacement, Quartz gray
--------	--

Front Doors: Plexiglas is transparent and rim is quartz gray

E4461B	1.3 m Plexiglas Front Door
E4462B	1.6 m Plexiglas Front Door
E4463B	2.0 m Plexiglas Front Door

Rear Doors

Vented Rear Doors

E4477B	1.6 m Vented Rear Door
E4479B	2.0 m Vented Rear Door

Solid Rear Doors

E4476B	1.6 m Solid Rear Door
E4478B	2.0 m Solid Rear Door

Tie Kits

E4467B	1.3 m Tie Kit
E4468B	1.6 m Tie Kit
E7792A	2.0 m Tie Kit

Side Panels

E4458B	1.6 m Solid Side Panel
E7749A	2.0 m Solid Side Panel

Extractor Fans

E4470A	100/120 V 200 cfm Fan
E4471A	200/240 V 200 cfm Fan

Ballast

C2790AC	30 lb. Steel Ballast
---------	----------------------

Rackmount Kits

Monitor Rackmount Kit

J1519BC	Fits 14" – 19" Monitors
---------	-------------------------

Keyboard Rackmount Kits

J1518AC	Retractable Keyboard
E7714AC	Fixed Keyboard

Instrument Rackmount Kits

Handles and Rackmount Flanges

Instrument Module Height	Front Handle Kit Part No.	Flange Kit Part No.	Flange Kit and Handles Part No.	Flange Kit for supplied handles Part No.
88.1 mm (3 1/2 in)	5063-9226	5063-9212	5063-9219	5063-9232
88.1 mm (3 1/2 in)	—	5063-9213	5063-9220	—
132.6 mm (5 1/4 in)	5063-9227	5063-9214	5063-9221	5063-9234
177.0 mm (7 in)	5063-9228	5063-9215	5063-9222	5063-9235
221.5 mm (8 3/4 in)	5063-9229	5063-9216	5063-9223	5063-9236
265.9 mm (10 1/2 in)	5063-9230	5063-9217	5063-9224	5063-9237
310.4 mm (12 1/4 in)	—	5063-9218	5063-9225	—

Rack Adapter Kits

Instrument Module Height	Mounts 1/4 mw Module	Mounts 1/2 mw Module (or 2 ea. 1/4 mw modules)	Mounts 3/4 mw Module (3 ea. 1/4 mw or 1/4 + 1/2 mw side by side)
88.1 mm (3 1/2 in)	5063-9239	5063-9240	or 2 each 1/4 MW or 1/4 and 1/2 MW 5063-9241
132.6 mm (5 1/4 in)	—	5063-9243	—
177.0 mm (7 in)	—	5063-9245	—

Support Shelves

88.1 mm (3 1/2 in)	5063-9255
132.6 mm (5 1/4 in)	5063-9256
177.0 mm (7 in)	5063-9257

Required Slide Rail Kit

1494-0015	Slide Rail Kit for Support Shelf
-----------	----------------------------------

Replacement Part for Support Shelf

1600-1424	Tie-down Clip
-----------	---------------

Support Shelf Filler Panels

For 88.1 mm (3 1/2 in) H support shelf partially filled with instruments, and having the following front panel space to fill	1/2 MW to fill 5002-3999
--	--------------------------

Rail Kits

E3663AC	System II Rail Kit
E3664AC	3rd Party Rail Kit
E3665AC	VXI Rail Kit

Slide Rail Kits

Slide Kit: Non-tilting, Standard-duty

1494-0060	Fits 345.4 D and 421.6 D
1494-0059	Fits 497.8 D and 574.0 D

Slide Kit: Non-tilting, Heavy-duty

1494-0058	Fits 345.4 D and 421.6 D
-----------	--------------------------

End Brackets

1494-0061	Standard-duty, Quantity: 4
1494-0064	Heavy-duty, Quantity: 4

Lock Link Kit

5061-9694	Lock Link Kit
-----------	---------------

Small Parts, Cables & Adapters

Drawers

35181J	89 mm (3.5 in) Drawer
35181M	133 mm (5.25 in) Drawer

Plain Shelf

J1520AC	Plain Shelf (does not slide)
---------	------------------------------

Work Surface

46298S	Work Surface
--------	--------------

Sliding Shelf

J1526AC	Sliding Shelf
---------	---------------

Rack Filler Panels

E7731A	1 EIA Unit
E7732A	2 EIA Unit
E7733A	3 EIA Unit
E7734A	4 EIA Unit
E7735A	5 EIA Unit
E7736A	6 EIA Unit
E7737A	7 EIA Unit

Feedthrough Panels

E3668B	Feedthrough Panel w/2 cutout grooves
E3669B	BNC-BNC (f) to (f) Panel

Mounting Hardware

E7694A	50 Clip-on nuts; 50 10 – 32 screws; non-decorative
E7797A	50 Clip-on nuts; 50 10 – 32 screws; Quartz gray
0590-0804	1 Clip-on nut

Additional Hardware

5062-3999	Locking Feet Kit
-----------	------------------

Cables and Adapters

IEC-320 Cables

8120-1575C	IEC-320 Female-Male Power Cable (30 in)
8120-1860	IEC-320 Female-Male Power Cable (60 in)

Testmobiles and Accessories

Testmobiles

1180C	Scope Cart
1181B	System Cart

Accessories

35183B	Testmobile (1,180b) work surface
35181H	Testmobile plotter/printer stand
35181N	Testmobile keyboard shelf
35181J	89 mm (3.5 in) drawer
35181M	133 mm (5.25 in) drawer
35181K	Testmobile work surface
35181E	Testmobile anti-static mat for 35181D
35182C	Testmobile storage drawer (3.5 in), support shelf
35182D	Testmobile storage drawer (5.25 in), support shelf
8120-1575C	IEC-320 female-male power cable (30 in)
8120-1860	IEC-320 female-male power cable (60 in)
5181-8707	IEC-320 male power cable adapter

Key Literature

A complete catalog of Agilent racks and accessories is located at <http://www.agilent.com/find/enclosures>

Lightwave Test Solutions	354
Tunable Lasers Modules	361
Lightwave Test Modules	365
Loss and Dispersion Test Solutions	371
Optical Spectrum Analyzer	376
Error Performance Analyzer	382
Optical Wavelength Meter	383
Lightwave Test System	388

Modular Test and Measurement Platform for Optical Networks and Components

Flexible

Free combination of Agilent modules to generate the best fit for each application

Scalable

The right form factor for each setup in R&D and manufacturing

Efficient

Plug&Play drivers and the Photonic Foundation Library from Agilent provide a variety of application functions for increased measurement performance

Fast

Modules and controllers optimized for high test speed and data throughput

Ergonomic

Active color, high contrast displays for enhanced benchtop usability



Tunable laser modules
(Use with 8164B mainframe)



Compact tunable laser modules



Distributed feedback (DFB) laser modules



Fabry-Perot laser modules



Attenuator modules



Switch modules



Return loss modules



Power sensor modules



Optical heads



Lightwave Platform Application Portfolio

Lightwave Platform Application Matrix

	Optical Component Test				Passive Component Test						Optical Amplifier Test			Bit Error Ratio Test			
	Mux/DeMux/V-Mux	TFF Test	FBG Filter Test	Connector Test	Switch Test	TFF Align-/Adjustment	Fiber to AWG Alignment/ AWG Chip Test	Coupler/Splitter/Combiner	Isolator/Circulator	Variable Optical Attenuator	Gain Flattening Filter	EDFA	Raman Amplifiers	SOA	Rx/Tx	Line Card	System Test
Tunable Laser 81480B, 81640B, 81680B	•	•	•		•	•	•	•	•	•	•						
Tunable Laser 81482B, 81642B, 81682B					•			•	•	•	•	•	•				•
Compact Tunable Laser 81649A, 81689A/B								•	•			•	•	•	•		•
Distributed Feedback (DFB) Laser 81662A, 81663A												•	•	•	•		•
Fabry-Perot Laser 8165xA				•		•	•	•	•								
Power Meter ¹ 8163xB	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Optical Heads ¹ 8162xB	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Return Loss Modules 8161xA	•		•	•	•	•	•	•	•	•	•						
Optical Attenuator 8156xA 8157xA												•	•		•	•	•
Switches 8159xA	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Polarization Controller 8169A	•	•	•				•	•	•	•	•	•	•				
Polarization Controller 11896A				•	•			•	•	•		•	•	•	•		
Digital Communications Analyzer (DCA)															•	•	
Bit Error Ratio Tester (BERT)															•	•	
SONET/SDH Tester																•	•
Optical Spectrum Analyzer (OSA)		•	•			•					•	•	•	•	•	•	
Mainframes 8163B 8164B 8166B	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Photonic Foundation Library	•	•	•	•	•	•	•	•	•	•	•						

¹ Different types are available. For specifications, please visit: www.agilent.com/comms/pmm

8163/64/
66B

- **Fast** – modules and controllers optimized for high test speed and data throughput
- **Flexible** – free combination of Agilent modules to generate the best fit for each application
- **Scalable** – the right form factor for each setup in R&D and manufacturing



The Agilent Lightwave Solution Platform – the right choice of modules, controllers, and software for your application

From simple standalone connector testing, fully automated high-channel count test stations, optical amplifier test at high power levels to BERT testing on a complete transmission system – the modular Lightwave Solution Platform from Agilent Technologies always provides the combination of modules for your optical domain test needs.

Controllers and Software

The 8163B, 8164B and 8166B mainframes, together with the *Plug&Play* drivers and the Photonic foundation library from Agilent, form the backbone of your optical measurement application. The high data throughput rate of the controllers, the PFL's pre-tested ready-to-use software routines, and the enhanced displays make them the optimal team for remotely controlled and standalone setups.

Laser Modules for All Purposes

Four different families of laser source modules are available for the Lightwave Solution Platform – tunable laser sources (TLS), distributed feedback laser sources (DFB), compact tunable laser sources (CTLs), and Fabry-Perot (FP) laser sources.

The Agilent 81480B, 81482B, 81640B, 81642B, 81680B and 81682B tunable laser sources (TLS) are used for precise and fast swept measurements, mainly for testing critical passive components and for calibration purposes.

The Agilent 81662A and 81663A distributed feedback (DFB) laser sources are offered at all ITU wavelengths on a 100 GHz grid across the C and L-bands. They are mainly used as test load for optical amplifiers and DWDM transmission systems.

The same applications can be addressed with more flexibility using the Agilent 81649A, 81689A and 81689B compact tunable laser sources (CTLs).

The Agilent 8165xA Fabry-Perot (FP) laser sources are available as single or dual wavelength sources. They are insensitive to back reflections and are stabilized for short and long term applications.

Signal Conditioning

The Agilent 8157xA optical attenuator modules feature excellent wavelength flatness and can handle high input power levels. Combined with their low insertion loss, they are ideal for optical amplifier test, such as characterization of EDFAs and Raman amplifiers, as well as for other multi-wavelength applications, such as DWDM transmission system test. The optional power control functionality allows setting the output power level of the attenuator directly.

Power Meters and Optical Heads

Different power sensor modules and external power sensors or optical heads cover the important wavelengths and power range. Thanks to superior accuracy, high linearity, and low polarization dependent loss (PDL), excellent measurement results are ensured. The measurement speed can be decreased to 200 μ s, which further optimizes the power measurements. Each power sensor and each optical head is individually calibrated over its wavelength range and is traceable to NIST and PTB for precise optical power measurements. A broad variety of advanced interfaces and adapters make it easy to connect the test devices.

Return Loss Solutions

The Agilent 8161xA return loss modules offer high precision and high accuracy for the best possible measurements. Due to the excellent stability of the built-in laser source, the return loss modules also provide the convenience of self-calibration, when speed is of the essence.

8163/64/66B Mainframes – Specification

Mainframes

8163B Lightwave Multimeter, 2 slot mainframe
8164B Lightwave Measurement System, 4 slot plus 1 slot for tunable laser
8166B Lightwave Multichannel System, 17 slot mainframe

Software

N4150A Photonic Foundation Library, single-user license

Full-Size Tunable Laser Sources

81480B Tunable Laser Module, Low-SSE, 1400 nm
81482B High Power Tunable Laser Module, 1400 nm
81640B Tunable Laser Module, Low-SSE, 1600 nm
81642B High Power Tunable Laser Module, 1600 nm
81680B Tunable Laser Module, Low-SSE, 1550 nm
81682B High Power Tunable Laser Module, 1550 nm
81940 1520 to 1630 nm, >+10 dBm
81980 1465 to 1575 nm, >+10 dBm

Compact Tunable Laser Source Modules

81949 1520 to 1630 nm, >+10 dBm
81989 1465 to 1575 nm, >+10 dBm

DFB Source Modules (C and L-Band)

81662A ITU grid 100 GHz, 10 dBm
81663A ITU grid 100 GHz, 13 dBm

Source Modules 0 dBm (Fabry-Perot)

81650A 1310 nm, single-mode
81651A 1550 nm, single-mode
81654A 1310/1550 nm, single-mode

Source Modules 17 dBm (Fabry Perot)

81655A 1310 nm, single-mode
81656A 1550 nm, single-mode
81657A 1310/1550 nm, single-mode

Optical Attenuator Modules

81570A High Power Module, Straight Contact Connector
81571A High Power Module, Angled Contact Connector
81573A High Power Module, Pigtail Version
81575A High Power Module, PMF Pigtail Version
81576A 2 Slot Wide High Power Module with Power Control, Straight Contact Connector
81577A 2 Slot Wide High Power Module with Power Control, Angled Contact Connector

Power Sensor Modules

81634B InGaAs, +10 dBm to –110 dBm, 800 to 1700 nm
81635A (Dual Sensor) InGaAs, +10 dBm to –80 dBm, 800 to 1650 nm

Fast Power Sensor Modules

81636B InGaAs, +10 dBm to –80 dBm, 1250 to 1640 nm

High Power Sensor Module

81630B InGaAs, +28 dBm to –70 dBm, 970 to 1650 nm

Optical Heads

Optical heads require an interface module, Agilent 81618A (single) or 81619A (dual).

81624B InGaAs, +10 dBm to –90 dBm, 800 to 1700 nm
81625B InGaAs, +20 dBm to –80 dBm, 850 to 1650 nm

High Power Optical Heads

Optical heads require an interface module, Agilent 81618A (single) or 81619A (dual).

81622B Ge, +27 dBm to –55 dBm, 850 to 1650 nm
81626B InGaAs, +27 dBm to –70 dBm, 850 to 1650 nm
81628B InGaAs integrating sphere, +40 dBm to –60 dBm, 800 to 1700 nm

Return Loss Modules

81610A InGaAs, no internal source, dynamic range 70 dB
81611A InGaAs, internal source 1300 nm, dynamic range 75 dB
81612A InGaAs, internal source 1550 nm, dynamic range 75 dB
81613A InGaAs, internal sources 1310/1550 nm, dynamic range 75 dB
81614A InGaAs, internal sources 1550/1625 nm, dynamic range 75 dB

Accessories for Optical Heads 8162xB

81624CE Extension Cable, 4 m
81624DD Adapter (D-shape)
81624RM Rackmount for two heads
81625RM Rackmount for four heads

Accessories for Return Loss Modules 8161xA

81610CC Calibration Cable (requires connector interface 81000SI for connection to return loss module)
81610FP Foot Paddle (start/stop measurement)

Ordering Information

For the most up-to-date information on the Agilent lightwave solution platform, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lwmultimeter

This overview shows all modules, controllers, and software packages for the Agilent lightwave solution platform.

All modules, except the full-size tunable laser sources (used with the 8164B mainframe), may be used with any of the mainframes.

The modules support a wide range of fiber connectors. Connector interfaces should be ordered for each input and output.

8163/64/
66B

8163B

- Variety of plug-in modules for optimized setups
- Benchtop solution for alignment
- Cost efficient solution for connector testing (return loss)
- Ready-to-use applications
- High-contrast color display
- Backward compatible with 815xx and 816xx-series modules



The Agilent 8163B – Modular Stimulus-Response Solutions with Excellent Performance

The two slot wide Agilent 8163B lightwave multimeter is one of the basic measurement tools in the fiber optics industry. It ensures accurate and fast results on optical components and systems, even for the most demanding measurements. Its modularity and compact format makes it flexible enough to meet changing measurement needs, whether measuring optical power, insertion loss, or return loss for single or multimode components.

10

Built-In Applications

- Passive component test (PACT) – test pigtailed or connectorized-devices over all wavelengths with a compact tunable laser module and a power meter module
- Return loss/loss – measure the return loss and insertion loss of your devices with one of the 8161xA return loss modules and a power meter module
- Stability – check the long term power stability of the device under test with a source module and a power meter module or power head
- Logging – perform statistical analysis on the power readings of your device

Compatibility – Preserve Your Investment

The Agilent 8163B lightwave multimeter mainframe is compatible with the modules from its successful predecessors, the 8153A and the 8163A-series. You can mix new modules, such as the new modular attenuators from Agilent Technologies, with previously purchased ones from the 8153A and 8163A-series, to suit your measurement needs.

Easy Hands-On and Remote Operation

When used as a benchtop instrument, you will appreciate the new high-contrast color display of the 8163B. For test automation, it is easy to integrate the 8163B into your setups via the GPIB and RS-232C ports using direct SCPI calls, VISA *plug&play* drivers, or the Agilent Photonic foundation library. For more information on the Photonic foundation library, please refer to page 373.

Ergonomic Results Viewing

The new Agilent 8163B high-contrast color display gives you more freedom in the layout of your measurement workstation. The wide viewing angle allows for clear readings, even when the instrument cannot be placed right in front of you.

Smart Carry-Along Tunable Loss Test Set

With an 8163B mainframe, 81689A compact tunable laser, and power meter module you get a smart, portable loss test set that lets you check devices and links at all wavelengths in the DWDM window.

Ordering Information

For the most up-to-date information on the 8163B lightwave multimeter, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lwmultimeter

8163B Lightwave Multimeter

Two slot compact mainframe for standard Agilent lightwave measurement modules, 3.8 inch active color display.

- Extender platform for high channel-count applications (multiplexers or cross-connect testing)
- Hosts an ITU DFB grid for optical amplifier test or an attenuator array for multichannel line-card test



The Agilent 8166B – Lightwave Multichannel System

The Agilent 8166B lightwave multichannel system is the mainframe of choice for applications that involve testing high-channel count devices or devices with a need for a complete array of sources under tight space restrictions. The 8166B offers 17 slots which can be equipped with any combination of plug-in modules from the Agilent 816xx series¹. The compact form and small footprint of this system saves valuable rack or bench space and gives an excellent price/performance ratio per channel.

Easy Hands-On and Remote Operation

When used as a benchtop instrument, you will appreciate the new high-contrast color display of the 8166B. For test automation it is easy to integrate the 8166B into your setups via the GPIB and RS-232 ports using direct SCPI calls, VISA *Plug&Play* drivers, or the Agilent Photonic foundation library. For more information on the Photonic foundation library, please refer to page 373.

The Ideal System for Manufacturing Floor and R&D Labs

8166B

In manufacturing, the Agilent 8166B lightwave multichannel system helps to increase throughput with its fast, simultaneous, and synchronized measurement capabilities. R&D engineers will value the quick multichannel or system characterizations, as well as easy troubleshooting. The Agilent 8166B lightwave multichannel system is a versatile tool for accelerated multiple stimulus/response measurements at fixed or variable wavelengths.

Some Applications Just Need More

Whether you configure one or more 8166Bs as a DFB grid for optical amplifier test, use it with the Agilent power meter modules as a receiver array for swept measurements on multiplexers, or with the new Agilent modular attenuators for line card testing – the 8166B lightwave multichannel system will always give you superior measurement performance. With the 8166B you can push your measurement system to new channel-count limits, while enjoying the advantages of the Agilent line of mainframes.

Ordering Information

For the most up-to-date information on the 8166B lightwave multichannel system, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lwmultichannel

8166B Lightwave Multichannel System

17 slot mainframe for standard Agilent lightwave measurement modules, 3.8 inch active color display.

¹ Please note that the 8153A series modules are not compatible with the 8166A/B lightwave multichannel systems.

8164B

- Platform for tunable laser modules
- High data throughput rate to external application controller
- Ready-to-use applications
- Backward compatible with 815xx and 816xx series modules



The Agilent 8164B – A New Platform for Testing Fiber Optic Components

The Agilent 8164B lightwave measurement system supports a wide range of tunable laser modules and all Agilent 815xx and 816xx measurement modules.

The 8164B mainframe features connectivity to a wide range of controlling equipment through GPIB and RS-232C ports. Configurable hardware input and output trigger ports complete the ability of the Agilent 8164B to operate in an automated test environment. For easy standalone operation of the 8164B, a 3.5 inch floppy disk drive, VGA port, PS/2 keyboard connector, and parallel printer port are provided.

Built-In Applications

- Passive component test (PACT) – test pigtailed or connectorized devices over all wavelengths with an Agilent tunable laser module and our power meter modules
- Stability – check the long term power stability of your device with a source module and a power meter module or power head
- Logging – Perform statistical analysis on the power readings of your device. Save the results to disk or print out a hardcopy

High Speed, High Power, High Dynamics

With the 8164B and fast tunable and high power laser sources from Agilent Technologies, you can speed up your measurements in passive component or optical amplifier test. Programming your 8164B based setup, with VISA *plug&play* drivers and the Agilent Photonic foundation library, will bring down test development cost and increase measurement accuracy at the same time. For more information on the Photonic foundation library, please refer to page 373.

Ordering Information

For the most up-to-date information on the 8164B lightwave measurement system, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lightwave

8164B Lightwave Measurement System

Four slots for standard Agilent lightwave measurement modules, one slot for 8164xx/8168xx tunable laser sources, 6.5 inch active color display, and built-in 3.5 inch floppy disk drive.



The 81600B All-band Tunable Laser Source with 8164B Mainframe

Agilent High-Performance Tunable Laser Sources

- Market-leading portfolio of tunable laser sources
- Reduce the test cost of CWDM and DWDM components
- Fast sweep time without compromising measurement uncertainty for speed
- Minimum number of tunable laser sources to cover 1260 to 1640 nm
- 80 nm/s fast sweeping speed
- Low SSE output for high dynamic range (81480B/680B/640B and 81600B)
- Built-in wavemeter for the optimum tuning precision

The 81672B, 81480B/482B, 81680B/682B, 81640B/642B and 81600B Agilent tunable laser source family offers complete wavelength range of 1260 to 1640 nm with a minimum numbers of lasers without any wavelength gap. This gives you the maximum flexibility in a test set up. These modules fit into the bottom slot of the 8164B mainframe.

Agilent 81600B All-band Tunable Laser Source

- 200 nm widest tuning range to cover S, C and L-band
- High power output at low SSE output port for higher dynamic range

The Agilent 81600B all-band tunable laser source is the flagship product in Agilent's market-leading portfolio of tunable laser sources. Its 200 nm tuning range covers all S, C and L-band with just a single laser. Its low-SSE output provides 9 dB more output power at a 10 dB better signal to SSE ratio compared to our previous flagship models. This ultimately leads to a high dynamic range enabling the characterization of advanced DWDM devices.

Reduce the Test Cost of CWDM and DWDM Components

Testing optical filters is based on a very generic principle, so called stimulus-response test. The state-of-the-art approach of wavelength resolved stimulus-response measurement utilizes a tunable laser source, which is capable of sweeping quickly and precisely across the entire wavelength range and optical power meters.

For DWDM components, high wavelength accuracy and dynamic range are most important. For CWDM components, wide wavelength range, high power stability and the tight cost targets are key. The cost of such a solution can be shared among many different type of filters, hence the contribution to each individual filter is minimal and the cost targets for CWDM components can be met while not sacrificing accuracy. The investment into the 81600B all-band tunable laser source results in the required cost efficiency and performance.

It Sweeps as Precisely as It Steps

As manufacturing yield becomes more and more stringent, it is important that all instruments have the optimum performance under all measurement conditions. The 81600B can sweep as fast as 80 nm/s without compromising measurement uncertainty for speed. Unlike other concepts which require external wavelength tracking, the 81600B sweeps as precisely as it steps.

200 nm Widest Tuning Range to Cover all S, C and L-band

The 81600B offers 200 nm tuning range from 1440 to 1640 nm, which is enough to cover the wavelength range of an 8-channel CWDM components. As 81600B has just a single laser to cover all S, C and L-band, its output power curve is smooth and continuous across the entire wavelength range. Its power curve also shapes flat on the top, it provides higher power over a broader wavelength range.

High Power Output at Low SSE Output Port for Higher Dynamic Range

Agilent has increased the output power of low SSE output port by 9 dB over the previous flagship model, which brings a 10 dB better signal to SSE ratio. This ultimately leads to a high dynamic range enabling the characterization of advanced DWDM devices with highest channel isolation.

80 nm/s Fast Sweeping Speed

Agilent has doubled its sweeping speed of 40 nm/s to a new speed of 80 nm/s, and also specified its performance under these sweep conditions. Thus leading to the minimum test uncertainty at the highest throughput.

Agilent 81672B High Power Tunable Laser Source, 1300 nm band

The 81672B high power tunable laser source offers a wavelength range of 1260 to 1375 nm and 9 dBm peak output power. As with other tunable laser family products, it sweeps up to 80 nm/s with specified performance. PMF output port is standard. Its wavelength range covers 4-channel CWDM devices in O-band.

Tunable Laser Modules

Agilent Tunable Laser Family Specifications

Parameter	Agilent 81672/81482/81682/81642B	Agilent 81480/81680/81640B	Agilent 81600B
Wavelength Range	1260 – 1375 nm (672B) 1370 – 1495 nm (482B) 1460 – 1580 nm (682B) 1495 – 1640 nm (642B)	1370 – 1495 nm (480B) 1460 – 1580 nm (680B) 1495 – 1640 nm (640B)	1440 – 1640 nm
Output Power	+9/+8.5/+8/+8.5 dBm peak	Output 1: -4.5/-4/-5 dBm peak Output 2: +5.5/+6/+4 dBm peak	Output 1: +2 dBm (1520 – 1610 nm) -2 dBm (1475 – 1625 nm) Output 2: +8 dBm (1520 – 1610 nm) +4 dBm (1475 – 1625 nm)
Signal to SSE	>45/42/45/45 dB/nm	Output 1: >63/63/60 dB/nm Output 2: >42/45/45 dB/nm	Output 1: >70 dB/nm Output 2: >48 dB/nm
Signal to Total SSE	>28/28/30/27 dB	Output 1: >60/60/55 dB Output 2: >28/30/27 dB	Output 1: >65 dB Output 2: >30 dB
Maximum Tuning Speed		80 nm/s	
Wavelength Repeatability		±0.5 pm	
Wavelength Stability		±1 pm (24 h)	
Power Stability		±0.01 dB (1 h)	
Power Repeatability		±3 mdB	

Upgrade Information

All Agilent 81480A, 81680A/682A and 81640A/642A can be upgraded to any "B". For more information, please visit our web site at: www.tunablelaserupgrades.com

Agilent Tunable Laser Family Dynamic Specifications

Parameter	Common to all Family Products			
	Specifica- tion Under Static Condition	Under Continuous Sweep Condition, Add Following Uncertainty		
		at 5 nm/s	at 40 nm/s	at 80 nm/s
Abs. Wavelength Accuracy	±10 pm	±0.4 pm	±1.0 pm	±2.5 pm
Rel. Wavelength Accuracy	±2 pm	±0.4 pm	±0.8 pm	±2.0 pm
Dyn. Wavelength Repeatability		±0.3 pm	±0.4 pm	±0.7 pm
Dyn. Power Reproducibility		±5 mdB	±10 mdB	±15 mdB

Ordering Information

- 8164B** Lightwave Measurement System (mainframe)
- 81600B** All-band Tunable Laser Source (1440 – 1640 nm), replaced by 81600B-200
- 81672B** High Power Tunable Laser Source (1260 – 1375 nm), replaced by 81600B-132
- 81480B** Low SSE Tunable Source (1370 – 1495 nm), replaced by 81600B-140
- 81680B** Low SSE Tunable Source (1460 – 1580 nm), replaced by 81600B-150
- 81640B** Low SSE Tunable Source (1495 – 1640 nm), replaced by 81600B-160
- 81482B** High Power Tunable Laser Source (1370 – 1495 nm), replaced by 81600B-142
- 81682B** High Power Tunable Laser Source (1460 – 1580 nm), replaced by 81980A
- 81642B** High Power Tunable Laser Source (1495 – 1640 nm), replaced by 81940A

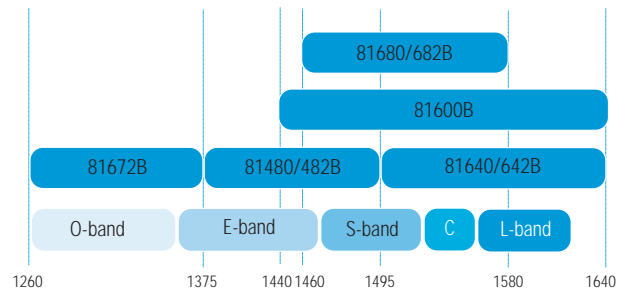
* All tunable lasers must be ordered with one connector option.

#071 for PMF, straight output

#072 for PMF, angled output

* Two Agilent 81000xl-series connector interfaces are required for 81600B/480B/ 680B and 640B.

One Agilent 81000xl-series connector interface is required for 81672B/482B/682B and 642B.



Agilent tunable laser family and wavelength range



High Power Compact Tunable Lasers for S-, C- and L-band

The Agilent 819xxA compact tunable laser sources provide high output power up to +13 dBm. Each module covers a total wavelength range of 110 nm, either in the S+C-band with the high power in C-band (81980A and 81989A), or in the C+L-band with the high power in the L-band (81940A and 81949A).

Modular Design for Multichannel Platform

The 819xxA tunable lasers are a family of plug-in modules for Agilent's 8163A/B, 8164A/B and 8166A/B mainframes. Their compact single-slot format makes them a flexible and cost-effective stimulus for single-channel and multichannel DWDM applications.

Device Characterization at High Power Levels

The high optical output power of the 819xxA tunable lasers improves the testing of all types of optical amplifiers and other active components as well as broadband passive optical components. It helps overcome losses in test setups or in the device under test itself. Thus, engineers can test optical amplifiers such as EDFAs, Raman amplifiers, SOAs and EDWAs to their limits. These tunable lasers provide high power levels required to help speed the development of innovative devices by enabling the test and measurement of nonlinear effects.

SBS Suppression Feature Enables High Launch Power

A new SBS-suppression feature avoids the reflection of light induced by Stimulated Brillouin Scattering (SBS). It enables the launch of the high optical output power into long fibers without intensity modulation to avoid impairment in time-domain measurements.

Coherence Control Avoids Interference-Induced Power Fluctuations

A high-frequency modulation function is used to increase the effective linewidth to avoid power fluctuations due to coherent interference effects. The modulation pattern is optimized for stable power measurements, even in the presence of reflections.

Built-In Wavemeter for Active Wavelength Control

The 81980A and 81940A both feature a built-in wavelength meter with a closed feedback loop for enhanced wavelength accuracy. In continuous sweep mode, it allows dynamic wavelength logging to make measurements during the sweep.

Dynamic Power Control for Excellent Repeatability

The integrated dynamic power control loop ensures highly repeatable measurements to reduce errors when comparing the results of several wavelength sweeps. As these modules are mode-hop free over their entire tuning range with continuous output power, they achieve highly accurate measurements over wavelength.

Continuous Sweep Mode with Wavelength Logging

All 819xxA modules can be operated in the stepped mode that is usually used when measurements are done at a certain wavelength. The 81980A and 81940A can also be operated in the continuous sweep mode with dynamic wavelength logging to make measurements during the wavelength sweep.

Internal Modulation

The internal modulation feature enables an efficient and simple time-domain extinction (TDE) method for Erbium-based optical amplifier test when used together with the external gating feature of Agilent's OSA.

It also supports the transient testing of optical amplifiers by simulating channel add and drop events.

The 81980A, 81940A, 81989A and 81949A are produced to ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control. Specifications describe the instrument's warranted performance. They are verified at the end of a two meter long patchcord and are valid after warm-up and for the stated output power and wavelength ranges. Each specification is assured by thoroughly analyzing all measurement uncertainties. Supplementary performance characteristics describe the instrument's non-warranted typical performance. Every instrument is delivered with a commercial certificate of calibration and a detailed test report.

Tunable Laser Modules

364

Agilent 8198xA and 8194xA Compact Tunable Laser Source (cont.)

8198xA Series
8194xA Series

Preliminary

81980A and 81989A Compact Tunable Laser Source, 1465 nm – 1575 nm
81940A and 81949A Compact Tunable Laser Source, 1520 nm – 1630 nm

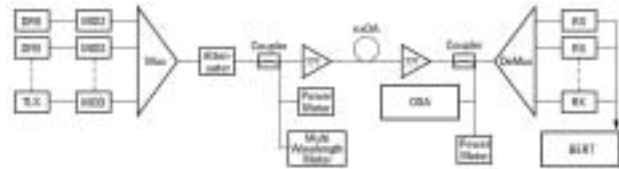
	Agilent 81980A, 81940A	Agilent 81989A, 81949A
Wavelength Range	1465 nm to 1575 nm (81980A and 81989A) 1520 nm to 1630 nm (81940A and 81949A)	
Wavelength Resolution	1 pm, 125 MHz at 1550 nm	5 pm, 625 MHz at 1550 nm
Mode-Hop Free Tuning Range	full wavelength range	
Maximum Tuning Speed	50 nm/s	
Absolute Wavelength Accuracy	±20 pm	±100 pm
Relative Wavelength Accuracy	±10 pm, typ. ±5 pm	±50 pm
Wavelength Repeatability	±2.5 pm, typ. ±1 pm	±5 pm
Wavelength Stability (typ., over 24 h)³	±2.5 pm	±5 pm
Linewidth (typ.), Coherence Control Off	100 kHz	
Effective Linewidth (typ.), Coherence Control On¹	>50 MHz for 1525 nm – 1575 nm (81980A and 81989A) >50 MHz for 1570 nm – 1620 nm (81940A and 81949A)	
Maximum Output Power (Continuous Power During Tuning)	≥+10 dBm ≥+13 dBm for 1525 nm – 1575 nm (81980A and 81989A) ≥+13 dBm for 1570 nm – 1620 nm (81940A and 81949A)	
Minimum Output Power	+6 dBm	
Power Linearity (typ.)	±0.1 dB	
Power Stability²	±0.01 dB over 1 hour typ. ±0.0075 dB over 1 hour typ. ±0.03 dB over 24 hours	
Power Flatness Versus Wavelength	±0.3 dB, typ. ±0.15 dB	
Power Repeatability (typ.)	±10 mdB	
Side-Mode Suppression Ratio (typ.)¹	≥45 dB	
Signal to Source Spontaneous Emission Ratio²	≥45 dB 48 dB/nm for 1525 nm – 1575 nm (81980A and 81989A) 48 dB/nm for 1570 nm – 1620 nm (81940A and 81949A)	
Signal to Total Source	≥25 dB	
Spontaneous Emission Ratio (typ.)¹	≥30 dB for 1525 nm – 1575 nm (81980A and 81989A) ≥30 dB for 1570 nm – 1620 nm (81940A and 81949A)	
Relative Intensity Noise (RIN) (typ.)¹	–145 dB/Hz	
Dimensions (H x W x D)	75 mm x 32 mm x 335 mm	

¹ At maximum output power as specified per wavelength range.

² Value for 1 nm resolution bandwidth.

³ At constant temperature ±0.5 K.

- Center wavelengths from 1529 to 1610 nm
- Fine tuning capability ± 850 pm
- Excellent power and wavelength stability
- Up to 20 mW output power
- Adjustable coherence control for SBS suppression and power stability



Typical DWDM transmission system test setup

81662A
81663A

Test of Optical Amplifiers

A set of DFB lasers are the ideal test load for modern optical amplifiers due to their excellent stability and good price versus performance ratio. These sources address the ever increasing demand for higher stimulus power and support the trend towards higher power amplifiers.

Test of Integrated Zero Loss Devices

The migration of amplification to former passive components forming integrated zero loss devices creates new challenges for test equipment. The 81662A and 81663A DFB lasers have a PMF fiber output as a standard feature, bringing polarization issues under control. The 81662A and 81663A DFB laser sources support the trend towards waveguide-based devices and integrated optics.

DFB Lasers for C and L-Bands

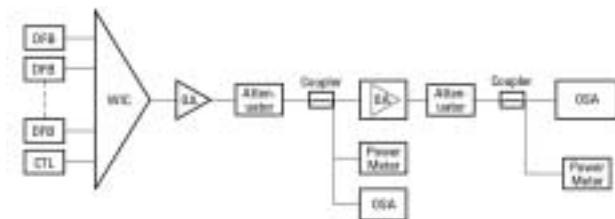
The Agilent 81662A and 81663A DFB laser modules operate at a specific wavelength of the ITU grid within the C and L-bands (refer to Ordering Information on page 367 for more information). The modules can be fine tuned by up to ± 850 pm around their ITU center wavelength. All modules are calibrated against any drift to allow constant power after detuning and constant wavelength after attenuation.

High Output Power

The Agilent 81662A modules provide +10 dBm output power and the 81663A modules offer +13 dBm output power to overcome the power penalties given in today's test setups. Their excellent stability in power and wavelength is key for accurate testing of any kind of optical amplifiers, such as EDFA, TDFA, semiconductor, and Raman amplifiers.

Applications

- Optical amplifier test
- DWDM transmission system test
- Stimulus-response measurement



Typical optical amplifier test setup

DFB Laser Modules For High Channel Count DWDM Systems

The DFB laser modules are best suited to address the test requirements of today's DWDM transmission systems. Their fine tuning capability provides a basic amount of flexibility, as is sometimes desired by DWDM submarine systems and reduced cost for spare grids. The modularity of the lightwave solution platform easily allows the user to perfectly match test setups to the latest requirements of the DWDM systems to be tested. Most important, it leaves room for future expansions and refinements.

Variable Linewidth for SBS Suppression

To avoid problems with stimulated Brillouin scattering (SBS), and interference effects generated by unwanted cavities, the 81662A and 81663A DFB lasers allow the user to change the linewidth simply by selecting an appropriate coherence level within a wide range.

PnP Software Drivers for Fast Process Automation

The powerful and easy to use *Plug&Play* drivers allow fast implementation of complex measurement control programs. The latest PnP drivers can be downloaded free of charge via our webpage at: www.agilent.com/comms/dfb

81662A
81663A

Specifications

Specifications describe the instruments warranted performance. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal value, and are printed in *italic*. Typical specifications are printed in **bold**.

	81662A ¹	81663A ¹
Type	CW DFB laser with built-in isolator	CW DFB laser with built-in isolator
Wavelength ²	ITU Grid (100 GHz)	ITU Grid (100 GHz)
Tuning Range	> ±500 pm	> ±850 pm
Display Resolution	10 pm	10 pm
Repeatability ³	±3 pm (±1 pm)	±5 pm (±2 pm)
Stability (15 minutes) ^{3,4}	±3 pm (±1 pm)	±5 pm (±2 pm)
Stability (24 hours) ^{3,4}	±5 pm	±5 pm
Fiber Type	Panda PMF 9/125 μm	Panda PMF 9/125 μm
Output Connector ⁵	Compatible to angled contact APC, ASC, DIN47256/4108	Compatible to angled contact APC, ASC, DIN47256/4108
Power		
Maximum Output ^{6,7}	> +10 dBm (10 mW)	> +13 dBm (20 mW)
CW Stability (15 minutes) ³	±0.005 dB	±0.003 dB
CW Stability (24 hours) ^{3,4}	±0.03 dB	±0.01 dB
Side Mode Suppression Ratio (SMSR) ⁷	45 dB	50 dB
Polarization Extinction Ratio (PER)	>20 dB	>30 dB
Dimensions	75 mm H x 32 mm W x 335 mm D (2.8 in x 1.3 in x 13.2 in)	
Weight	0.5 kg (1 lb)	
Recalibration Period	1 year	
Operating Temperature	15°C to 35°C	
Warm-up Time ⁴	60 minutes	
Laser Classification	FDA Laser Class IIIb according to 21 CFR 1040.10 IEC Laser Class 3A according to IEC 60825-1	
Supplementary Performance Characteristics	<ul style="list-style-type: none"> • <i>Internal digital modulation mode: free selection 200 Hz to 100 kHz. All output signals are pulse shaped, duty cycle 50%</i> • <i>Internal coherence control for linewidth broadening</i> • <i>ON-switching with fast output power stabilization <20 s</i> • <i>Output power "attenuation" at default wavelength 6 dB in steps of 0.1 dB</i> • <i>Tuning speed over full range 30 s</i> • <i>Polarization maintaining fiber orientation: TE mode in slow axis, in line with connector key</i> 	

10

¹ For peak wavelengths, refer to options.

² ITU-grid wavelength is shown on display as the default.

³ Controlled environment ΔT = ±1°C.

⁴ If previously stored at the same temperature, 20 minutes.

⁵ Connector interface not included.

⁶ Class 3A according to IEC 60825-1 (1998) and Class IIIb according to FDA CFR 21 (1995).

⁷ At maximum power setting and default wavelength at the end of a 2 m single-mode patchcord.

Ordering Information

For the most up-to-date information on the 81662A and 81663A DFB tunable laser modules, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/dfb

81662A

81663A

81662A/81663A Option	ITU Frequency (THz)	Center Wavelength (nm)	81662A/81663A Option	ITU Frequency (THz)	Center Wavelength (nm)
309	196.00	1,529.55	409	191.00	1,569.59
311	195.90	1,530.33	411	190.90	1,570.42
313	195.80	1,531.12	413	190.80	1,571.24
315	195.70	1,531.90	415	190.70	1,572.06
317	195.60	1,532.68	417	190.60	1,572.89
319	195.50	1,533.47	419	190.50	1,573.71
321	195.40	1,534.25	421	190.40	1,574.54
323	195.30	1,535.04	423	190.30	1,575.37
325	195.20	1,535.82	425	190.20	1,576.20
327	195.10	1,536.61	427	190.10	1,577.03
329	195.00	1,537.40	429	190.00	1,577.86
331	194.90	1,538.19	431	189.90	1,578.69
333	194.80	1,538.98	433	189.80	1,579.52
335	194.70	1,539.77	435	189.70	1,580.35
337	194.60	1,540.56	437	189.60	1,581.18
339	194.50	1,541.35	439	189.50	1,582.02
341	194.40	1,542.14	441	189.40	1,582.85
343	194.30	1,542.94	443	189.30	1,583.69
345	194.20	1,543.73	445	189.20	1,584.53
347	194.10	1,544.53	447	189.10	1,585.36
349	194.00	1,545.32	449	189.00	1,586.20
351	193.90	1,546.12	451	188.90	1,587.04
353	193.80	1,546.92	453	188.80	1,587.88
355	193.70	1,547.72	455	188.70	1,588.73
357	193.60	1,548.51	457	188.60	1,589.57
359	193.50	1,549.32	459	188.50	1,590.41
361	193.40	1,550.12	461	188.40	1,591.26
363	193.30	1,550.92	463	188.30	1,592.10
365	193.20	1,551.72	465	188.20	1,592.95
367	193.10	1,552.52	467	188.10	1,593.79
369	193.00	1,553.33	469	188.00	1,594.64
371	192.90	1,554.13	471	187.90	1,595.49
373	192.80	1,554.94	473	187.80	1,596.34
375	192.70	1,555.75	475	187.70	1,597.19
377	192.60	1,556.55	477	187.60	1,598.04
379	192.50	1,557.36	479	187.50	1,598.89
381	192.40	1,558.17	481	187.40	1,599.75
383	192.30	1,558.98	483	187.30	1,600.60
385	192.20	1,559.79	485	187.20	1,601.46
387	192.10	1,560.61	487	187.10	1,602.31
389	192.00	1,561.42	489	187.00	1,603.17
391	191.90	1,562.23	491	186.90	1,604.03
393	191.80	1,563.05	493	186.80	1,604.88
395	191.70	1,563.86	495	186.70	1,605.74
397	191.60	1,564.68	497	186.60	1,606.60
399	191.50	1,565.50	499	186.50	1,607.47
401	191.40	1,566.31	501	186.40	1,608.33
403	191.30	1,567.13	503	186.30	1,609.19
405	191.20	1,567.95	505	186.20	1,610.06
407	191.10	1,568.77			

Optical Power and Return Loss Modules

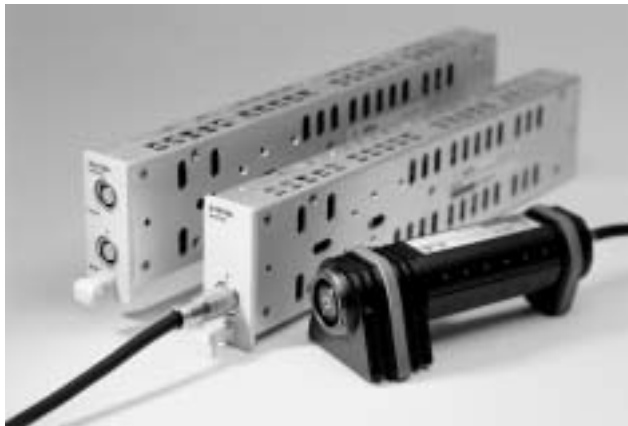


8161xx Return Loss Modules

The return loss modules offer high precision and high accuracy and provide the best possible measurements. The return loss modules can provide either the convenience of self calibration or allows manual calibration for the highest sensitivity. The built-in monitor diode monitors the optical power and compensates for power fluctuations in the source. This ensures very stable measurements and requires fewer manual recalibrations.

8163xx Power Sensor Modules

Different power sensor modules cover the important wavelengths and power ranges. Thanks to excellent accuracy, high linearity, and low polarization dependent loss (PDL), excellent measurement results are ensured. A measurement speed of 25 μ s (on the fast power sensors), further optimizes the power measurements. Each power sensor is individually calibrated over its wavelength range and is traceable to NIST and PTB, ensuring precise optical power measurements. A broad variety of connector interfaces makes it easy to connect the test devices.



8162xx Optical Heads

Optical heads make it possible to place the power sensor very close to the test device. Flexible positioning on the bench also allows convenient adaptation to bare fiber. The high power head, with the attached integrating sphere, allows measurements of the highest optical power. As with the power sensors, the optical heads are individually calibrated and are traceable to NIST and PTB. The optical heads are suitable for open beam applications or, with connector adapters, can be used with a broad variety of connectors.

- Set power levels directly
- Enables test and characterization of cutting edge technology optical amplifiers
- Short test time due to no corrections of wavelength dependency required
- Easy and fast calibration of optical setups with high accuracy
- High flexibility, small footprint and reduced cost per channel



Modular Design for a Multichannel Platform

The Agilent 8157xA optical attenuator modules attenuate and control the optical power of light in single mode optical fibers. They are a family of plug-in modules for the Agilent 8163A/B, 8164A/B and 8166A/B lightwave multichannel platform. The 81570A, 81571A and 81573A modules occupy one slot, while the 81576A and 81577A occupy two slots. With 17 slots, the Agilent 8166A/B lightwave multichannel system can host up to 17 single slot modules or up to 8 dual slot modules.

Variable Optical Attenuators

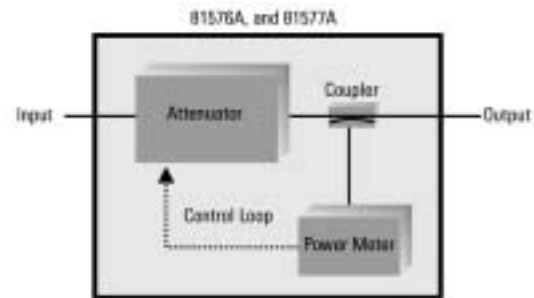
The Agilent 81560A and 81561A are small, cost effective attenuator modules with high resolution for single wavelength applications. By entering the operating wavelength, the instrument automatically applies the appropriate corrections. Various calibration features allow the user to set a reference power. Then both the attenuation and the power level, relative to the reference power, can be set and displayed in the user interface. An integrated shutter, which can be used for protection purposes or to simulate channel drops, is available.

Attenuators for High Optical Input Power

The Agilent 81570A and 81571A modules feature excellent wavelength flatness and can handle high input power levels. Combined with their low insertion loss, they are ideal for optical amplifier test, such as characterization of EDFAs and of Raman amplifiers, as well as for other multi-wavelength applications, such as DWDM transmission system test. They feature the reference power functionality and an integrated shutter. A pigtail version can be used for optimization of insertion loss, polarization dependent loss and return loss when the fibers are spliced into the setup.

Attenuators with Power Control

The Agilent attenuators feature power control functionality that allows you to set the output power level of the attenuator, for single wavelength applications. The attenuator module firmware uses the feedback signal from a photodiode after a monitor tap, both integrated into the module, to set the desired power level at the output of the module. By entering the operating wavelength, the instrument automatically applies all appropriate corrections for the intrinsic wavelength dependencies. Wavelength and offset value pairs can be stored in a table to compensate for wavelength dependent effects in the optical path of the setup. After an initial calibration for the uncertainties at connector interfaces, absolute power levels can be set with high accuracy. The absolute accuracy of these power levels depends on the accuracy of the reference power meter used for calibration.



Attenuators for High Optical Input Power and with Power Control

The Agilent 81576A and 81577A also have the power control functionality, feature high power handling capability and excellent wavelength flatness for DWDM applications. To set a total power level of a multi-wavelength signal, it is necessary to determine the convolution of the signal's spectrum with the sensitivity of the photodiode over wavelength. An enhanced calibration feature supports this process and enables setting the integral power of a DWDM signal with a known spectrum.

Calibration Processes

Comprehensive offset functionality in the firmware enhances the calibration of the optical path in various test setups. There is an offset for the attenuation factor, and an independent offset for the output power level, which is used to calibrate for losses due to the patchcords and connectors. This allows you to set the optical power level at the device under test.

Calibration is even easier and more convenient if the reference power meter and the attenuator are hosted by the same mainframe. All power related offsets can be determined by a firmware function that reads a value from the reference power meter. The difference between the power value read by the reference power meter and the actual value of the attenuator is automatically stored as the offset.

Specifications for 8157xA

Agilent's modular optical attenuators are a family of plug-in modules for Agilent's 8163A/B, 8164A/B and 8166A/B mainframes. Their high power handling capability together with excellent wavelength flatness and low insertion loss make them ideal for testing optical amplifiers and other DWDM test applications.

Modular Optical Attenuator Modules for High-Power Applications

	81570A	81571A	81573A	81575A	81576A	81577A
Connectivity	Straight connector versatile interface	Angled connector versatile interface	SMF pigtail FC/APC termination	PMF pigtail SC/APC termination	Straight connector versatile interface	Angled connector versatile interface
Fiber Type	9/125 μm SMF28			Fujikura PANDA 8/125 cutoff <1400 nm	9/125 μm SMF	
Wavelength Range	1200 – 1700 nm			1250 – 1650 nm		
Attenuation Range				0 – 60 dB		
Resolution				0.001 dB		
Repeatability ¹	±0.01 dB			±0.010 dB	±0.015 dB ¹⁴	±0.010 dB ±0.015 dB ¹⁴
Accuracy (uncertainty) ^{1,2,3}	±0.1 dB			±0.2 dB	±0.1 dB	N/A ±0.1 dB N/A
Settling Time (typical) ⁵	100 ms			100 ms	300 ms	100 ms 300 ms
Transition Speed (typical)				0.1 – 12 dB/s		
Relative Power Meter Uncertainty ¹⁵				±0.03 dB ± 200 pW ¹⁶		
Attenuation Flatness ^{1,4,6}				<±0.07 dB (typically ±0.05 dB) for 1520 nm <λ <1620 nm ⁸ typically ±0.10 dB for 1420 nm <λ <1640 nm ⁸		
Spectral Ripple (typical) ⁷				±0.003 dB		
Insertion Loss ^{2,4,9,10}	Typically 0.7 dB excluding connectors <1.6 dB (typically 1.0 dB) including connectors ¹¹			Typically 0.7 dB (excl. connectors) Typically 1.2 dB (incl. connectors) ¹¹	Typically 0.9 dB (excluding connectors) <1.8 dB (typically 1.2 dB) Connectors Including ¹¹	
Insertion-Loss Flatness (typical) ^{1,11}				±0.1 dB for 1420 nm <λ <1615 nm ⁴		
Polarization-Dependent Loss ^{2,9,11}	<0.08 dBpp (typically 0.03 dBpp)			N/A	<0.10 dBpp (typically 0.05 dBpp)	
Polarization Extinction Ratio	N/A			typically 20 dB ^{1,2,12}	N/A	
Return Loss (typical) ^{9,11}	45 dB	57 dB	57 dB	57 dB	45 dB	57 dB
Maximum Input Power ¹³				+33 dBm		
Shutter Isolation (typical)				100 dB		

¹ At constant temperature

² Temperature within 23°C ± 5°C

³ Input power <+30 dBm; λ = 1550 nm ± 15 nm; typical for 1250 nm <λ <1650 nm

⁴ For unpolarized light (SMF versions), or polarized light with TE mode injected in the slow axis (PMF version)

⁵ Stepsize <1 dB; for full range: typically 6 s

⁶ Relative to reference at 0 dB attenuation

⁷ Linewidth of source ≥100 MHz

⁸ λ_{disp} set to 1550 nm; attenuation ≤20 dB.

For attenuation >20 dB:

add typically 0.01 dB (α [dB] – 20) for 1520 nm <λ <1620 nm and typically 0.02 dB (α [dB] – 20) for 1420 nm <λ <1640 nm

⁹ For λ = 1550 nm ± 15 nm

¹⁰ Add typically 0.1 dB for λ = 1310 nm ± 15 nm

¹¹ Measured with Agilent reference connectors

¹² Excluding connectors, measured using a broadband source

¹³ Agilent Technologies assumes no responsibility for damages caused by scratched or poorly cleaned connectors.

¹⁴ Output power >–40 dBm, input power <+27 dBm; for input power >+27 dBm add typically ±0.01 dB

¹⁵ Wavelength and SOP constant; temperature constant and between 23°C ± 5°C; λ <1630 nm

¹⁶ Input power ≤+27 dBm; for input power >+27 dBm add ±0.02 dB

Ordering Information

For the most up-to-date information on Agilent 8157xA optical attenuators, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lightwave

Please contact your Agilent Technologies sales representative for a polarization maintaining fiber pigtail version.

Connector Interface

All modules require two connector interfaces, 81000xl series (physical contact).



The 81910A All-Parameter Analyzer consists of a tunable laser, a polarization controller and the optical test head

Agilent 81910A Photonic All-Parameter Analyzer

- Industry's fastest and most accurate all-parameter
- Simultaneous all-optical measurement of insertion loss (IL), polarization dependent loss (PDL), group delay (GD) and differential group delay (DGD) in transmission and reflection
- Display of chromatic dispersion and polarization mode dispersion
- Single connection setup
- Specifications support thorough test of optical devices for loss and dispersion
- Jones Matrix Analysis for deepest insight into a device's optical parameters
- All specifications apply to swept wavelength operation for high throughput testing
- Real-time trace updates
- Evolution of the industry's leading solution for loss measurements
- Measurement range from 1475 nm to 1620 nm optional
- User-selectable measurement time by choice of appropriate resolution and accuracy for device specific test needs
- Software enables multi-port testing
- Integrated optical bench for ease-of-use in manufacturing

Agilent 81910A – A Quantum Leap for the Test of Fiber Optic Components

As networks move to 10 Gb/s and beyond, not only spectral loss but also “run-time” properties of the signal become important. In advanced networks, passive components must meet stringent specifications of any of the four parameters spectral loss (IL-RTL), polarization dependent loss (PDL), group delay (GD), and differential group delay (DGD).

The Agilent 81910A photonic all-parameter analyzer is designed for those customers who deal with advanced optical components. Typical devices include fiber Bragg gratings, thin film filters, arrayed waveguide gratings, or dispersion compensators. The 81910A introduces a paradigm shift in test and measurement because it allows for precise characterization of all device parameters with the highest accuracy in a single setup.

As most passive components are used to route or redirect light, test solutions must provide leading-edge spectral loss measurement performance. To address this need, the Agilent 81910A uses the industry leading combination of a tunable laser source and a power meter to determine loss and PDL properties. As loss characteristics of state-of-the-art passive components often go hand in hand with steep dispersion traces, test requirements for advanced components are best described as “high accuracy, high dynamic range, and high resolution” – both for loss and dispersion. To cope with these challenges in terms of dispersion resolution and accuracy, swept homodyne interferometry (a method very similar to an electrical vector network analyzer) has been added as a building block to determine dispersion properties.

An Unparalleled Approach

The Agilent 81910A uses an innovative approach – swept homodyne interferometry – to determine dispersion properties. Within the test head the optical signals are mixed all-optically to achieve the highest resolution, in shorter periods of time. This gives advantage when high wavelength resolution, measurement accuracy and high speed are required.

The 81910A provides instantaneous, complete and thorough measurements of all device properties relevant to DWDM: insertion loss (IL), polarization dependent loss (PDL), group delay (GD) and differential group delay (DGD); simultaneously in transmission and reflection.

A Breakthrough Solution for R&D and Manufacturing – Faster Than Ever

The 81910A is designed for all engineers that develop, test and manufacture modern and advanced passive optical devices and modules like fiber gratings, AWGs or add-drop modules. The 81910A is the most complete test solution to verify complex designs of advanced optical devices.

For 2003, the 81910A has been re-engineered and greatly enhanced – in addition to new features and algorithms the 81910A now delivers its test results ten times faster than previously possible. This is key in helping optical network component engineers and manufacturers to dramatically cut development and production costs.

81910A

Helping to Design and Manufacture Advanced Devices

Test of all parameters is most important for advanced components used in 10+ Gb/s networks. The Agilent 81910A photonic all-parameter analyzer is a unique solution to measure “all parameters” of advanced components – providing unparalleled advantages:

- The 81910A allows all parameters to be viewed online – as it includes real-time trace updates for higher test throughput and process control
- By optimizing the resolution and test time, extremely high accuracy can be obtained. Details are provided in the technical data sheet (5988-5870EN)
- Maximum ROI and easy adoption to different test needs: the SW enables unlimited port testing so the 81910A can be applied to test devices like couplers, fiber Bragg gratings, thin film filters or arrayed waveguide gratings
- Loss and GD are calculated as the true average of their polarization dependency to obtain non-ambiguous results
- An Application-Programmable Interface (API) allows remote control of the instrument, enabling smooth integration into manufacturing environments and supporting advanced measurement solutions
- As a member of the Agilent lightwave measurement system, the 81910A can be used to enhance existing loss measurement setups by integration of existing laser sources

A Solid Foundation

The Agilent 81910A, and the Photonic Analysis Toolbox software supplied with it, are based on Agilent’s established and proven Photonic Foundation Library (PFL). This library provides a rich set of functionalities that make it quick and easy to implement specific tests, tasks and analysis. The comprehensive collection of basic and advanced functions helps you run the tests you require, and get exactly the results you need, to support your development or manufacturing processes.

Designed for High Throughput

A device under test is hooked onto the test head and connected by two patch cords only – all parameters are measured without reconnecting the device, saving measurement time and reducing test uncertainty.

Future Proof Investment

To allow all-parameter measurements anywhere within an unequalled range of 1475 nm to 1620 nm, the instrument is now available with the Agilent 81600B All-Band Laser, which offers the widest tuning range of any tunable laser source currently available.

Upgrading Existing Equipment

The complete consists of a 81640B or 81600B tunable laser, a 8169A polarization controller, licensed software, accessories, a system controller and the optical test head. For those customers who already own equipment (e.g. 81640A or 81680A), options allow an easy upgrade path to add the optical test head and software.

Supplementary Dispersion Measurement Characteristics:

Group delay and differential group delay measurement uncertainty can be easily customized and optimized to any application requirements in terms of accuracy, resolution, and measurement time by adjusting resolution bandwidth and number of averaged sweeps. The relation between accuracy, resolution bandwidth and averages is shown in Figure 1. For full details please refer to the technical data sheet 5988-5870EN and check our web site www.photonic-all-parameter.com

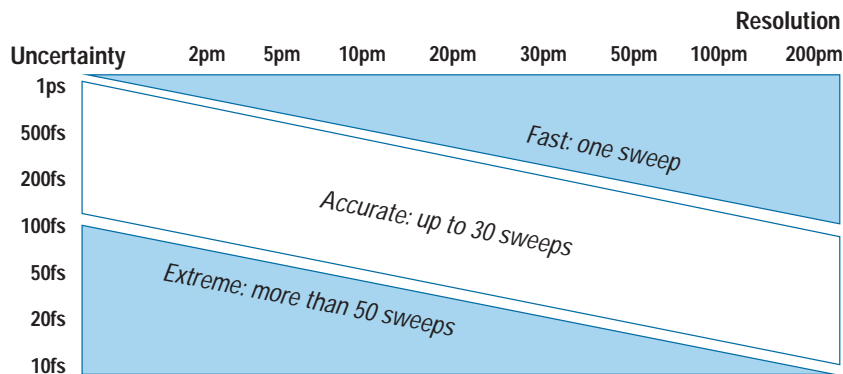


Figure 1

Technical Specifications

Specifications describe the instrument's warranted performance. The specifications below are valid between 1520 nm to 1620 nm. 81910A #003 allows additional range between 1475 nm and 1520 nm.

Loss and Polarization Dependent Loss Measurement Specifications

	Transmission	Reflection
Loss Uncertainty		
loss \geq 0.5 dB	± 0.010 dB	± 0.020 dB
loss \geq 10 dB	± 0.015 dB	± 0.025 dB
loss \geq 30 dB	± 0.025 dB	± 0.040 dB
loss \geq 40 dB	± 0.050 dB	
Loss Range (typical)	>55 dB	>45 dB
Polarization Dependent Loss (PDL) Uncertainty		
loss \leq 0.5 dB	$\pm(0.040$ dB + 3% of device PDL)	$\pm(0.040$ dB + 3% of device PDL)
loss \leq 10 dB	$\pm(0.050$ dB + 3% of device PDL)	$\pm(0.055$ dB + 3% of device PDL)
loss \leq 30 dB	$\pm(0.060$ dB + 3% of device PDL)	$\pm(0.100$ dB + 3% of device PDL)
Absolute Wavelength Uncertainty	± 4 pm (± 1.5 pm typ.)	
Wavelength Repeatability (typical)	± 0.3 pm	

Dispersion Measurement Specifications:

	Transmission	Reflection
Group Delay (GD)		
Group Delay Loss Range (typical)	30 dB	
Group Delay Resolution	<0.1 fs	
Group Delay Noise	< ± 50 fs	
Group Delay Relative Uncertainty	$\pm 1.5\%$ of device relative Group Delay	
Differential Group Delay (DGD)		
Differential Group Delay Loss Range (typical)	30 dB	
Differential Group Delay Resolution	<0.1 fs	
Differential Group Delay Noise	< ± 80 fs	
Polarization Mode Dispersion Uncertainty (typical)	< ± 5.0 fs	N/A
Absolute Wavelength Uncertainty	± 1.5 pm	
Maximum Device Optical Path Length (typical)	30 m	

Ordering Information:

81910A-001 Complete system includes 81640B tunable laser, 8164B mainframe, 8169A polarization controller, 81634B power meters, system controller, licensed software, accessories and optical test head. System controller may be used as host PC

81910A-002 Same as 81910A-001 but integrates a pre-owned tunable laser. Customer has to send back either one tunable laser source 81640A, 81680A, or 81480A for conversion into an 81640B and integration in the system, or a tunable laser source 81640B for integration

81910A-003 same as 81910A-001, but includes a 81600B tunable laser

81910A-004 same as 81910A-003, but integrates a pre-owned 81600B tunable laser. Customer has to send back one tunable laser source 81600B to Agilent Technologies for integration in the system

Optional:

If a second PC is used as a host, the following performance is required: PC with min. 500 MHz CPU, 192 MB RAM or more. Windows 2000 or Windows NT with SP6, 200 MB free hard disk space; 2 free PCI slots; 81910A operated by a SW revision greater 2.5

For further details, please contact your Agilent representative.

N415xA



Agilent N4155A and N4156A Solutions for High-Speed Spectral Loss and Polarization Dependent Loss Measurements

The innovative Agilent N4155A speeds up the characterization of wavelength-dependent devices such as fiber Bragg gratings (FBGs), thin film filters (TFFs) and related optical components. It provides rapid high-quality measurements of spectral transfer functions, plus:

- Optimization of alignment and adjustment
- Process monitoring for FBG writing and fiber tapering

The Agilent N4155A uses a continuously sweeping tunable laser to monitor the spectral loss of test devices, thus reducing test and manufacturing cost by faster alignment and adjustment. Comprising a high-performance tunable laser, up to four fast power meters, and the Photonic Foundation Library, the N4155A solution acquires data every 25 μ s, at a wavelength accuracy of ± 1 pm, making update rates over one measurement per second possible testing ultra-narrowband components with 25 GHz spacing and below. Interleavers can be completely analyzed over the full C- or L-band in 2 s or less.

The N4156A high-performance solution provides fast and highly accurate spectral loss (IL) and polarization dependent loss (PDL) measurements of critical DWDM passive components like multiplexers/demultiplexers or filters.

Consisting of a high-performance tunable laser, a polarization controller, several optical power meters and the Photonic Foundation Library (PFL), the N4156A solution helps to reduce test cost and increase manufacturing yields by short test times and tight specifications. The PFL adds increased accuracy through the advanced Mueller Method for PDL measurements, and correction of the delay and distortion effects in swept wavelength test systems.

Acquiring test data on multiple device ports in parallel, and with a wavelength uncertainty of ± 1 pm at a resolution of 0.5 pm, the N4156A is ideally suitable for the test of arrayed waveguides (AWG), and even for ultra-narrowband components with channel spacings below 25 GHz.

Data Processing Functions

Routines and functions process the acquired data to determine the spectral loss analysis parameters, such as the bandwidth of a band-pass or notch filter and their center wavelength. These routines follow the most popular definitions and recent measurement standards. Similarly, crosstalk can be determined for multiple-channel devices.

Built-in error handling, automatic parameter checking, and a comprehensive programming manual lead to fast results and help to avoid programming mistakes.

Specified Performance

Comprehensive documentation of the recommended test equipment for passive optical components is available. The documentation includes the complete solution's technical specifications, such as measurement throughput and accuracy, and provides guidance for performing individual uncertainty analysis. Please refer to the product literature for further details at: www.agilent.com/comms/pfl

Supported Programming Environments

Both the Agilent Photonic foundation library and the 816x VISA VXIplug&play driver seamlessly integrate into Agilent VEE and National Instruments LabVIEW and Lab Windows graphical programming environments, allowing you to enhance productivity and efficiency of the test implementation. They can also be easily integrated with C, C++ and VisualBasic.

Programming examples for the most common measurement tasks, a printable programming guide, and online help files are included with the setup program on the product CD-ROM.

System Integration and Uptime Support Services

If you require custom or turnkey test solutions, or if you wish to receive a system uptime support offer, please refer to page 29 for Agilent Technologies' support and services.

Ordering Information

For the most up-to-date ordering information on the Photonic foundation library, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/pfl

N4150A Photonic Foundation Library, single user license

N4151A Photonic Analysis Toolbox

Multi-user and site licenses are available through your local Agilent sales office.

A demo version of the Agilent Photonic foundation library, and the free-of-charge 816x VISA VXIplug&play driver are included on CD-ROM with the following Agilent instruments: 8163A/B, 8164A/B, and 8166A/B. To obtain extra copies, please order the 08164-90BCX product CD-ROM or download the Photonic foundation library from our web site at:

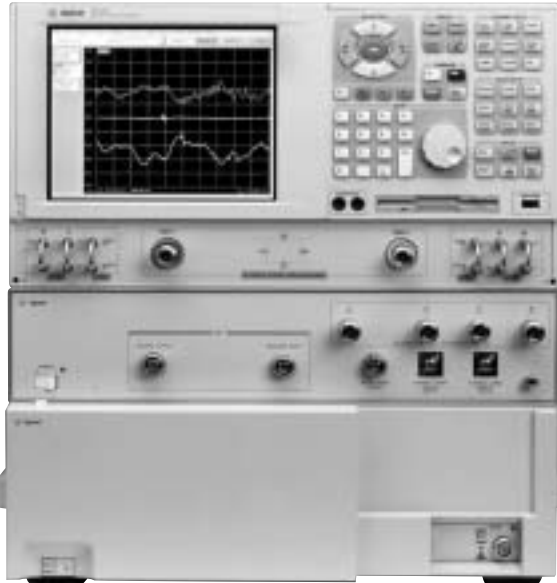
www.agilent.com/comms/pfl

To evaluate the Photonic foundation library, you can use the demo license included with the CD-ROM. It allows the use of the product's full functionality for sixty days. After the evaluation period, only a reduced set of functions remain available until your license code is entered.

Accessories

A jumper cable kit is recommended to connect the tunable laser to the 8169A polarization controller. The kit includes a protected fiber patchcord and two connector interfaces. Use the N4160A cable kit if both instruments are equipped with angled connectors. Use the N4161A cable kit if one of the instruments is equipped with straight connectors.

- Chromatic dispersion (CD), polarization mode dispersion (PMD), group delay (GD), polarization dependent loss (PDL), and insertion loss/gain (IL) measurements with a single connection
- Highly accurate, high-speed measurements of narrow band components, dispersion compensating gratings, fiber, amplifiers, and optical systems
- Excellent wavelength resolution for narrowband component measurements
- Two ports for simultaneous parallel testing of the device under test doubles throughput in manufacturing
- Chromatic dispersion measurements automatically corrected for polarization artifacts



The Agilent 86038A – a standalone, compact desktop solution

The Agilent 86038A – An Innovative Solution for Dispersion and Loss Measurements

The new Agilent 86038A optical dispersion analyzer can simultaneously measure CD, PMD, group delay and insertion loss/gain, and PDL with a single connection. This makes the 86038A ideal for R&D and manufacturing environments that require highly accurate, high-speed testing of DWDM components, dispersion compensating grating, optical fiber, amplifiers, and systems. The 86038A can perform relative, differential, and absolute group delay measurements. It also performs length measurements on optical fiber spools. This solution uses the industry standard modulation phase shift method and can perform simultaneous transmission and reflection measurements to minimize test time. The integrated Agilent 86122A multi-wavelength meter provides accuracy down to 0.3 pm.

Reduced Time to Market for 10 and 40 Gb/s Devices and Systems

Highly accurate and repeatable measurements of CD, PMD, PDL, and IL helps R&D engineers reduce their development time and bring high quality products to market quickly. Chromatic dispersion measurements are automatically corrected for polarization effects to allow extremely accurate CD measurements to be performed with the 86038A optical dispersion analyzer. R&D engineers can also quickly access DGD performance.

Each optical dispersion analyzer ships with a NIST traceable verification device, as well as documentation to help meet ISO 9000 requirements. Installation, verification, and training and support are also included in the solution price.

Increased Throughput for High Volume Manufacturing

Parallel testing of the devices under test allow manufacturers to double their throughput. The 86038A is designed for high-throughput measurements in the entire S, C, and L-bands (1370 to 1640 nm). High-speed dispersion measurements (CD, PMD) and loss characteristics (PDL, IL/gain) can be measured simultaneously using a single connection of the device under test. The two ports enable better equipment utilization to measure devices in transmission or reflection modes that provide a total of eight traces simultaneously.

Reduced Cost of Test

The 86038A allows the customer to provide the tunable laser source, which reduces the cost of the solution by allowing you to use an existing tunable laser source. The reduced investment for test equipment, combined with the high speed measurement capability and parallel testing of devices, offers reduced capital equipment cost for the 86038A analyzer.

Easy-to-Use Desktop Solution

The 86038A optical dispersion analyzer consists of a performance network analyzer, next generation optical test set, and tunable laser. This instrument is a standalone, compact desktop solution, which is ideal for a space-constrained R&D lab or on the manufacturing floor.

The 86038A has an easy-to-operate user interface to meet the needs of both the R&D and manufacturing environments. With the push of a single button, measurements can be acquired. The 86038A offers an extensive set of data processing and smoothing algorithms for post processing of data, which can be quickly exported for data processing and smoothing. The instrument is fully remote controllable and can easily be integrated into an existing test setup.

Specifications

Specifications describe the instrument's warranted performance. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in *italic* typeface. Typical specifications are printed in **bold**.

Specifications show absolute accuracy for CD, PMD, IL, and PDL in transmission and reflection modes. Specifications are preliminary and subject to change.

Group Delay Accuracy¹: < ±0.05 ps (50 fs)

Differential Group Delay Accuracy¹: < ±0.05 ps (50 fs)

Measurement Time²: 3 ms/point

Wavelength Range: 1370 to 1640 nm

Absolute Wavelength Accuracy: ±3 pm

Relative Wavelength Accuracy (with integrated 86122A wavelength meter): ±0.3 pm

Polarization Dependent Loss Accuracy¹: ±0.1 dB

Laser Classification: FDA Laser Class I according to 21 CFR 1040.10; IEC Laser Class 1 according to IEC 60825

Ordering Information

For the most up-to-date information on the 86038A optical dispersion analyzer, please contact your Agilent Technologies sales representative or visit our web site at: www.agilent.com/comms/lightwave

86038A Optical Dispersion Analyzer

86038A-100 Wavelength Meter for ±0.3 pm Accuracy

Source

At least one tunable laser source must be ordered with the instrument.

86038A-111 Standard CD/PMD/PDL/IL Solution for C and L-Bands (1510 to 1640 nm)

86038A-112 Dual Band CD/PMD/PDL/IL Solution for S, C, and L-Bands (1370 to 1480, 1510 to 1640 nm)

86038A-321 Customer-provided Laser for Standard CD/PMD/PDL/IL Solution for C and L-Bands (1510 to 1640 nm)

¹ Transmission and reflection.

² Measurement time for CD measurements.

- Filter mode
- Excellent wavelength accuracy and low polarization dependence
- 90 dBm sensitivity and 70 dB dynamic range
- Flexible monochromator output model
- Applications with automatic pass/fail checking
- Web-enabled



Agilent 86146B

The Agilent 8614xB family of grating-based optical spectrum analyzers display the amplitude of light versus wavelength over a 600 to 1700 nm wavelength range. The OSA uses a patented double-pass monochromator design to simultaneously achieve high sensitivity and dynamic range with a fast sweep time. This is key for characterizing DWDM components and multiple channel systems, especially in a manufacturing environment where speed, accuracy, and throughput are critical. The OSAs also have a two year calibration cycle keeping production on-line longer.

The family consists of both benchtop (86140B, 86142B, and 86146B) and portable (86143B, 86144B, and 86145B) units that have integral printers and floppy disk drives to allow instant documentation of results and transfer of electronic copies to a PC. A VGA port allows a PC monitor to be connected directly to the OSA screen, and a parallel (Centronics) interface enables clear color copies of measurement results to be generated. The GPIB interface provides high transfer speeds across the bus which are critical in a high throughput environment. The uncluttered front panel has been designed to compliment the intuitive graphical user interface (GUI). In addition, a software package from Agilent will web-enable the entire 8614xB family OSAs, allowing for remote operations and data transfer over LAN.

	Benchtop OSA	Portable OSA
High Performance	86142B	86145B
Standard	86140B	86143B
Filter Mode	86146B	86144B

High Performance

The benchtop Agilent 86142B and portable Agilent 86145B analyzers are top-of-the-range high performance units ideally suited to WDM applications where dynamic range and low polarization dependence are critical. In these units, many of the OSA high performance parameters have been optimized to cover the EDFA extended wavelength bands (1525 to 1610 nm). This extended wavelength range also makes these OSAs ideal for testing WDM passive components (filters, multiplexers and Bragg gratings), characterizing DWDM transmitter lasers and analyzing DWDM multichannel system performance.

Value Performance

The Agilent 86140B benchtop and Agilent 86143B portable optical spectrum analyzers maintain much of the high performance of the Agilent 86142B and 86145B, but are priced at a lower cost.



Agilent 86145A

Built-in Applications

Agilent Technologies has developed a unique concept for built-in applications. The complete suite of applications enables the user to develop tests that can be customized to their particular measurement. The current package of applications contains the following:

- Passive component test application
- WDM application
- Amplifier test application
- Source test application

Passive Component Test Application

Agilent has a pass/fail application for passive components. After filling in a spreadsheet template and loading the program into the OSA via a floppy disk, the user can test parameters such as the 3 dB bandwidth, insertion loss, and so forth. The OSA will then display the pass/fail results in an easy to read table that can be saved to a file or printed.

WDM Application

This application gives accurate wavelength, power, and optical-signal-to-noise-ratio (OSNR) measurements, and displays the results in an easy-to-read table. The WDM application utilizes a unique dual sweep measurement technique. The first sweep uses a very narrow band filter to measure the power density of the noise floor, while the other uses a slightly broader filter to accurately measure signal power. In addition, Agilent noise markers, which are corrected for filter shape, provide improved accuracy for the noise floor power density measurement.

Amplifier Test Application

The amplifier test application allows engineers and technicians to quickly and easily characterize optical amplifiers using single or multi-channel signals, resulting in reduced testing time. It is designed to calculate the noise figure and gain of an amplifier at each channel of a multi-channel source stimulus using the Interpolated Source Subtraction (ISS) technique.

Source Test Application

The standard set of automated source tests for LEDs, Fabry-Perot and DFB lasers is provided with the source test application. In addition, the application has complete remote capability for greater flexibility. The LED has a broad spectrum and the parameters of interest include peak wavelength, center frequency, total power, FWHM and sigma. Other parameters of interest for lasers include mode spacing, peak amplitude and SMSR.

Additional Features

The Agilent 8614xB family of optical spectrum analyzers feature up to six traces and four independent markers. The built-in trace math function of the OSA allows for multiple traces to be used for normalization measurements. The markers allow for easy measurement of wavelength separation (GHz or nm), power density and optical signal-to-noise ratio.

Benchtop Platform

The benchtop OSA has a large, bright 10.4" active matrix color LCD display and can support a variety of EELED, white light source, and wavelength calibration options. This OSA is ideal for R&D and manufacturing environments where display clarity and ease of use are important.

Portable Platform

The high performance portable platform has a small 16 cm H x 32.5 cm x 43 cm D (6.4 in x 12.8 in x 16.8 in) footprint and weighs in at 14.5 kg (16 lbs). This is designed for applications where space is at a premium and yet full optical spectrum analyzer capability is required. It also supports a wavelength calibration option. This makes the OSA ideal for both field and factory use, particularly in high level system installations or situations where bench space is limited. The portable unit has a high clarity 6.4 inch active matrix LCD display.

Filter Mode

Introducing the portable 86144B and benchtop 86146B, Agilent's newest OSA models! These models enable new test methods you may never have thought possible. The heart of Agilent's grating-based OSA is the monochromator. This piece of hardware will spread the input light spectrum and analyze a selectable band of that spectrum at a time. The time it takes to analyze the entire spectrum is referred to as the sweep time. When in filter mode, the monochromator seizes to sweep and analyzes only one selectable portion of the input spectrum. The monochromator output is then diverted by an internal flexure from a 50 μm multimode internal fiber into a 9 μm single-mode internal fiber that leads to the front panel. At the front panel, the user has the option of routing the light back into the OSA, via a front panel jumper, or to couple the output to another device for further testing. When a channel is "dropped", the monochromator output is sent to the front panel of the OSA as a single-mode output.

Channel Drop

One of the features of filter mode is to allow a single tightly spaced DWDM signal to be isolated. The WDM firmware application can sequentially or selectively drop WDM channels that require additional analysis. It is possible to select a certain wavelength or a certain channel to be dropped out. It can then be quantitatively analyzed in the time domain. It is now possible to switch between parametric measurements in the physical domain to functional measurements in the time domain.

For spectral analysis and eye-diagram, the user should connect the single-mode output from the front panel of the Agilent OSA into an input connector of an Agilent 86100B Infiniium DCA with an optical-to-electrical plug-in module. At this point, the OSA's WDM application provides a data table with channel power, channel OSNR, tilt, and peak-to-peak deviation. The DCA will simultaneously provide an eye mask compliance graph and extinction ratio data. Refer to Figure 1.

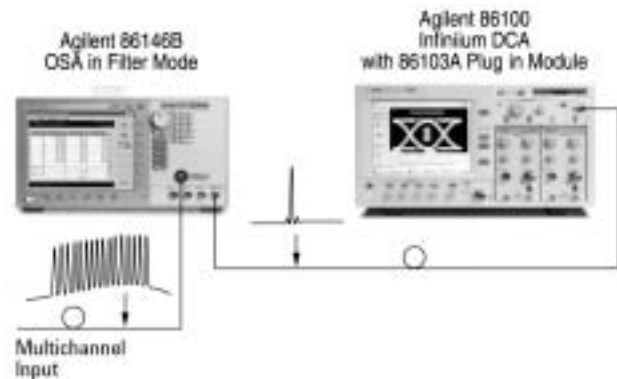


Figure 1. Eye mask compliance graph and extinction ratio data

Filter mode can also be used to provide other information, such as bit error ratio. The user can still utilize the same test equipment by connecting the single-mode output from the Agilent OSA into an Agilent 86130A BitAlyzer. The OSA's WDM application will provide the data table while the BitAlyzer displays channel bit error ratio (BER) and channel Q-factor. Refer to Figure 2.

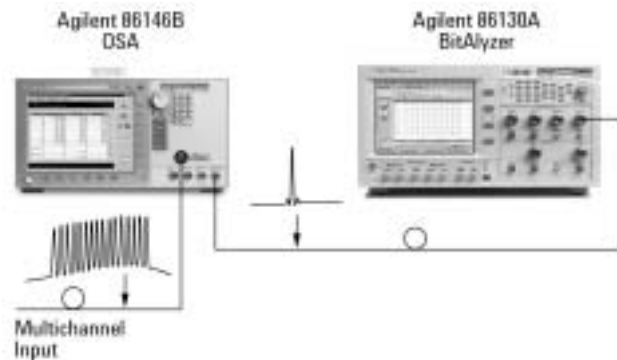


Figure 2. Channel bit error ratio (BER) and channel Q-factor

Time Resolved Chirp

Agilent's filter mode channel-drop feature enables lower cost of test and higher flexibility of use than other solutions. However, the benefits don't end there. A second feature of Agilent's filter mode is the ability to measure time-resolved chirp (TRC). Chirp is the small frequency shift that occurs during optical signal modulation. It is caused by the slight changes in refractive index of the optical modulator. TRC is the instantaneous optical frequency deviation versus time. Measuring TRC enables lower cost lasers to be used in DWDM components. These lower cost lasers bring down the overall cost of DWDM components, but they exhibit chirp at high modulation rates. The TRC measurement will enable R&D to reduce chirp in these less expensive lasers. Manufacturing can also use the TRC measurement to screen out lasers that exhibit high chirp, so that they aren't detrimental to system performance. Thus, measuring TRC can enable more economical DWDM components. Agilent offers a dynamic solution for measuring TRC.

The test setup shown in Figure 3 will produce an accurate TRC measurement, as well as SMSR, wavelength, power, and eye-diagram, all at the same time. With an Agilent OSA filter mode model, testing limitations become a thing of the past. Dynamic test configurations, combined with fast and accurate results, make Agilent the company of choice for professionals in any position or industry.

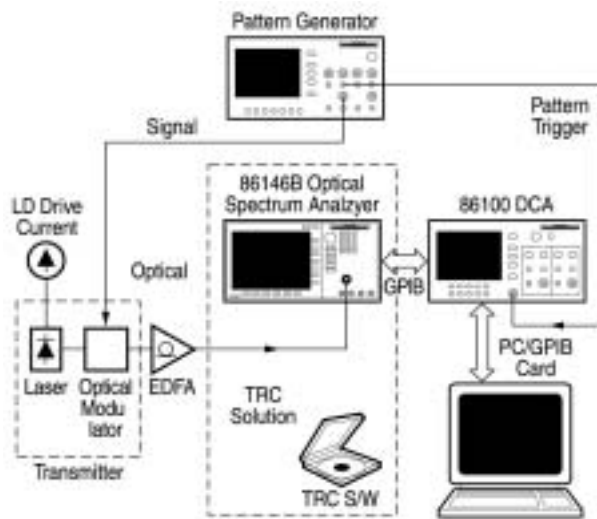


Figure 3. Test setup

Specifications

Specifications apply to all functions auto-coupled over the temperature range 0°C to 55°C and relative humidity <95%, unless otherwise noted. All specifications apply after the instrument's temperature has been stabilized after one hour of continuous operation and the auto-align routine has been run. Unless otherwise noted, specifications apply without USER CAL.

Specifications describe the instrument's warranted performance. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in *italic* typeface.

Specification for 8614xB

WAVELENGTH

Range: 600 nm to 1700 nm

Span Range: 0.2 nm to full range and zero span

Accuracy

- After calibration with internal calibration source, with enhanced wavelength calibration on for specified range.
 - 1480 to 1570 nm¹: ± 0.01 nm
 - 1570 to 1620 nm¹: ± 0.025 nm
- After calibration with external reference source(s)
 - ±10 nm of calibration reference point(s)¹: ± 0.01 nm
- After user calibration over full wavelength range (600 to 1700 nm)²: ± 0.2 nm
- Absolute accuracy (factory calibration, 2 year cycle)³: ± 0.5

MONOCHROMATOR INPUT

Input Return Loss⁴

Straight connector (9/125 μm) : >35 dB

SWEEP

Maximum Sweep Rate: 40 nm/56.3 ms

Maximum Sampling Rate in Zero Span: 50 μs/trace point

Sweep Cycle Time

- 50 nm span, auto zero off: <180 ms
- 50 nm span, auto zero on: <340 ms
- 100 nm span: <400 ms
- 500 nm span: <650 ms

ADC Trigger Accuracy

- Jitter (distributed uniformly): <± 0.5 μs
- Trigger delay range: 2 μs – 6.5 ms

COMPUTER INTERFACING

Remote Control

- Compatibility: Web-enabled controls, IEEE-488.1, IEEE-488.2 (100%)
- Interfaces: GPIB, Parallel Printer Port, External VGA Monitor, Keyboard and Mouse (PS/2)

Floppy Disk : 3.5" 1.44 MB, MS-DOS⁵

- Data export: Spreadsheet and Word Processor compatible (CSV ASCII)
- Graphics export: CGM, PCL, GIF

Instrument Drivers: Universal Instrument Drivers (PNP), compatible with VEE, Labview⁶, Visual Basic and C++

¹With applied input fiber 9/125 μm. Resolution of 10 nm is available for first order grating response only.

²With applied input fiber 9/125 μm, T^{20 to 30°C}.

³With applied input fiber 9/125 μm, for resolution ≥0.2 nm, T^(room).

⁴Depends on the quality of the attached connector.

⁵MS-DOS is a U.S. registered trademark of Microsoft Corporation.

⁶Labview is a U.S. registered trademark of National Instruments.

Specification for 8614xB (cont.)

8614xB

RESOLUTION BANDWIDTH (RBW)	86140B/42B/43B/45B	86146B	86140B with 86140B-025	
FWHM (3 dB bandwidth) ¹	0.06, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm	0.06, 0.07, 0.1, 0.14, 0.2, 0.33, 0.5, 1, 2, 5, 10 nm	0.07, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm	
Noise Marker Bandwidth Accuracy (using noise markers 1525 to 1610 nm) ²	≥0.5 nm	±2%	±3%	
	0.2 nm	±3%	±5%	
	0.1 nm	±7%	10%	
	0.06 nm	±12%	—	
Polarization Dependence ³	1310 nm	±0.25 dB	±0.12 dB	—
	1530 nm, 1565 nm	±0.2 dB	±0.05 dB	—
	1600 nm	±0.25 dB	±0.08 dB	—
	1250 to 1650 nm	±0.3 dB	±0.25 dB	±0.5 dB

¹ With applied input fiber 9/125 μm. Resolution of 10 nm is available for first order grating response only.

² With applied input fiber 9/125 μm, T_(20-30°C).

³ With applied input fiber 9/125 μm, for resolution ≥0.2 nm, T_(room).

	86140B/43B	86142B/45B/46B	86140B with 86140B-025
DYNAMIC RANGE			
In 0.1 nm Resolution Bandwidth⁴			
1250 to 1610 nm (chop mode on) ±0.5 nm, ±1 nm, ±5 nm ⁵		– 70 dB	
1550 nm	at ±0.8 nm (±100 GHz at 1550 nm) ⁶		– 60 dB
	at ±0.5 nm (±62.5 GHz at 1550 nm)	– 58 dB ⁷	– 55 dB ⁷
	at ±0.4 nm (±50 GHz at 1550 nm)	– 55 dB ⁷	– 52 dB ⁷
	at ±0.2 nm (±25 GHz at 1550 nm)	– 40 dB ⁷	—
PULSE MODE ACCURACY			
Turn On (≥2 μs after rising edge)		<± 0.2 dB (starting from dark)	
Turn Off (≥ 10 μs after falling edge)	<± 0.2 dB	<± 0.2 dB (30 dB extinction)	±0.2 dB

⁴With applied input fiber 9/125 μm, excluding multiple order grating response.

⁵Chop mode not available on the 86144B and 86146B models.

⁶Average of all states of polarization.

⁷Characteristic for 86140B-025, 86141B-025, 86143B-025, 86140B-025 options.

10

General Specifications

	Benchtop	Portable
	86140B, 86142B, 86146B	86143B, 86145B
Dimensions (H x W x D)	222 mm x 425 mm x 427 mm (8.8 in x 6.8 in x 16.8 in)	163 mm x 325 mm x 427 mm (6.4 in x 12.8 in x 6.8 in)
Weight	16.5 kg (36 lb)	14.5 kg (16 lb)
Environmental		
Temperature ¹	Operating: 0°C to 55°C; Storage: –40°C to 70°C	
Humidity	Operating: <95% RH; Storage: Non-condensing	
Shock Vibration	300g, half sine, 2 ms pulse	
EMI	Conducted and radiated interference is in compliance with CISPR Publication 11, IEC 801-3, IEC 801-4, and IEC 555-2	
Power Requirements		
Voltage and Frequency	90 Vac, to 260 Vac, 44 to 444 Hz	
Maximum Power Consumption	230 W	

¹Floppy disk and printer operating temperature range 0°C to 45°C.

8614xB-002 Built-in White Light Source Output Option

This option is available for benchtop models only.

	Benchtop OSA 86140B, 86142B, and 86146B
Wavelength	900 – 1700 nm (filtered below 850 nm)
Spectral Power Density	
Into 9/125 μm fiber	0.2 nW/nm (900 – 1600 nm), 0.1 nW/nm (1600 – 1700 nm)
Into 50/125 μm fiber	10 nW/nm
Into 62.5/125 μm fiber	25 nW/nm
Stability over 10 minutes	±0.02 dB
Lamp Lifetime	Mean time between failure >5000 hours

8614xB

Stimulus Response System Specifications – Passive Optical-to-Optical Devices

Measurement Range

- 1250 – 1600 nm and 9/125 μm fiber: 0 to 33 dB in 10 nm RBW (36 dB typical)
- 1000 – 1600 nm and 50/125 or 62.5/125 μm fiber: 0 to 40 dB (10 nm RBW)

Dynamic Range

- 1250 – 1600 nm and 9/125 μm fiber: 36 dB (with 10 nm RBW)
- 1000 – 1600 nm and 50/125 or 62.5/125 μm fiber: 36 dB (10 nm RBW)

Measurement Accuracy

- 1250 – 1600 nm and 9/125 μm fiber: ±0.1 dB (excluding connector repeatability)
- 1000 – 1600 nm and 50/125 or 62.5/125 μm fiber: ±0.2 dB (excluding connector repeatability)

Optical-to-Electrical Devices (with 86141B only)

- Minimum Responsivity: 0.01 A/W
- Accuracy: ±0.9 dB (excluding connector repeatability)

8614xB-004/005 EELED Sources Option

These options are available for benchtop models only.

	Benchtop OSA
	86140B, 86142B, and 86146B
Minimum Spectral Power Density¹	
1540 to 1560 nm (8614xB-005)	>–40 dBm/nm 100 nW/nm
1470 to 1620 nm (8614xB-005)	>–60 dBm/nm 1 nW/nm
1300 to 1320 nm, 1540 to 1560 nm (8614xB-004)	>–40 dBm/nm 100 nW/nm
1250 to 1620 nm (8614xB-004)	>–60 dBm/nm 1 nW/nm
Return Loss	
With straight connector	>25 dB
Stability (ambient temperature <±1°C)	
Over 15 minutes	<±0.02 dB
Over 6 hours	<±0.05 dB
LED Classification	IEC LED Class 1 according to IEC 60825

¹Temperature range 0°C to 45°C.

Ordering Information

For the most up-to-date ordering information, please contact your Agilent sales representative or visit our web site at: www.agilent.com/comms/osa

86140B Benchtop Optical Spectrum Analyzer

Internal Sources

- 86140B-002 White Light Source
- 86140B-004 1300 nm/1550 nm EELED
- 86140B-005 1550 nm EELED
- 86140B-050 No Optical Source

Internal Wavelength Calibrator

- 86140B-006 Wavelength Calibrator
- 86140B-051 No Calibrator

Fiber Input (choose one or two)

- 86140B-020 Single-mode Fiber Input
- 86140B-025 Multimode Fiber Input

Accessories

- 86140B-AXE Rack Flange Kit (for use with handles)
- 86140B-AX4 Rack Mount Kit (cannot be used with handles)
- 86140B-1CN Handle Kit

86142B Benchtop Optical Spectrum Analyzer

Internal Sources

- 86142B-002 White Light Source
- 86142B-004 1300 nm/1550 nm EELED
- 86142B-005 1550 nm EELED
- 86142B-050 No Optical Source

Internal Wavelength Calibrator

- 86142B-006 Wavelength Calibrator
- 86142B-051 No Calibrator

Accessories

- 86142B-AXE Rack Flange Kit (for use with handles)
- 86142B-AX4 Rack Mount Kit (cannot be used with handles)
- 86142B-1CN Handle Kit

86143B Portable Optical Spectrum Analyzer

Internal Wavelength Calibrator

- 86143B-006 Wavelength Calibrator
- 86143B-051 No Calibrator

Fiber Input (choose one or two)

- 86143B-020 Single-mode Fiber Input
- 86143B-025 Multimode Fiber Input

Accessories

- 86143B-030 Replacement Lid for Portable OSA

86145B Portable Optical Spectrum Analyzer

Internal Wavelength Calibrator

- 86145B-006 Wavelength Calibrator
- 86145B-051 No Calibrator

Accessories

- 86145B-030 Replacement Lid for Portable OSA

86146B Benchtop Optical Spectrum Analyzer

Internal Sources

- 86146B-001 Current Source
- 86146B-002 White Light Source
- 86146B-004 1300 nm/1550 nm EELED
- 86146B-005 1550 nm EELED
- 86146B-050 No Optical Source

Internal Wavelength Calibrator

- 86146B-006 Wavelength Calibrator
- 86146B-051 No Calibrator

Software

- 86146B-TRC Time Resolved Chirp Application Software

Accessories

- 86146B-AXE Rack Flange Kit (for use with handles)
- 86146B-AX4 Rack Mount Kit (cannot be used with handles)
- 86146B-1CN Handle Kit

Optical Connectors

Orders must include a connector. Choose from the list below. The most common is the FC/PC connector (81000FI) and should be chosen if the buyer cannot specify. Additional connector adapters can be ordered separately.

- 81000AI HMS-10 Connector
- 81000FI FC Connector
- 81000KI SC Connector
- 81000SI DIN Connector
- 81000VI ST Connector

Documentation

Commercial Calibration Data is included with all models.

Current dispersion penalty measurements are long and tedious. Agilent Technologies' time-resolved chirp (TRC) solution with the dispersion penalty calculation algorithm reduces test times by a factor of 60, significantly reducing manufacturing test costs for transmitter manufacturers by providing:

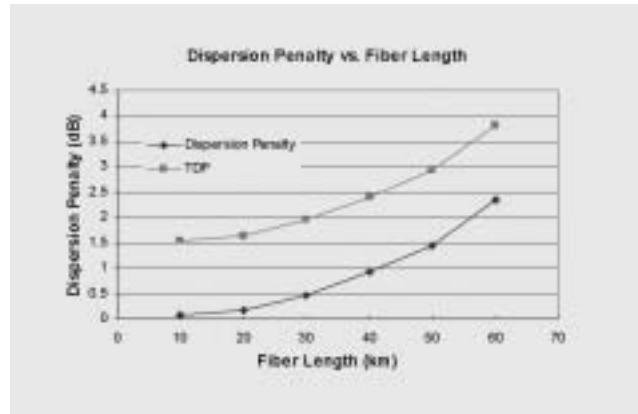
- Fast measurement speed
- Dispersion penalty versus fiber length
- Dispersion penalty versus fiber type
- Transmitter dispersion penalty
- BER versus OSNR

The 86146B Option DPC is a unique solution for the design, verification, and manufacture of laser transmitters.

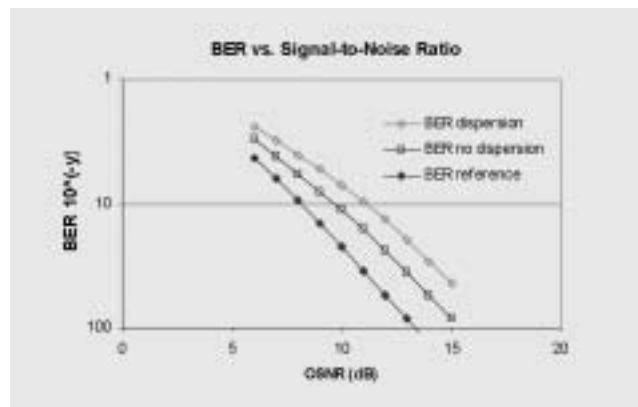
Dispersion penalty, a commonly used parameter of laser transmitters, is the apparent change in receiver sensitivity due to the distortion of the signal waveform during its transmission over a specified path. It is manifested as a shift of the system's BER curves from the fiber path to a no-fiber path. Dispersion penalty is primarily a function of laser chirp interacting with fiber chromatic dispersion. TDP, as defined in IEEE 802.3ae-2002, 10 Gb/s Ethernet, is similar to dispersion penalty but the reference BER is for a high-quality reference transmitter.

As developers and manufacturers of laser transmitters are attempting to go to higher rates and longer distances, they are finding that chirp is limiting their ability to achieve a required dispersion penalty. Direct measurement of dispersion penalty requires two BER measurements over a reference receiver input range that yields BER values from typically 10^{-4} to 10^{-11} . This measurement can easily take one hour.

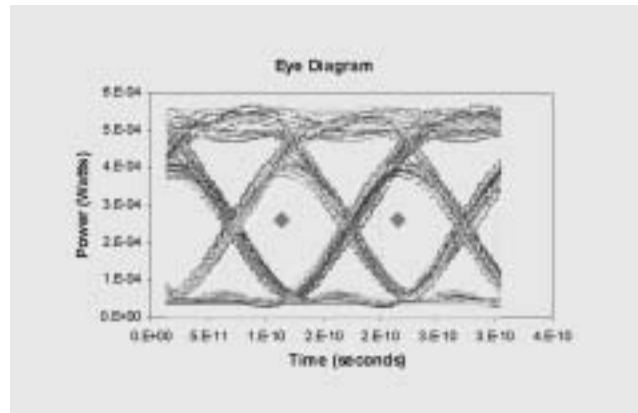
To solve this problem, Agilent has created the dispersion penalty option for the 86146B optical spectrum analyzer (OSA). The unique algorithm accurately calculates the dispersion penalty from time-resolved chirp (TRC) measurements for a particular length and type of optical fiber. This new dispersion penalty calculation reduces measurement time to one minute or less.



Dispersion Penalty versus Fiber Length



BER versus OSNR



Eye Diagram

Error Performance Analyzer

71612C

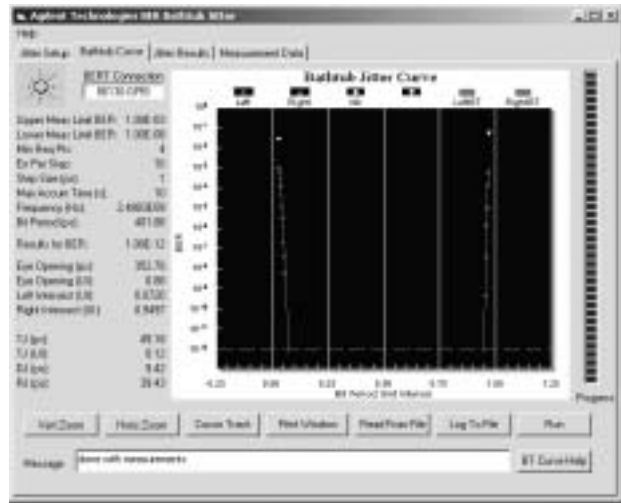
- Automatically measures total jitter (TJ), random jitter (RJ), and deterministic jitter (DJ)
- Accelerated BER

Automatically extrapolate BERs to 1E-14 from measurements made quickly at much higher BERs.

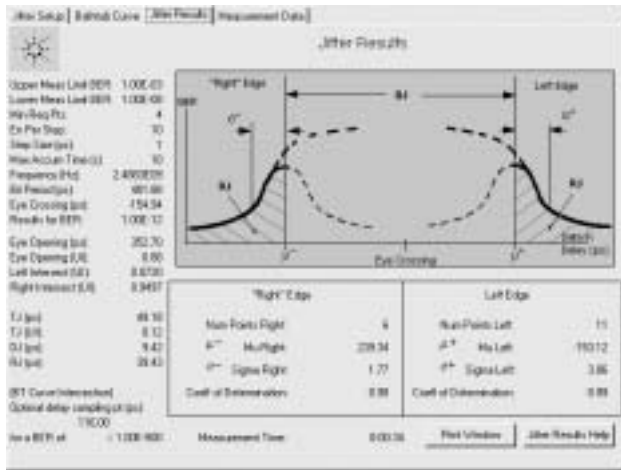
- Easy-to-use graphical user interface
- Graphical results with zoom and panning
- One-button printing
- Log results to .CSV file for further analysis in other applications

Implement jitter test automation immediately with the help of new bathtub jitter software from Agilent. With an easy to use Windows® users interface, graphical results, and one-button printing, you will be analyzing your results in no time. What does a bathtub have to do with jitter test? Tests for these parameters generate a graph known as the bathtub curve, when the BER versus sample time is plotted. This is also referred to as a BER scan. Agilent's Bathtub software enables test automation and builds a database in which the test data is easily manipulated and analyzed through a friendly user interface. The data is easily transported to other applications, such as an excel spreadsheet for further analysis.

See page 452 for more information about BERT.



Example of a "Bathtub" Curve



Example of Statistical Results

- Characterize WDM spectra during R&D, manufacturing, and commissioning
- Wavelength accuracy up to ± 0.2 ppm
- Simultaneously measure wavelengths and powers of up to 1000 channels
- Automatic optical signal-to-noise ratio measurements
- Automated measurement routines and data logging



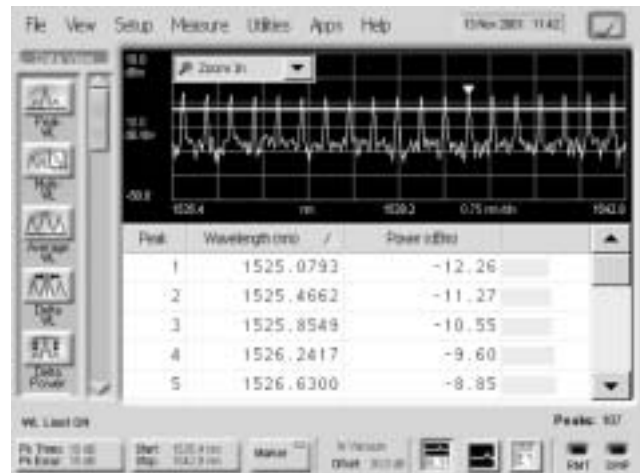
As the demand for access to more information increases, the need for greater capacity on transmission systems drives component manufacturers and network equipment manufacturers to push their capabilities to new limits. The successful design and deployment of dense wavelength division multiplexing (DWDM) systems require stringent performance criteria be met in order to insure quality, uninterrupted communication. With Agilent multi-wavelength meters, you will be able to address these demands with confidence.

The Performance You Need – When You Need It

The Agilent family of multi-wavelength meters is just that – a family. Each model number uses compatible SCPI remote commands. You pay for only the performance you need, when you need it. If your needs become more demanding in the future, you can substitute another Agilent multi-wavelength meter, avoiding unnecessary cost and time developing new code for your test system. With the new 86122A, you can even upgrade your existing unit to the best performance available. Agilent multi-wavelength meters allow you to optimize test costs while protecting your investment.

Simultaneously Measure up to 1000 Wavelengths and Powers

The Agilent 86120B, 86120C, and 86122A multi-wavelength meters, like other Michelson interferometer-based wavelength meters, allow you to measure the average wavelength of the input signal. In addition, the Agilent Technologies multi-wavelength meters – with advanced digital processing – accurately and easily differentiate and measure up to 1000 (200 and 100 for the 86120C and 86120B, respectively) discrete wavelengths.



The new 86122A offers an easy-to-use graphical interface to optimize efficiency

Agilent multi-wavelength meters simultaneously measure the individual powers of discrete wavelengths, offering the following measurement capabilities:

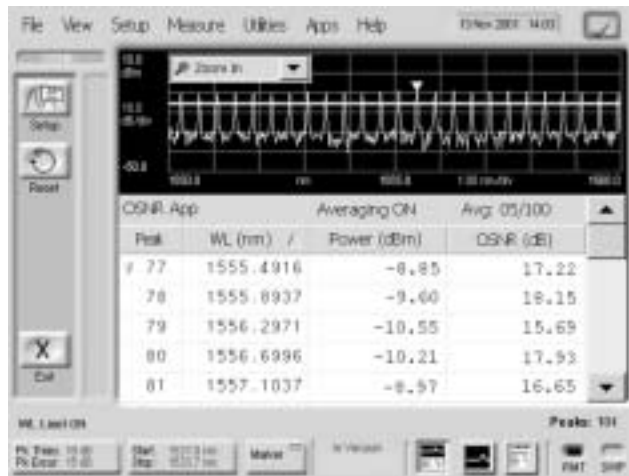
- 1 to 1000 wavelengths and powers
- Average wavelength and total power
- Up to ± 0.2 ppm wavelength accuracy
- Up to 5 GHz wavelength resolution
- Calibrated for elevation in air or vacuum
- Wavelength units in nm, THz, or wave number (cm^{-1})
- Amplitude units in dBm, mW, or μW
- OSNR and averaged OSNR for WDM SONET/SDH systems
- Rugged design to withstand strong shocks and vibration

86120B/C
86122A

WDM Transmission Systems

Combining measurement performance with reliability, the Agilent Technologies multi-wavelength meters let you easily and accurately verify the optical carrier performance of transmission systems by measuring wavelength, power, and optical signal-to-noise ratios during design, manufacturing, and test.

The 86122A multi-wavelength meter is optimized for measuring ultra-dense channel spacing with an absolute wavelength accuracy of up to ± 0.2 ppm (± 0.3 pm referenced to 1550 nm). With a resolution of < 5 GHz, it is an ideal solution in the design and manufacturing of next-generation optical networks.



The Agilent 86122A displaying signal-to-noise ratios

With a rugged and portable package, the 86120B and 86120C multi-wavelength meters are ideal for optical network commissioning and monitoring applications. With the 86120C resolution of < 10 GHz (< 20 GHz for the 86120B) and absolute wavelength accuracy of ± 2 ppm or ± 3 pm at 1550 nm (± 3 ppm, ± 5 pm at 1550 nm for the 86120B), you can confidently verify system performance of DWDM systems with channels spaced at < 50 GHz.



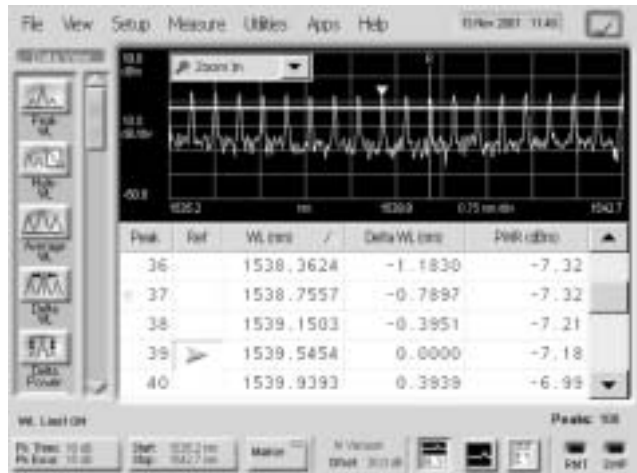
The Agilent 86120B/C and 86122A can simultaneously resolve and measure the individual optical carrier wavelengths and powers to confirm channel spacing, drift, crosstalk, and optical signal-to-noise ratios.

Sources

The superior wavelength and amplitude measurement capabilities of the Agilent 86120B, 86120C and 86122A multi-wavelength meters enable you to maximize the performance of your components in the factory. You can measure DFB, FP, and multiple DFB laser wavelengths and amplitudes during burn-in, environmental evaluation, final test, and incoming inspection. You can also calculate center wavelengths of broader linewidth sources, such as LED's or Bragg-grating filtered ASE responses, using the user-selectable broadband algorithm.

Relative Wavelength and Amplitude Measurements

The Agilent 86120B, 86120C, and 86122A allow you to optimize systems or components for wavelength stability and channel spacing. You can compare individual optical carrier wavelengths and powers to those of a user-selected reference, and monitor dynamic changes.



In Delta Mode, the Agilent 86122A displays relative wavelengths and powers

Built-in Data Logging

Designed with the R&D engineer in mind, the 86122A multi-wavelength meter allows you to capture changes in all system parameters over time, without having to develop external remote programs. Using the data-logging mode, the 86122A records measured data at user-specified intervals with a time stamp and stores the data on the built-in hard drive of the instrument. This data can then be easily downloaded via floppy drive, GPIB, or the LAN as a comma-separated variable (.csv) file to your spreadsheet program for graphing and analysis.

Advanced Measurement Applications Allow System Verification and Monitoring

The Agilent 86120B/C and 86122A multi-wavelength meters augment your productivity by processing the measurement data to automatically and directly give you system performance results, such as:

Drift

The Drift routine allows you to monitor, as a function of time or other dynamic conditions, changes in wavelength and amplitude of your optical signal or signals while simultaneously logging wavelength and amplitude:

- Current values – to give you the real-time status of your laser sources
- Maximum and minimum values – so you can record the limits reached during the measurement
- Total drift – so that you can measure the total variation of your signals during testing

Optical Signal-To-Noise Ratio

Verify transmission system performance with the Optical Signal-to-Noise Ratio routine, which easily allows you to determine all the signal-to-noise ratios in your system with:

- Noise measured halfway between channels – for quick verification
- Noise measured at user-defined wavelengths – for maximum flexibility
- Noise normalized to a 0.1 nm bandwidth – for easy comparison

Key Features

The key differences in features and performance between the Agilent 86120B, 86120C and 86122A multi-wavelength meters are shown in the table below.

Key Features		86120B	86120C	86122A
Number of Simultaneous Laser Lines Measured		100	200	1000
Wavelength	Range	700 – 1650 nm	1270 – 1650 nm	1270 – 1650 nm
	Absolute Accuracy at 1550 nm	±3 ppm	±2 ppm	±0.5 ppm (±0.2 ppm with 86122A-002 option)
	Resolution Bandwidth at 1550 nm			
	Normal Update	0.12 nm	0.06 nm	0.03 nm
	Fast Update	1.0 nm	0.12 nm	0.03 nm
Optical Signal-to-Noise Ratio		>35 dB, 200 GHz spacing	>35 dB, 100 GHz spacing	>35 dB, 100 GHz spacing
(0.1 nm noise bandwidth)		>27 dB, 100 GHz spacing	>27 dB, 50 GHz spacing	>27 dB, 50 GHz spacing
Built-in Applications/Modes		Coherence Length	Fabry-Perot Laser Characterization	Fabry-Perot Laser Characterization Data Logging

Fabry-Perot Laser Characterization (available on 86120C and 86122A)

This measurement routine allows you to characterize your Fabry-Perot laser source quickly, easily, and accurately. You can obtain immediate results of:

- Total power
- Full-width at half maximum
- Mean wavelength
- Mode spacing

Coherence Length (available on 86120B only)

The Agilent 86120B automatically allows accurate measurements of the coherence length of Fabry-Perot laser sources typically used in CD-ROM drives or datacom transmission systems:

- Measurement range from 1 to 200 mm
- Accuracy within 5%
- Display laser coherence length and cavity optical length

Instrument Drivers

Instrument drivers compatible with LabView, Visual Basic, C++, and LabWindows are available for the Agilent 86120B, 86120C, and 86122A multi-wavelength meters. These drivers enable remote program development by offering building blocks that allow you to customize your measurements.

Optical Wavelength Meter

386

86120B/C and 86122A Multi-Wavelength Meters (cont.)

Specifications

The technical specifications apply to all functions over the temperature range 0 to 55°C and relative humidity <95%, unless otherwise noted. All specifications apply after the instrument's temperature has been stabilized for 15 minutes in Normal Update mode, unless otherwise noted. Specifications describe the instrument's warranted performance. Supplementary performance characteristics provide information about non-warranted instrument performance in the form of nominal values, and are printed in *italic* typeface.

		86120B	86120C	86122A
Maximum Number of Laser Lines Input		100	200	1000
Wavelength	Range	700 – 1650 nm (182 to 428 THz)	1270 – 1650 nm (182 to 236 THz)	1270 – 1650 nm (182 to 236 THz)
	Absolute Accuracy	±3 ppm (±0.005 nm at 1550 nm, ±0.004 nm at 1310 nm) for laser lines separated by ≥30 GHz	±2 ppm (±0.003 nm at 1550 nm and 1310 nm) for laser lines separated by ≥15 GHz	±0.5 ppm (±0.75 pm at 1550 nm and ±0.65 pm at 1310 nm); ±0.2 ppm ¹ (±0.3 pm at 1550 nm and 1310 nm) for laser lines separated by ≥10 GHz
Minimum Resolvable Separation (equal power lines input)		20 GHz (0.16 nm at 1550 nm, 0.11 nm at 1300 nm) ²	10 GHz (0.08 nm at 1550 nm, 0.06 nm at 1300 nm) ³	5 GHz (0.04 nm at 1550 nm; 0.03 nm at 1310 nm) ⁴
Display Resolution		0.001 nm, normal update mode; 0.01 nm, fast update mode	0.001 nm	0.0001 nm
Units		nm (vacuum or standard air), cm ⁻¹ , THz	nm (vacuum or standard air), cm ⁻¹ , THz	nm (vacuum or standard air), cm ⁻¹ , THz
Power	Absolute Accuracy	±0.5 dB (at ±30 nm from 780, 1310, and 1550 nm)	±0.5 dB (at ±30 nm from 1310 and 1550 nm)	±0.5 dB (at ±30 nm from 1310 and 1550 nm)
	Flatness, 30 nm from any wavelength	±0.2 dB, 1200 – 1600 nm ±0.5 dB, 700 – 1650 nm	±0.2 dB, 1270 – 1600 nm ±0.5 dB, 1270 – 1650 nm	±0.2 dB, 1270 – 1600 nm ±0.5 dB, 1270 – 1650 nm
	Linearity	±0.3 dB, 1200 – 1600 nm, lines above –30 dBm	±0.3 dB, 1270 – 1600 nm, lines above –30 dBm	±0.3 dB, 1270 – 1600 nm, lines above –30 dBm
	Polarization Dependence	±0.5 dB, 1200 – 1600 nm	±0.5 dB, 1270 – 1600 nm ±1.0 dB, 1600 – 1650 nm	±0.5 dB, 1270 – 1600 nm ±1.0 dB, 1600 – 1650 nm
	Units	dBm, mW, μW	dBm, mW, μW	dBm, mW, μW
Sensitivity⁵	Single Line Input	–40 dBm, 1200 – 1600 nm	–40 dBm, 1270 – 1600 nm –30 dBm, 1600 – 1650 nm	–40 dBm, 1270 – 1600 nm –30 dBm, 1600 – 1650 nm
	Multiple Lines Input	30 dB below total input power, but not less than single line input sensitivity, 700 – 1650 nm	30 dB below total input power, but not less than single line input sensitivity, 1270 – 1650 nm	30 dB below total input power, but not less than single line input sensitivity, 1270 – 1650 nm
Input Power	Maximum Displayed Level (sum of all lines input)	+10 dBm	+10 dBm	+10 dBm
	Maximum Safe Input Level (sum of all lines input)	+18 dBm	+18 dBm	+18 dBm
Built-in Automatic Measurement Applications				
Signal-to-Noise Ratio (0.1 nm noise bandwidth), lines above –25 dBm		>35 dB, channel spacing ≥200 GHz >27 dB, channel spacing ≥100 GHz	>35 dB, channel spacing ≥100 GHz >27 dB, channel spacing ≥50 GHz	>35 dB, channel spacing ≥100 GHz >27 dB, channel spacing ≥50 GHz
Signal-to-Noise Ratio of Modulated Lasers (with averaging) (0.1 nm noise bandwidth), lines above –25 dBm, 100 averages		>35 dB, channel spacing ≥200 GHz >27 dB, channel spacing ≥100 GHz	>35 dB, channel spacing ≥100 GHz >27 dB, channel spacing ≥50 GHz	>35 dB, channel spacing ≥100 GHz >27 dB, channel spacing ≥50 GHz
Drift		Max, Min, Max-Min wavelengths and powers over time		
Laser Classification		FDA Laser Class I according to 21 CFR 1040.10; IEC Laser Class 1 according to IEC 60825		
Dimensions		140 mm H x 340 mm W x 465 mm D (5.5 in x 13.4 in x 18.3 in)		133 mm H x 425 mm W x 520 mm D (5.2 in x 16.7 in x 20.5 in)
Weight		9 kg (19 lb)		14.5 kg (32 lb)

¹Specify 86122A-002 option.

²For lines separated by less than 30 GHz, wavelength accuracy is reduced.

³For lines separated by less than 15 GHz, wavelength accuracy is reduced.

⁴For lines separated by less than 10 GHz, wavelength accuracy is reduced.

⁵Contact Agilent Technologies for availability of special instruments with higher sensitivity.

Ordering Information

For the most up-to-date ordering information, please contact your Agilent sales representative or visit our web site at:
www.agilent.com/comms/mwmmeters

86120B/C Multi-Wavelength Meter**Optical Connectors** (replacing the standard FC/PC connector interface)

- 86120x-011 Diamond HMS-10 Connector
- 86120x-012 FC Connector (default)
- 86120x-013 DIN Connector
- 86120x-014 ST Connector
- 86120x-017 SC Connector
- 86120x-020 Straight (non-angled) Contact Interface-PC
- 86120x-022 Angled Contact Interface-APC

Fixed External 10 dB Attenuators

- 86120x-412 Attenuator with FC/PC Connector (must be ordered with 86120x-020 option)
- 86120x-417 Attenuator with FC/APC Connector (must be ordered with 86120x-022 option)

Accessories

- 86120x-AXE Rack Flange Kit with Handles
- 86120x-IA4 Rack Flange Kit without Handles
- 86120x-UK5 Nylon Carrying Case with Shoulder Strap
- 86120x-UK6 Commercial Calibration Certificate with Test Data
- 86120x-UK7 Hard Carrying Case

Documentation

- 86120x-ABA English Operation Manual (default)
- 86120x-ABJ Japanese Operation Manual
- 86120x-OBO Do not include an Operation Manual

86122A Multi-Wavelength Meter**Performance Options**

- 86122A-001 Standard Performance (default)
- 86122A-002 High Accuracy Performance (± 0.2 ppm absolute wavelength accuracy)

Optical Connectors (replacing the standard FC/PC connector interface)

- 86122A-020 Straight (non-angled) Contact Interface-PC (default)
- 86122A-022 Angled Contact Interface-APC
- 86122A-400 Front-Panel Fiber Input (default)
- 86122A-401 Rear-Panel Fiber Input
- 81000AI Diamond HMS-10 Connector
- 81000FI FC Connector (default)
- 81000KI SC Connector
- 81000SI DIN Connector
- 81000VI ST Connector

Fixed External 10 dB Attenuators

- 86122A-412 Attenuator with FC/PC Connector (must be ordered with 86122A-020 option)
- 86122A-417 Attenuator with FC/APC Connector (must be ordered with 86122A-022 option)

Accessories

- 86122A-1CM Rack Mount Kit without Handles
- 86122A-1CN Handle Kit
- 86122A-1CP Rack Mount Kit with Handles
- 86122A-UK6 Commercial Calibration Certificate with Test Data

Documentation

- 86122A-ABA English Operation Manual (default)
- 86122A-ABJ Japanese Operation Manual
- 86122A-OBO Do not include an Operation Manual

86120B/C
86122A

JS1000

- SONET/SDH Compliance testing of jitter generation, tolerance, and transfer for 2.4 – 3.1 Gb/s and 9 – 13 Gb/s ranges
- Low clock jitter level testing with industry leading <100 micro UI intrinsic jitter
- Beyond compliance development diagnostic information that helps focus design improvement efforts



For R&D engineers designing high-performance, low-jitter clock recovery and clock/data recovery modules, the JS-1000 is a fully configured SONET jitter test solution that provides complete and compliant jitter testing and characterization of 2.4 – 3.1 Gb/s and 9 – 13 Gb/s rate clock recovery or clock/data recovery devices, either independently or within MUX/DEMUX components. With an ultra-low system intrinsic clock jitter of <100 micro UI rms, it can measure and characterize components that are designed to have very low jitter. The system also allows the component developer to differentiate data dependent jitter from random jitter and provides valuable diagnostic information needed to improve a components jitter performance.

In addition, the JS-1000 has optional capability that allows the measurement of jitter on electrical data signals for two port devices such as electrical-optical plus optical-electrical converter pairs.

A complete JS-1000 solution for serial components requires the addition of the Agilent 71612C serial pattern generator and bit error tester which can be provided by the user or ordered with the system.

Key Electrical Measurement Capabilities

Jitter Generation – the measurement of rms and pp jitter, a 2 M point histogram of p-p jitter, and a spectral density plot of the jitter with non-random jitter components differentiated from random components.

Jitter Transfer – a plot of high resolution jitter transfer measurements (resolution of 0.005 dB to 10 MHz of modulation rate), flexible selection of the number of test points used.

Jitter Tolerance – a plot of jitter tolerance with failed test points clearly identified, flexible selection of the number of test points used.

The JS-1000 derives much of its accuracy and advanced diagnostic capability from using the E5500 Series Phase Noise Solution as a major component of the system. The E5500 series phase noise measurement system, along with the low jitter system clock can be used standalone to measure the phase noise characteristics of high speed clocks.

Worldwide Support & Services

The JS-1000 comes standard with on-site productivity assistance for installation, start-up and training. With our innovative, Internet-based, Cooperative Assistance plans, technical assistance support can be delivered to remote locations quickly.

- Fully automated, integrated turn-key solutions
- Fast, accurate test methods (ISS, TDE)
- Modular and scalable test platform
- Use in production test, design verification, or quality assurance
- Latest OA measurements for the metro market (transients, PDG)



E2156A ISS Based Test System, E2158A ISS and TDE Test System

Agilent offers a fully integrated turnkey solution for optical amplifier test. No other system on the market provides a complete test set for all Optical Amplifiers and the modularity to allow just enough test for price sensitive manufacturing requirements.

Gain, noise figure (NF), polarization dependent gain (PDG), and other derived parameters are measured with a variety of test methods such as interpolation with source subtraction (ISS) and, time domain extinction (TDE).

Our systems provide accurate and complete optical amplifier characterization. Agilent drives down test time and manufacturing costs with fast measurement methods and a variety of options.

Agilent's OA test system is a flexible platform allowing designers and manufacturers the ability to utilize the same modular test approach for a variety of amplifiers including EDFA's, EDWA's, SOA's and Raman.

User Friendly Software

The Agilent OA tests are written to keep logical steps at a high level. This simplifies the test plan. Each test step has its own pop-up configuration box to enter desired test conditions and limits. The software provides test plan flexibility through the use of a test executive (NI TestStand).

Options to Meet Your Testing Needs

Choose options that satisfy your testing requirements including:

- Polarization Controller / PDG
- Transient Measures
- High Power WDM sources with Pre-Emphasis
- Multi-DUT Testing
- Pmp Current Control
- DUT Power Supply Control
- Source Switch

System Tailoring

The Agilent OA test system is an open and modular architecture allowing the system to be tailored to meet your specific requirements including adding:

- Environmental Chamber Control
- DUT Monitoring
- Pump Optimization
- Noise Gain Profile Measurements (NGP)
- SOA Measurements
- Micropositioning
- Noise Figure measurements due to MPI

Worldwide Support & Services

The XOA test system comes standard with on-site productivity assistance for installation, start-up and training. With our innovative, internet-based, cooperative plans, technical assistance support can be delivered to remote locations quickly.

E2156A
E2158A

One Box Test Sets and Test Applications	392
Wireless Test Manager Software	401
Lab Applications	402
Wireless Protocol Test Set and Software	408
<i>Bluetooth</i> Test Set	411
Base Station Test Set	413
Wireless Network Optimization Platform	416
Air Interface Remote Monitoring System	417
Wireless Network Planning and Design Software	418
Wireless Test Systems and Solutions	419

E5515C
8960

- The flexible design of the 8960 Series 10 supports multiple modes and wireless technologies in a single chassis
- Provides all the features and functionality you need for fast, accurate, repeatable, and automated testing of today's most popular wireless formats
- Supports cdma2000, IS-95, W-CDMA, GPRS, GSM, EGPRS, IS-136 (TDMA), AMPS, 1xEV-DO
- Lab applications and other enhancements accelerate the pace of product development and help move your design from the lab into manufacturing in the shortest possible time
- Fast-settling hardware eliminates waiting for the measurement path to stabilize
- Separate analog-to-digital converters for measurements eliminate the wait for shared resources, allowing protocol, receiver, and transmitter measurements to run simultaneously
- Separate processors and receivers handle the link maintenance and make RF measurements
- Hardware speed is optimized using fast processing algorithms and the latest processor technology



The Agilent 8960 Series 10 wireless communication test set offers mobile manufacturers **immediate competitive advantages**. Developed for high-volume, automated mobile phone manufacturing test, the proven 8960 Series 10 test set offers **speed, accuracy, repeatability, multi-format capability, ease of programming, and format-flexible** architecture. For the mobile manufacturer, this translates into lower test costs and higher production output to help meet customer demand for phones now and into the future.

Recent additions to the 8960 Series 10 extend its use into the design and development of wireless devices. Use the new **lab applications** to verify and troubleshoot your wireless designs by using powerful protocol logging features in addition to the extensive parametric testing.

The 8960 Series 10 can be configured for W-CDMA, cdma2000, 1xEV-DO, IS-95, GSM/GPRS, EGPRS, 1xEV-DO, TIA/EIA-136, and AMPS mobile phone testing.

Specifications

Detailed specifications are found in the data sheets for the individual test applications and lab applications.

Accessories

8960 Series 10 Test Applications and Lab Applications

- E1961A AMPS/136 Mobile Test Application
- E1962B cdma2000/IS-95/AMPS Mobile Test Application
- E1963A W-CDMA Mobile Test Application
- E1966A 1xEV-DO Terminal Test Application
- E1968A GSM/GPRS Mobile Test Application
- E1985D GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, cdma2000 Mobile Test Application (fast switching)
- E1991B 8960 Series 10 Test Application Suite
- E6701C GSM/GPRS Lab Application
- E6702A cdma2000 Lab Application
- E6703A W-CDMA Lab Application
- E6704A EGPRS Lab Application
- E6785A GSM/GPRS_W-CDMA Lab Application (fast switching)
- E6719A Lab Application Suite

Wireless Test Manager Test Automation Software

- E6560A cdma2000/IS-95 Wireless Test Manager
- E6562A W-CDMA Wireless Test Manager
- E6563A AMPS/136 Wireless Test Manager
- E6564A 1xEV-DO Wireless Test Manager
- E6566A GSM/GPRS Wireless Test Manager
- E6568B W-CDMA/GSM/GPRS Wireless Test Manager
- E6569B Wireless Test Manager Suite

Key Literature & Web Link

- www.agilent.com/find/8960
- www.agilent.com/find/wtmanagers

Ordering Information

- E5515C Wireless Communications Test Set
- E5515C-002 2nd RF Source
- E5515C-003 Flexible CDMA Base Station Emulator

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960>
8960 Configuration Guide, 5968-7873E

- Increase throughput and shorten test development time with extremely faster combined overall test time of up to 20 seconds
- High-level programming decreases test times, shortens test development, and decreases support costs
- Multi-format capabilities in a single, high performance test set



The Agilent E1968A GSM/GPRS mobile test application for the E5515C – 8960 Series 10 test set provides critical capabilities to verify the performance of your GSM and GPRS mobile devices. This test application, designed for high-volume manufacturing and wireless device development, helps you achieve your time-to-market goals for GSM and GPRS wireless devices.

The E1968A offers a faster combined overall testing time of up to 20 seconds for both GSM and GPRS. This is achieved by non-interruption of the broadcast channel during switching between GSM calls and GPRS data connections. The device under test will maintain camp/attach, and will result in a much shorter combined test time. Although now combined, it will still be possible to specify GSM only or GPRS only operation.

The E1968A will be Available Free of Charge for Existing E1960A GSM or E1964A GPRS Users

Get the proven benefits of the Agilent E5515C test set. Because this GSM/GPRS test solution is based on the high-performance E5515C test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the test set can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, and minimize support costs.

E1968A also offers optional EGPRS test support.

Specifications

GSM Functionality

- Mobile station power output level control: meets GSM phase one and phase two power control levels
- Traffic channels: TCH/FS – FR, EFR and HR speech modes
- Broadcast channel configuration: BCCH + CCCH + SDCCH/4
- Signaling protocol setup: FACCH
- Audio speech echo: 1-second fixed delay
- External trigger: signal output each frame with user-settable timeslot and bit
- Measurement coordination: flexible control of burst type, ARFCN and timeslot

Transmitter Measurements

- Frequency error
- Transmit power
- Phase error (peak and rms)
- Power vs time (burst mask comparison)
- Burst timing
- Output RF spectrum due to switching
- Output RF spectrum due to modulation
- IQ tuning
- Decoded audio level

Audio Functionality

- Choice of speech encoded on downlink TCH: none, echo, 300 Hz sine, 1 kHz sine, 3 kHz sine, or PRBS-15
- Audio generator
- Analog audio measurement (audio level, distortion, frequency, SINAD)

Receiver Measurements

- Burst-by-burst bit error ratio (fast BER)
- Normal bit error ratio (BER)

GPRS Functionality

- Coding schemes: CS-1, CS-2, CS-3, CS-4
- Multislot configurations: 1 x 1, 2 x 1, 3 x 1, 4 x 1, 2 x 2, 3 x 3 (downlink x uplink)
- Multislot classes supported: 1 through 10
- Control channels: BCH on timeslot 1 on any ARFCN in any band
- Broadcast channel configuration: FCCH + SCH + BCCH + CCCH + SDCCH/4 (0-3) + SACCH/C4 (0-3)
- Downlink PDTCH: one, two, three or four on the same PDTCH ARFCN with one or two PDTCH amplitudes user-settable between 0 and 42 dB below BCH amplitude; amplitudes in unused time slots user-selectable as off, PRL one or PRL two
- External trigger: signal output each frame with user-settable timeslot and bit

Transmitter Measurements

- Multislot-tolerant frequency error
- Multislot-tolerant transmit power
- Multislot-tolerant phase error (peak and rms)
- Multislot power versus time (burst mask comparison)
- Burst timing
- Multislot-tolerant output RF spectrum due to switching
- Multislot-tolerant output RF spectrum due to modulation
- General purpose spectrum monitor

Receiver Measurements

- Multislot bit error ratio (BER) using ETSI test mode B
- Multislot block error ratio (BLER)

EGPRS (EDGE) Functionality Option

- Coding Schemes MCS1-9
- GMSK Measurements same as GPRS + additional 8PSK
- Switched Radio Block (SRB) Loopback Data Connection Type

Accessories

E1985D (GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, IS-95/cdma2000 Mobile Test Application – fast switching)

E6566A Wireless Test Manager Test Automation Software makes it quick and easy to automate GSM and GPRS testing with the E1968A test application

E6571A Wireless Test Manager Run-Time License

Key Literature & Web Link

www.agilent.com/find/E1968A

www.agilent.com/find/E1985D

www.agilent.com/find/E6566A

www.agilent.com/find/E6571A

Ordering Information

E1968A GSM/GPRS Mobile Test Application
E1968A-101 GSM Functionality
E1968A-102 GPRS Functionality
E1968A-201 GSM and GPRS Functionality

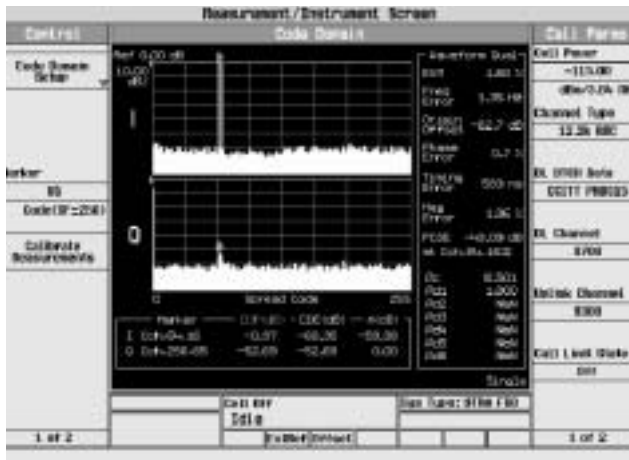
For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>

8960 Configuration Guide, 5968-7873E

E1963A

- TS34.121 measurements for production test
- Move between all of your installed UMTS formats – GSM, GPRS, and W-CDMA, with either Fast TA Switching, or our lightning fast W-CDMA to GSM handover
- Call types of Test Control or Call Control Voice Echo
- Complete set of test channels with 12.2 k, 64 k, and 384 k RMC’s
- Security procedures Authentication and Integrity Protection
- In-call Spectrum Analysis
- Frequency bands are GSM/EGSM, DCS1800, PCS1900, and the new IMT-2000 band
- No hardware upgrade required if you have E5515C-003 installed



11

The Agilent E1963A W-CDMA mobile test application for the 8960 Series 10 test set provides critical capabilities to verify the performance of your third generation digital devices. This test application, designed for high-volume manufacturing and wireless device/user equipment (UE) development, helps you achieve your time-to-market goals for W-CDMA wireless devices/UEs. Use the E1963A to turn your 8960 test set into a powerful UMTS system simulator and parametric tester.

The E1963A offers an extensive list of transmitter and receiver tests for the W-CDMA format with graphics, statistics, and variables that extend these tests beyond just Manufacturing. You can be confident in your measured results because all tests conform to UMTS/3GPP UTRA FDD TS 34.121 specifications for user equipment.

Get the proven benefits of the Agilent 8960 test set. Because this W-CDMA test solution is based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

TX Measurements

- Thermal power
- Channel power
- Adjacent channel leakage power ratio (ACLR)
- Modulation quality
 - Error vector magnitude (EVM)
 - Frequency error
 - Magnitude error
 - Phase error
 - Origin offset
 - Peak code domain error (PCDE)
 - Time error
- Spectrum emissions mask
- Occupied bandwidth
- Code domain measurements
- IQ Tuning
- Inner Loop Power
- PRACH TX ON/OFF

RX Measurements

- Demodulation of 12.2 k, 64 k, and 384 k Reference Measurement Channels
- Loopback BER

Call Processing

- Test Control call processing for RMC
- Call Control call processing for Voice Echo
- Reduce signaling FDD Test mode
- Location update
- MS and BS Originate/Release
- UARFCN Hard Handoff
- GSM system handover
- UL power control
 - Algorithms 1 & 2
 - Active bits
 - Alternating bits
 - All Up
 - All Down
- AWGN and OCNS sources

Accessories

- E1985D (GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS Mobile Test Application – fast switching)
- E6562A Wireless Test Manager Test Automation Software makes it quick and easy to automate W-CDMA testing with the E1963A test application
- E6571A Wireless Test Manager Run-Time License

Key Literature & Web Link

- www.agilent.com/find/E1963A
- www.agilent.com/find/E1985D
- www.agilent.com/find/E6562A
- www.agilent.com/find/E6571A

Ordering Information

E1963A W-CDMA Mobile Test Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960>
8960 Configuration Guide, 5968-7873E

- Supports all modulation modes with packet data rates up to 2.4 Mbps (QPSK, 8PSK, and 16QAM)
- Supports Test Application Protocol (TAP) for RF test interface
- Easy firmware upgrade for existing CDMA-capable 5515C test sets



The Agilent E1966A 1xEV-DO test application for the 8960 Series 10 test set (E5515C) provides the first, one-box manufacturing solution for testing at high data rates giving you confidence in your wireless access terminals.

Developed for mobile manufacturers as well as developers and designers of leading edge 1xEV-DO wireless access terminals. The E1966A is run on Agilent's industry standard platform, the E5515C, ensuring efficient test times, accuracy, and repeatability in your 1xEV-DO test processes.

Because this 1xEV-DO test solution is based on the high-performance 8960 Series test set (E5515C), you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. These proven features help you shorten test development time, increase throughput, and minimize support costs.

Easy Upgrade for Existing CDMA Capable 8960 Test Sets

Units that support the CDMA test applications, like the E1962B, are easily upgraded to 1xEV-DO test capabilities. It's a simple firmware upgrade with no hardware requirements.

To help you keep up with the increasing pace of mobile phone industry, the 8960 Series 10 test set (E5515C) is designed to quickly support changing and emerging standards enabling you to meet your time-to-market and production goals.

Specifications

1xEV-DO Call Processing

- UATI Assign
- Session Negotiation
- Session Open
- Connect/Disconnect
- FTAP Support
- RTAP Support

TX Measurements

- Average Power
- Code Domain Power
- Modulation Quality
- Spectrum Monitor
- Channel Power
- Access Probe Power
- Time Response of Open Loop Power
- TX Spurious Emissions

RX Measurements

- PER Dynamic Range
- Sensitivity
- PER with AWGN

Accessories

E6564A Wireless Test Manager Test Automation Software makes it quick and easy to automate 1xEV-DO testing with the E1966A test application

E6571A Wireless Test Manager Run-Time License

Key Literature & Web Link

www.agilent.com/find/E1966A

www.agilent.com/find/E6564A

www.agilent.com/find/E6571A

Ordering Information

E1966A 1xEV-DO Terminal Test Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>

8960 Configuration Guide, 5968-7873E

E1966A

E1962B

- Extremely fast cdma2000, IS-95, and AMPS transmitter measurements
- Simultaneous receiver and transmitter measurements enable maximum test throughput
- Provides call processing and key RF parametric test capability for assessing the quality and RF performance of IS-2000 based wireless devices
- Provides flexible cdma2000 and IS-95 forward-link emulation for control of the pilot, sync, paging, AWGN, and other channels, levels and data rates used in R&D and production test applications
- The new built-in Spectrum Monitor provides a quick check of power, waveform and frequency for the reverse traffic channel while on a call



The Agilent E1962B cdma2000 mobile test application for the 8960 Series 10 test set provides critical capabilities to verify the RF performance of your cdma2000 and IS-95 devices. This test application, designed for high-volume manufacturing and wireless device development, helps you achieve your time-to-market goals for cdma2000/IS-95/AMPS tri-mode wireless devices based on the new IS-2000 standard.

The fully-coded IS-2000 forward-link emulation supports Radio Configurations 1 through 5 and all supplemental channel data rates associated with those configurations. Comprehensive signal generation capabilities including all applicable CDMA channels, modulation, and an AWGN source. Flexible user control of the forward link emulation is provided through easy-to-use front panel control and remote GPIB.

Get the proven benefits of the Agilent 8960 test set. Because this cdma2000 test solution is based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. These proven features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

IS-95 and IS-2000 Call Processing

- Registration
- MS origination
- IS-2000 to IS-95 handoff
- One button page
- Hard handoff (band & channel)
- AMPS handoff
- F/R-SCH support

CDMA TX Measurements

- Channel power
- Access probe power
- Code domain power
- Gated power
- TX spurious emissions
- Average power
- Modulation quality
- Code channel time/phase error
- Time response of open loop power

CDMA RX Measurements

- Sensitivity
- FER with AWGN
- TSDO (S032) on F-SCH
- Dynamic range
- Loopback service options 2, 9, and 55

AMPS Call Processing

- Registration
- MS origination
- TX power level change
- One button page
- Hard handoff (channel)

AMPS Measurements

- TX power
- TX FM distortion
- Audio level
- TX FM deviation
- TX audio frequency
- SINAD sensitivity

Accessories

E6560A Wireless Test Manager Test Automation Software makes it quick and easy to automate cdma2000, IS-95, and AMPS testing with the E1962B test application

E6571A Wireless Test Manager Run-Time License

Key Literature & Web Link

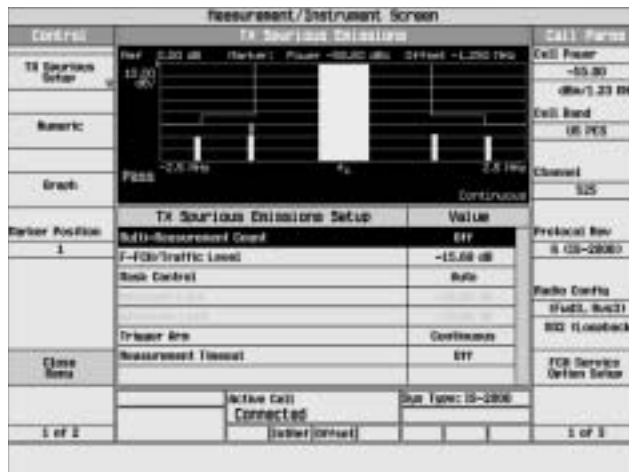
www.agilent.com/find/E1962B
www.agilent.com/find/E6560A
www.agilent.com/find/E6571A

Ordering Information

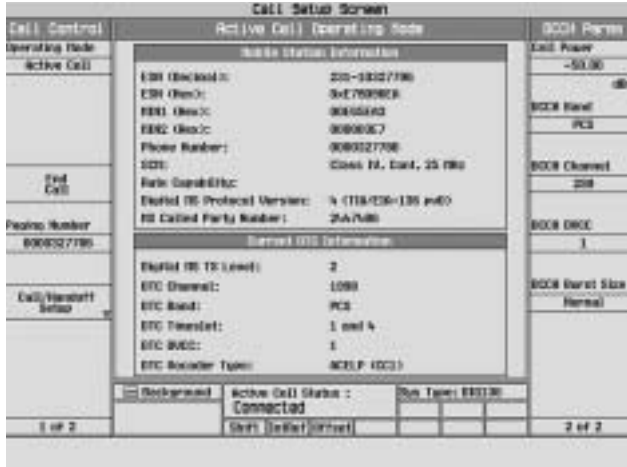
E1962B cdma2000/IS-95/AMPS Mobile Test Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>
 8960 Configuration Guide, 5968-7873E



- Cellular formats supported: IS-136 (800 MHz and 1900 MHz bands) and AMPS
- Extremely fast transmitter and receiver measurements
- High level programming decreases test times, shortens test development, and decreases support costs
- Statistical test results and measurement integrity reporting



The Agilent E1961A AMPS/136 mobile test application for the 8960 Series 10 test set provides critical capabilities to verify the performance of your AMPS/136 mobile devices. This test application, designed for high-volume manufacturing and wireless device development, helps you achieve your time-to-market goals for AMPS/136 wireless devices.

The E1961A offers an extensive list of transmitter and receiver tests for the AMPS/136 format. Additional tests provide extensive audio and call processing performance analysis. AMPS/136 test operating modes include full signaling (active mode), limited signaling (DTC or AVC generation in the test mode) and CW modes.

Get the proven benefits of the Agilent 8960 test set. Because this AMPS/136 test solution is based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

Analog Transmitter Measurements

- analog Tx power
- RF frequency and frequency error
- FM deviation and distortion
- modulation frequency

Analog Receiver Measurements

These measurements can be made using the RF generator and audio analyzer:

- SINAD
- audio harmonic distortion
- hum and noise
- expander
- audio frequency response

Digital Transmitter Measurements

- modulation accuracy (includes rms EVM, rms EVM 10, origin offset, frequency error, rms phase error and rms magnitude error)
- digital Tx power
- adjacent first alternate and second alternate channel powers
- IQ tuning

Digital Receiver Measurement

- loopback bit error rate (BER)

Signal Generation Functionality

- RF generator
- audio generator
- RF IN/OUT port
- RF OUT ONLY port

RF Analysis Functionality

- general purpose spectrum monitor

Audio Analyzer Functionality

- audio level measurement using rms or peak detector
- SINAD measurement
- distortion measurement
- frequency measurement
- swept audio measurement
- expander on or off
- 750 microseconds de-emphasis on or off

Audio Analyzer Filters

User-selectable choice of none or:

- C-message
- 100 Hz bandwidth tunable band pass
- 50 Hz to 15 kHz band pass
- 300 Hz to 15 kHz band pass

Mobile-reported Information

- electronic serial number (ESN)
- mobile identification number (MIN)
- phone number
- station class mark (SCM)
- mobile protocol capability indication for analog control channels (MPCI)
- protocol version for digital control channels
- rate capability for digital control channels
- called number
- MAHO BER on digital traffic channels
- MAHO RSSI on digital traffic channels and neighboring channels

AMPS/136 Functionality

- **mobile station power output level control:** meets TIA/EIA 136 and 136A power control levels
- **digital traffic channels:** full rate speech
- **audio speech echo:** minimum reasonable delay
- **analog measurement coordination:** flexible control of ACC channel number and SID, AVC channel number and power level, SAT color code, FM rate and FM deviation
- **digital measurement coordination:** flexible control of DCCH band, channel number, DVCC, SID, MCC, SOC and burst size, DTC band, channel number, power level, timeslot, DVCC, burst size, vocoder type and induced error level
- **external trigger:** signal output each frame with user-settable timeslot and bit

Signalling Modes

- **full signalling call setup (active cell mode):** protocol used to establish, maintain, change channels and power levels and terminate the link. Full signalling is available with analog and digital signals in both bands
- **no signalling call setup (test mode):** mobile station is set up on a channel without the test set. Test set provides RF generator output and RF and audio analysis input. Test mode with no signalling is available with analog and digital signals in both bands

E1961A

E1961A

Call Processing Functionality

	ACC	Cell, DCCH	PCS DCCH	AVC	Cell. DTC	PCS DTC
Camp	Yes	Yes	Yes	NA	NA	NA
Register	Yes	Yes	Yes	NA	NA	NA
Originate	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC		From ACC From cell. DCCH From PCS DCCH	From ACC From cell. DCCH From PCS DCCH	From cell. DCCH From PCS DCCH
Page	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC		From ACC From cell. DCCH From PCS DCCH	From ACC From cell. DCCH From PCS DCCH	From cell. DCCH From PCS DCCH
Conversation	NA	NA	NA	Yes	Yes	Yes
Hand Off	NA	NA	NA	To AVC To cell. DTC	To AVC To cell. DTC To PCS DTC	To AVC To cell. DTC To PCS DTC
MS Release	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH
BS Release	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	From AVC From cell. DTC From PCS DTC	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH	To ACC To cell. DCCH To PCS DCCH

Accessories

E1985D (GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, cdma2000 Mobile Test Application – fast switching)
E6563A Wireless Test Manager Test Automation Software makes it quick and easy to automate IS-136 (TDMA) and AMPS testing with the E1961A test application
E6571A Wireless Test Manager Run-Time License

Ordering Information

E1961A AMPS/136 Mobile Test Application
 For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960>
 8960 Configuration Guide, 5968-7873E

Key Literature & Web Link

www.agilent.com/find/E1961A
www.agilent.com/find/E1985D
www.agilent.com/find/E6563A
www.agilent.com/find/E6571A

- Ordering convenience of one model number, providing a suite of test application formats for the 8960 Series 10 test set
- Test applications included: E1961A (AMPS/136), E1962B (cdma2000/IS-95), E1963A (W-CDMA), E1966A (1xEV-DO), E1968A (GSM/GPRS/EGPRS), and E1985D (fast switching)
- Test applications can be ordered separately also; see the individual model numbers for more information



The Agilent E1991B test application suite for the 8960 Series 10 test set delivers the most popular wireless formats in one easy-to-order model number providing the most cost-effective way to purchase multiple test applications for your Agilent 8960 Series 10 (E5515C). You can now meet shifting market demands by having all popular cellular formats available when you need them. Your test set and production lines can be ready to go with a new format in minutes to give you maximum flexibility on your production lines.

Get the proven benefits of the Agilent 8960 test set. Because these test solutions are based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, accuracy, repeatability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These proven features help you shorten test development time, increase throughput, and minimize support costs.

E1991B

Specifications

The 8960 Series 10 Mobile Test Application Suite combines the measurements and features from the following into a single model number:

E1961A AMPS/136, E1962B cdma2000/IS-95, E1963A W-CDMA, E1966A 1xEV-DO, and the E1968A GSM/GPRS/EGPRS Mobile Test Applications, and the E1985D fast switching Mobile Test Application which allows fast switching between GSM/GRPS/EGPRS, AMPS/136, W-CDMA or GSM/GPRS/EGPRS, cdma2000.

Accessories

E6569B (Wireless Test Manager Suite)

Key Literature & Web Link

www.agilent.com/find/E1991B
www.agilent.com/find/E6569B
www.agilent.com/find/E6571A

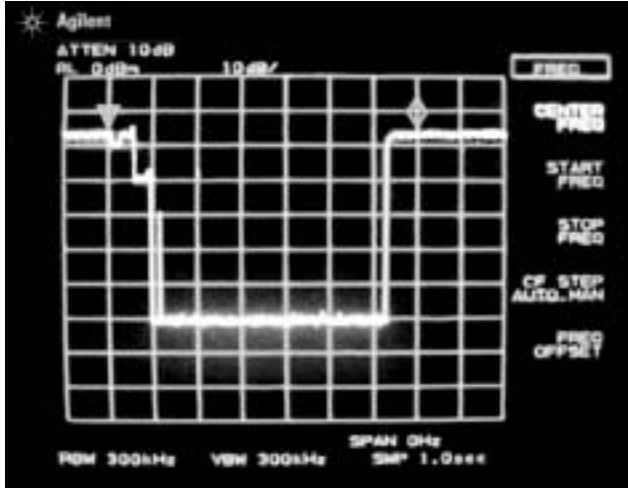
Ordering Information

E1991B Mobile Test Application Suite

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960>
 8960 Configuration Guide, 5968-7873E

E1985D

- GSM/GPRS/EGPRS, IS-136 (800 MHz and 1900 MHz bands), AMPS, and W-CDMA (fast switch)
- GSM/GPRS/EGPRS, cdma2000 (fast switch)
- Switches between wireless formats in less than two seconds
- Extremely fast transmitter and receiver measurements in all communications formats
- Send programming commands to an idle format while testing an active format for further test time reductions



Typical switching time between IS-136 and GSM

The Agilent E1985D GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, cdma2000 mobile test application (fast switching) for the 8960 Series 10 test set significantly reduces test times to meet your customer demands for GSM/GPRS/EGPRS, AMPS/136, and W-CDMA or GSM/GPRS/EGPRS, cdma2000 multi-format wireless devices. These new multi-format devices require test equipment that provides both technology flexibility and the ability to switch between those technologies very quickly to minimize setup and test times. With the E1985D you can minimize setup time when reconfiguring production lines by switching between installed test applications in less than two seconds.

The E1985D offers an extensive list of transmitter and receiver tests for several analog and digital mobile formats. The test applications support both full signaling (active mode), limited signaling (test mode) and CW modes. Find out more about the test capabilities for a specific wireless format by reading more about GSM/GPRS/EGPRS (see the E1968A), AMPS/136 (see the E1961A), cdma2000 (see the E1962B) and W-CDMA (see the E1963A).

Get the proven benefits of the Agilent 8960 test set. Because these test solutions are based on the high-performance 8960 Series 10 test set, you gain the additional benefits of extremely fast measurement speed, ease of programming, accuracy, reliability, and worldwide service and support. The multi-format capabilities of the 8960 can reduce your costs by offering format-flexible manufacturing with a single test set. These features help you shorten test development time, increase throughput, and minimize support costs.

Specifications

The GSM/GPRS/EGPRS, AMPS/136, W-CDMA and GSM/GPRS/EGPRS, cdma2000 Mobile Test Application combines the measurements and features from the E1961A AMPS/136, the E1963A W-CDMA, and the E1968A GSM/GPRS/EGPRS, and the E1962B cdma2000/IS-95/AMPS Mobile Test Applications into fast switching test applications.

The E1985D does not include the individual test applications, only the ability to fast switch between them when they are installed concurrently. Purchase the individual test applications you need along with the E1985D or purchase the E1991B test application suite that includes the E1985D.

Accessories

Requires the purchase of two or more individual mobile test applications in order to fast switch between them (E1961A, E1962B, E1963A, E1968A) E6560A, E6566A, E6562A Wireless Test Manager Software Applications and the E6571A Wireless Test Manager Run-Time License

Key Literature & Web Link

- www.agilent.com/find/E1985D
- www.agilent.com/find/E6560A
- www.agilent.com/find/E6566A
- www.agilent.com/find/E6562A
- www.agilent.com/find/E6571A

Ordering Information

E1985D Mobile Test Applications Fast Switching

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>
8960 Configuration Guide, 5968-7873E

- Software family supports cdma2000, IS-95, 1xEV-DO, W-CDMA, GSM, GPRS, *Bluetooth*[™] and AMPS
- Technology specific, pre-defined automated test plans help you start testing immediately
- High-level, technology specific test steps make for compact, easy to read test plans
- Simple and powerful test step sequencer for fast custom test development
- Common, easy-to-use operator interface decreases training time and operator errors
- Simple interface to set test parameters, limits and system hardware configuration simplifies customization and support
- Common Microsoft[®], Visual Basic[®] based development for powerful test and calibration program/debug capability
- Integrated test wizard reduces the programming required to add custom tests and hardware
- Windows[®] PC compatible including XP, 2000, NT and 98 Second Edition
- Integrated HELP application for test executive and measurement technology assistance



Revolutionize the Automation of Test to Get Your Wireless Device to Market Quickly and Reduce Test Cost

Agilent's wireless test manager is a family of test automation software for wireless device calibration and test. The wireless test manager supports most popular wireless technologies. Developed for a Windows PC, the wireless test manager controls Agilent test sets and other test system hardware via GPIB and serial interfaces. Features include ready-to-use tests, pre-defined test plans, customizable test sequencing, an integrated Visual Basic test development environment and custom application development utilities.

Multiple Technologies

Available for the key wireless technologies, the wireless test manager products support W-CDMA, cdma2000, 1xEV-DO, IS-95, GSM, GPRS, *Bluetooth*, IS-136 (TDMA) and AMPS testing.

Simplify and Expedite Test Efforts

Designed specifically for test engineers, the test manager eliminates the frustrating complexity associated with automating device testing. Why struggle with computer control and data management issues, when the test manager lets you focus on test?

Use Agilent or Custom Test Plans

Run a pre-defined Agilent test plan, customize an existing plan, or create your own custom test plan. The test manager makes it easy to modify test parameters, adjust test limits, change the order of test steps, or build your own test plan – without programming.

Create Custom Test Steps

To guide you through the process of adding your own custom test steps, the test manager features a test wizard. Tests created with the wizard and Visual Basic are added to the test menu and can be used in a custom test plan without additional programming.

Flexibility to Meet Your Test Needs

The wireless test manager makes it easy to configure system hardware. It provides for point and click set-up of select Agilent test sets, power supplies, bar code readers, test fixtures, and printers. Other instruments can be added using a wizard. Plus the test manager gives you the flexibility to save test results for further analysis, and set run conditions to stop, continue, or retry on failure. For more information on the adaptable wireless test manager, visit the product pages on the Web.

Common Software Savings

The wireless test manager is easy to learn and simple to use. You will not have to learn complex applications and multiple programming languages to support calibration and testing. Since wireless test manager interfaces and development tools are common for all products, leveraging your knowledge across wireless technologies has never been easier.

Specifications

The tests supported for each technology include call processing, transmitter, receiver, general and fast-combined tests. To review the supported tests, PC requirements and supported hardware go to www.agilent.com/find/wtmanagers and select a product/technology then select the technical overview (or product overview) for that product.

Accessories

8960 Series 10 Test Applications and Lab Applications

Key Literature & Web Link

Technical information, specifications, downloadable demonstration software and product literature are available at www.agilent.com/find/wtmanagers

Ordering Information

Standard Wireless Test Managers

E6560A for cdma2000, IS-95, AMPS
 E6562A for W-CDMA
 E6563A for IS-136 (TDMA), AMPS
 E6564A for 1xEV-DO
 E6566A for GSM, GPRS
 N4019A for *Bluetooth*

Run-Time, Combination and Suite Wireless Test Managers

E6571A Run-Time License
 N4018A *Bluetooth* Run-Time License
 E6568B for W-CDMA, GSM and GPRS
 E6569B Suite (includes E6560A, E6562A, E6563A, E6566A, E6564A added in 2003)

For detailed configuration information, click the Wireless Test Manager Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/wtmanagers>

E6560A
 E6566A
 E6562A
 E6563A
 E6564A
 N4019A
 E6571A
 N4018A
 E6568B
 E6569B

E6701C

- Reduce cost of test right at your bench with data channel functionality to test end-to-end connectivity and to verify throughput, robustness of radio link control and IP connectivity
- Get complete verifications of designs with selectable and powerful triggering, filtering, and search capabilities of logs
- Viewing of raw data in either hex, decimal, or binary form
- EGPRS (EDGE) Lab Application extension option E6704A, enables 8PSK measurements, EGPRS Coding and Puncturing schemes etc
- Worldwide service and support



The E6701C gives R&D engineers a network emulator with RF measurement capability on their bench allowing them to quickly troubleshoot and validate GSM/GPRS wireless device designs. The flexible, comprehensive protocol analysis and data channel of the test set provides R&D engineers with the tools needed to accurately evaluate and verify a device's signaling functionality, IP performance, and user experience. These enhanced capabilities make the E5515C wireless communications test set one of the most advanced instruments available today.

The EGPRS (EDGE) extension to the GSM/GPRS lab application gives the same capabilities as the GPRS lab application alone, but the E6701C is required to run the EGPRS lab application on the test set.

Data devices have vastly increased protocol messaging and higher demands on their hardware design, compared with earlier voice-only phones. It is also necessary to have real data flow on a device to test receiver capability, as well as its data throughput under different conditions. The E6701C provides the same IP data connection to the Internet pioneered by the E6701A/B GPRS lab application (introduced in Oct 2001). It then adds a long list of customer-requested features: the ability to trigger external instruments off of protocol events; support for SMS; Packet Broadcast Control Channel (PBCCCH); advanced protocol analysis; and many other protocol extensions.

The Agilent E6701C GSM/GPRS lab application and EGPRS (EDGE) lab application for the 8960 Series 10 (E5515C) wireless communications test set provides real time phone to internet connectivity transferring live user data to test and verify real-life application scenarios to validate new wireless device designs quickly and accurately. These lab applications, designed specifically for wireless device development, are affordable enough to put on every design engineer's bench!

Specifications

Functionality

- Advanced protocol logging with the GSM/GPRS wireless protocol advisor
- Mobile-originated and mobile-terminated point-to-point GSM and GPRS short message service (SMS), MS - BS - MS loopback
- Cell broadcast GSM SMS
- Protocol event trigger outputs
- Device under test and Alternate address Ping
- Extensive GSM Frame Triggering
- PBCCCH and support for 8-bit or 11-bit PRACH
- Mobile Measurement Reports
- IP data connection for data transfer between a device under test and a network
 - Both packet switched (GPRS) and circuit switched (GSM)
 - IP Packet/Byte Counters for uplink and downlink
- Enhanced control of RLC/MAC, LLC, GMM and SM protocol events
- All features from E1968A GSM/GPRS mobile test application such as:
 - Multi-slot configurations for class 10 GPRS mobile devices
 - Single-slot GSM and Multi-slot GPRS RF parametric measurement
 - BLER, ETSI A and ETSI B data connection types
 - FR, EFR, HR GSM Speech Modes
 - Base Station Emulation control, settable ARFCN, MS Power level, Cell Power level, handoffs, Cell Parameters etc
 - Spectrum Monitor

Accessories

E6566A Wireless Test Manager Test Automation Software makes it quick and easy to automate GSM and GPRS testing with the E6701C lab application. Parametric measurements only

E6785A GSM/GPRS_W-CDMA Lab Application (fast switching)

Key Literature & Web Link

www.agilent.com/find/E6701C

www.agilent.com/find/E6566A

www.agilent.com/find/E6785A

Ordering Information

E6701C GSM/GPRS Lab Application

E6701C-001 GSM/GPRS Lab Application Upgrade from E6701A

E6701C-002 GSM/GPRS Lab Application Upgrade from E6701B

E6701C-003 GSM/GPRS Lab Application Upgrade from E1960A

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>

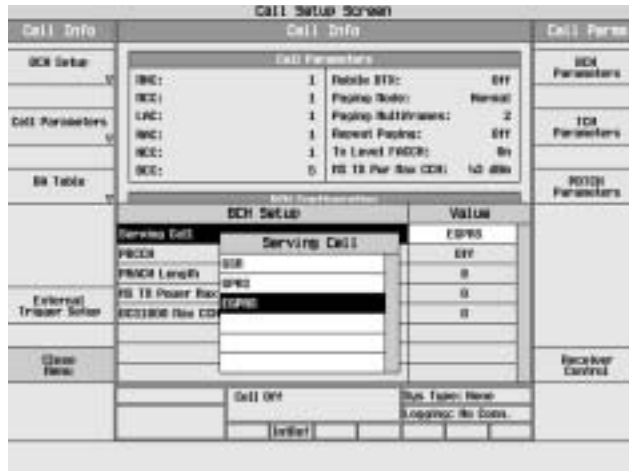
8960 Configuration Guide, 5968-7873E

- Real time, actual user data, RF to IP transfer, Auto connection type
- 8PSK EGPRS (EDGE) Signal Generation and RF Measurements
- All EGPRS Coding Schemes and Puncturing Schemes
- Incremental Redundancy
- All related GSM/GPRS features of the E6701C, e.g. infrequent network events, protocol event triggering, SMS, all other Network Emulation Capabilities, Protocol Logging using WPA

E6704A EGPRS Lab Application extends the “Network On A Bench” capabilities of the E6701C GSM/GPRS Lab Application to include EGPRS. All existing features of the E6701C, which relate to EGPRS (EDGE) are enhanced, for example, protocol logging using Wireless Protocol Advisor (WPA) now includes decodes for relevant EGPRS specific signaling.

E6704A
E6701C

The EGPRS Lab Application, also extends E6701C’s RF to IP web browsing, internet connectivity, network emulation feature to enable real time, real data throughput testing of EGPRS devices. All other EGPRS ETSI defined test modes are included, ETSI A, ETSI B, Switched Radio Block Loop-back (SRB), as well as Agilent’s own BLER connection type.



Specifications

E6704A adds the following functionality to E6701C:

- Cell type EGPRS option
- Coding Schemes MCS1 to 9 independently settable for uplink and downlink
- Puncturing Schemes P1, P2, P3 – user settable in test mode

Data Connection Types:

- EGPRS Extensions to ETSI Test Mode A and B
- Switched Radio Block (SRB) Loopback Mode (sometimes referred to as ETSI Test Mode C)
- Agilent BLER
- IPData (Auto) for full PDP connection to external sites
- Limited signaling BCH+PDTCH mode extended for new coding schemes

Link Quality Features:

- Incremental Redundancy
- Bit Error Probability
- Block Corruption to force re-transmission

8PSK EGPRS Receiver and Transmitter Measurements:

- BER/BLER
- Fast, one burst, Tx Power
- Power Versus Time with User settable mask
- Output RF Spectrum (Switching and Modulation)
- Modulation Accuracy

EGPRS Protocol Logging using Wireless Protocol Advisor (WPA)

Accessories

E6701C required to run E6704A

Key Literature & Web Link

www.agilent.com/find/E6701C

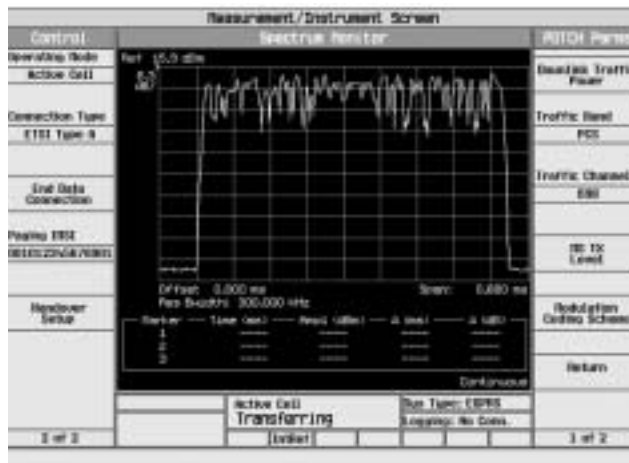
Ordering Information

E6704A EGPRS Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>

8960 Configuration Guide, 5968-7873E



E6703A

- All features of the E1963A W-CDMA test application, plus:
 - 384 k DL, 64 k UL data channel
 - 64 k Packet Switched data channel connected from RF to IP
 - 64 k Circuit Switched data channel
 - Advanced protocol analysis
 - Soft Handoff of all Radio Bearers
 - Mobile reported measurements



The Agilent E6703A W-CDMA lab application for the 8960 Series 10 (E5515C) wireless communications test set provides advanced logging, data channels to IP, ease-of-use, and is the first to provide W-CDMA to GSM hand-over. This lab application, designed specifically for wireless device development, is affordable enough to put on every design engineer's bench!

The E6703A gives R&D engineers a network emulator with RF measurement capability on their bench allowing them to quickly troubleshoot and validate W-CDMA wireless device designs. The flexible, comprehensive protocol analysis and data channel of the test set provides R&D engineers with the tools needed to accurately evaluate and verify a device's signaling functionality, IP performance, and user experience. These enhanced capabilities make the E5515C wireless communications test set one of the most advanced instruments available today.

Data devices have vastly increased protocol messaging and higher demands on their hardware design, compared with earlier voice-only phones. It is also necessary to have real data flow on a device to test receiver capability, as well as its data throughput under different conditions. The E6703A with the E5515C offer advanced protocol logging with Agilent's Wireless Protocol Advisor, data channels to IP, AMR voice echo, W-CDMA to GSM system hand-over, troubleshooting tools, in-call spectrum analysis, soft handoff, and all current test application features and functionality.

Specifications

TX Measurements

- Thermal power
- Channel power
- Adjacent channel leakage power ratio (ACLR)
- Modulation quality
 - Error vector magnitude (EVM)
 - Frequency error
 - Magnitude error
 - Phase error
 - Origin offset
 - Peak code domain error (PCDE)
 - Time error
- Spectrum emissions mask
- Occupied bandwidth
- Code domain measurements
- IQ Tuning
- Inner Loop Power
- PRACH TX ON/OFF

RX Measurements

- Demodulation of 12.2 k, 64 k, and 384 k Reference Measurement Channels
- Loopback BER

Call Processing

- Test Control call processing for RMC
- Call Control call processing for Voice Echo
- Reduce signaling FDD Test mode
- Location update
- MS and BS Originate/Release
- UARFCN Hard Handoff
- GSM system handover
- UL power control
 - Algorithms 1 & 2
 - Active bits
 - Alternating bits
 - All Up
 - All Down
- AWGN and OCNS sources

Accessories

- E6562A** Wireless Test Manager Test Automation Software makes it quick and easy to automate W-CDMA testing with the E6703A lab application. Parametric measurements only
- E6785A** GSM/GPRS_W-CDMA Lab Application (fast switching)

Key Literature & Web Link

- www.agilent.com/find/E6703A
- www.agilent.com/find/E6562A
- www.agilent.com/find/E6785A

Ordering Information

E6703A W-CDMA Lab Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960>
8960 Configuration Guide, 5968-7873E

- External wireless protocol analyzer software, which allows users to find and resolve difficult signaling functionality and timing issues
- Simulate two CDMA base station signals to give you the flexibility to test the soft/softer handoff capabilities
- Troubleshoot design issues or test setup problems with enhanced frame error rate measurement
- All test application features to smooth transition from development to manufacturing
- Data test capability for testing forward supplemental channels at data rates up to 153 kbps

	E6702A	E1962B
Applications	Verification/ Integration SW Developers	RF Hardware Developers Production
Internet Connection	✓	
RF Network Emulation	✓	✓
Logging	✓	
RF Measurements	✓	✓

The Agilent E6702A cdma2000 lab application for the 8960 Series 10 wireless communication test set (E5515C) speeds wireless appliance development with one-box support for soft and softer handoffs, comprehensive parametric measurement capabilities including enhanced frame error rate, and wireless protocol advisor support.

The E6702A cdma2000 lab application contains external wireless protocol analyzer software, which allows users to find and resolve difficult signaling functionality and timing issues. This software operates on an external PC connected to the 8960 test set through the 10 base-T ethernet port. You can capture targeted data with three levels of filtering and triggering, thereby reducing the time needed to view lengthy log files.

Simulate Two CDMA Base Station Signals

With a second independent base station emulation, the E6702A cdma2000 lab application loaded on the 8960 test set supports soft and softer handoffs. Fully configurable settings, such as PN offset, cell power and secondary base station signal delay give you the flexibility to test the soft/softer handoff capabilities of cdma2000 wireless devices.

Troubleshoot Mobile Performance

The enhanced frame error rate measurement indicates the source of frame errors which helps troubleshoot design issues or test setup problems. Also supported, TDSO (Test Data Service Option) support for FER measurements on the high speed supplemental channel.

All cdma2000/IS-95/AMPS Test Application Features to Smooth your Transition from Development to Manufacturing

Utilizing the same test equipment and establishing test limits in product development as in manufacturing, minimizes required set up time. You can implement manufacturing test code development earlier in your process, and with less effort.

To ease your transition from R&D to manufacturing, get all the performance and features you've come to expect from the 8960 test set and the E1962B cdma2000 test application, plus lab applications focusing more on your design needs.

Specifications

IS-95 and IS-2000 Call Processing

- Registration
- MS origination
- IS-2000 to IS-95 handoff
- Soft/softer handoff
- Protocol logging
- One button page
- Hard handoff (band and channel)
- AMPS handoff
- F/R-SCH support

CDMA TX Measurements

- Channel power
- Access probe power
- Code domain power
- Gated power
- TX spurious emissions
- Graphical Access Probe power
- Average power
- Modulation quality
- Code channel time/phase error
- Time response of open loop power

CDMA RX Measurements

- Sensitivity
- FER with AWGN
- TSDO (S032) on F-SCH
- Dynamic range
- Loopback service options 2, 9, and 55

AMPS Call Processing

- Registration
- MS origination
- TX power level change
- One button page
- Hard handoff (channel)

AMPS Measurements

- TX power
- TX FM distortion
- Audio level
- TX FM deviation
- TX audio frequency
- SINAD sensitivity

Accessories

E6560A wireless test manager test automation software makes it quick and easy to automate cdma2000, IS-95, and AMPS testing with the E6702A lab application

Key Literature & Web Link

www.agilent.com/find/E6702A
www.agilent.com/find/E6560A

Ordering Information

E6702A cdma2000 Lab Application
 E6702A-001 cdma2000 Lab Application Upgrade from E1962B

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>
 8960 Configuration Guide, 5968-7873E

E6719A

- Ordering convenience of one model number, providing a suite of lab application formats for the 8960 Series 10 test set
- A significant cost savings is provided versus purchasing individual lab applications
- Lab applications included: E6701C (GSM/GPRS), E6702A (cdma2000), E6703A (W-CDMA), and E6785A (fast switching)
- Lab applications can be ordered separately also; see the individual model numbers for more information



The Agilent E6719A lab application suite for the 8960 Series 10 test set delivers the most popular wireless formats in one easy-to-order model number. This provides the most cost-effective way to purchase multiple lab applications for your Agilent 8960 Series 10 (E5515C). You can now meet shifting market and design demands by having all popular cellular formats available when you need them.

For engineers who focus on hardware and firmware development or integration, our comprehensive bench-top package provides everything you need to troubleshoot and validate the RF parametric performance and functional capability of wireless data devices. This solution includes a family of wireless lab applications that run on the E5515C test set, giving you all the call processing, measurement, networking, and protocol analysis features necessary for complete device characterization and testing.

Specifications

The 8960 Series 10 Mobile Lab Application Suite combines the measurements and features from the following into a single model number: E6701C GSM/GPRS, E6702A cdma2000, E6703A W-CDMA, and the E6785A fast switching Lab Application which allows fast switching between GSM/GPRS and W-CDMA.

Key Literature & Web Link

- www.agilent.com/find/wirelessprotocol
- www.agilent.com/find/E6701C
- www.agilent.com/find/E6702A
- www.agilent.com/find/E6703A

Ordering Information

E6719A Lab Application Suite

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/8960> 8960 Configuration Guide, 5968-7873E

- Dual mode functionality between W-CDMA and GSM
- Available for free
- Requires the E6701C and E6703A licenses to operate



The Agilent E6785A GSM/GPRS_W-CDMA lab application for the 8960 Series 10 (E5515C) wireless communications test set provides all the capabilities of the E6701C and E6703A lab applications together with fast switch access to each format.

The E6785A gives R&D engineers a network emulator with RF measurement capability on their bench allowing them to quickly troubleshoot and validate W-CDMA wireless device designs, including a W-CDMA to GSM handover. The flexible, comprehensive protocol analysis and data channel of the test set provides R&D engineers with the tools needed to accurately evaluate and verify a device's signaling functionality, IP performance, and user experience.

The E6785A can be installed on a new E5515C order by specifying it in the order. It can also be installed on an existing E5515C by ordering the E6785A with opt 010 to receive a CD-ROM, or by a download from the Web. In all cases, the E6785A code is free, although it does require the E6703A and E6701C licenses to operate.

Specifications

Requires the purchase of two or more individual lab applications in order to fast switch between them (E6701C, E6703A, E6704A)

Accessories

- E6703A (W-CDMA Lab Application)
- E6701C (GSM/GPRS Lab Application)
- E6562A (W-CDMA Wireless Test Manager)
- E6566A (GSM/GPRS Wireless Test Manager)
- E6568B (W-CDMA/GSM/GPRS Wireless Test Manager)

Key Literature & Web Link

- www.agilent.com/find/E6703A
- www.agilent.com/find/E6785A
- www.agilent.com/find/E6562A
- www.agilent.com/find/E6701C
- www.agilent.com/find/E6566A
- www.agilent.com/find/E6568B

Ordering Information

E6785A GSM/GPRS_W-CDMA Lab Application

For detailed configuration information, click the 8960 Configuration Guide link in the Key Library Information section at

<http://www.agilent.com/find/8960>
8960 Configuration Guide, 5968-7873E

E6785A

One-Box Test Sets

408

Wireless Protocol Test Set

E6900A

- Real-time logging of inter-layer and peer-to-peer messages including developer's proprietary messages (raw data only)
- IP datagram capture and display
- Selectable and powerful triggering, filtering, and search capabilities of logs
- The traffic overview summarizing logged message information
- Decode view for viewing individual bit fields with appropriate labeling for each message



The Agilent E6900A wireless protocol test set is a new multi-format hardware platform that provides software developers who do not need all the RF capability of an Agilent E5515C test set, a cost-effective test and integration solution with support for base station, network and data channel emulation capability. Combined with a protocol application, these provide all the capability of the 8960 Series 10 wireless communications test set and a lab application (with the exception of RF measurements), at a greatly reduced price.

The E6900A can be configured for GSM/GPRS mobile phone testing. Visit the entire product family at www.agilent.com/find/E6900A

Specifications

Detailed specifications are found in the data sheets for the individual protocol applications

Accessories

E6910A GSM/GPRS Protocol Application

Key Literature & Web Link

www.agilent.com/find/E6900A

Ordering Information

E6900A Wireless Protocol Test Set

- Reduce cost of test right at your bench with data channel functionality to test end-to-end connectivity and to verify throughput, robustness of radio link control and IP connectivity
- Get complete verifications of designs with selectable and powerful triggering, filtering, and search capabilities of protocol message logs
- Viewing of raw protocol data in either hex, decimal, or binary form
- GSM call processing, circuit-switched data and SMS are fully supported
- Worldwide service and support



The E6910A gives software engineers a network on their bench allowing them to quickly troubleshoot and validate GSM/GPRS wireless device functionality. The flexible, comprehensive protocol analysis and data channel of the test set provides R&D engineers with the tools needed to accurately evaluate and verify a device's signaling functionality, IP performance, and user experience. These key capabilities make the E6900A wireless protocol test set one of the best values in instruments available today.

Today's data devices have vastly increased protocol messaging and software content, compared with earlier voice-only phones. It is also necessary to have real data flow on a device to fully test its functionality under a wide variety of user conditions. The E6910A provides the same GSM/GPRS signaling capability found in the E6701C GSM/GPRS lab application that runs on the E5515C wireless communications test set. It includes a long list of customer-requested features: the ability to trigger external instruments off of protocol events; support for SMS; Packet Broadcast Control Channel (PBCCCH); advanced protocol analysis; and many other protocol extensions.

The Agilent E6910A GSM/GPRS protocol application for the E6900A wireless protocol test set provides real time phone to internet connectivity transferring live user data to test and verify real-life application scenarios to validate new wireless device functionality quickly and accurately. These protocol applications, designed specifically for wireless software development, are affordable enough to put on every software engineer's bench!

Specifications

Functionality

- Advanced protocol logging with the GSM/GPRS wireless protocol advisor
- Mobile-originated and mobile-terminated point-to-point GSM and GPRS short message service (SMS), MS - BS - MS loopback.
- Cell broadcast GSM SMS
- Protocol event trigger outputs
- Device under test and Alternate address Ping
- PBCCCH and support for 8-bit or 11-bit PRACH
- IP data connection for data transfer between a device under test and a network
 - Both packet switched (GPRS) and circuit switched (GSM)
 - IP Packet/Byte Counters for uplink and downlink
- Enhanced control of RLC/MAC, LLC, GMM and SM protocol events
- Multislot configurations for class 10 GPRS mobile devices
- BLER, ETSI A and ETSI B data connection types
- FR, EFR, HR GSM Speech Modes
- Base Station Emulation control, settable ARFCN, MS Power level, Cell Power level, handoffs, Cell Parameters etc

Accessories

E6581A (GPRS Wireless Protocol Advisor)

Key Literature & Web Link

www.agilent.com/find/E6910A
www.agilent.com/find/wirelessprotocol

Ordering Information

E6910A GSM/GPRS Protocol Application

E6910A

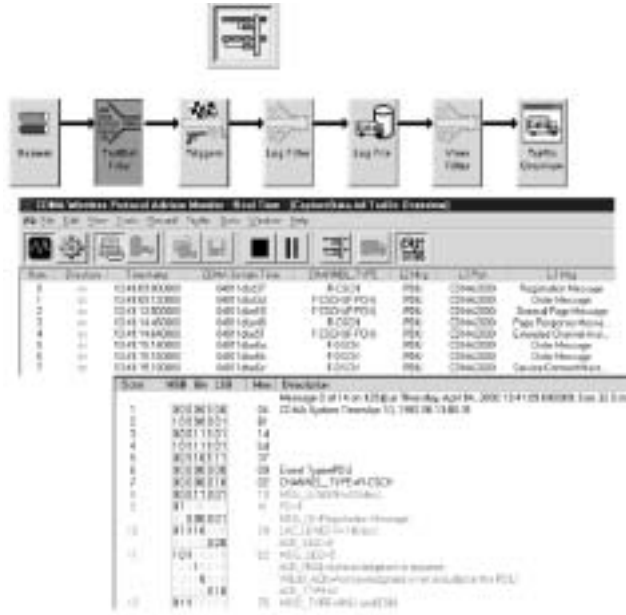
Wireless Protocol Advisor Software

410

Wireless Protocol Advisor Products

E6581A
E6582A
E6583A

- Log and view filtering, as well as log triggering with several qualifiers
- Real-time logging with data available in binary, hex, and decimal
- Large file storage directly to your PC with post-capture analysis capability
- Multiple view panes with each pane including an overview and detailed view
- LAN connectivity to the test set



Agilent's wireless protocol advisor software is included with each lab and protocol application purchased, as well as being available standalone. The software runs on an external PC and helps you collect and interpret protocol messages, verify wireless device functionality, and troubleshoot protocol problems. The end result to you is a faster design cycle, less rework, and increased quality for your customer!

Wireless Protocol Advisor software requires a license to operate, which comes with each sale. The license has an ID number and a code word that must be entered on installation. Upgraded revisions are installed over the old copy and use the same license information for validation.

Before downloading, please view the WPA Compatibility chart detailing the compatibility of software, application, and hardware.

Software	Application	Hardware
E6581A GPRS Wireless Protocol Advisor	E6701B GPRS Lab Application or E6701C GSM/GPRS Lab Application	E5515C Wireless Communications Test Set
E6581A GPRS Wireless Protocol Advisor	E6910A GSM/GPRS Protocol Application	E6900A Wireless Protocol Test Set
E6582A CDMA Wireless Protocol Advisor	E6702A cdma2000 Lab Application	E5515C Wireless Communications Test Set
E6583A W-CDMA Wireless Protocol Advisor	E6703A W-CDMA Lab Application	E5515C Wireless Communications Test Set

Accessories

E5515C Wireless Communications Test Set
E6900A Wireless Protocol Test Set
Lab Applications and Protocol Applications

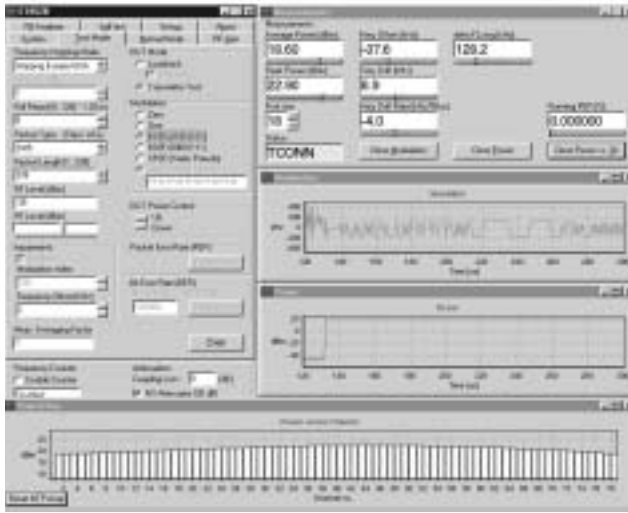
Key Literature & Web Link

www.agilent.com/find/E6581A
www.agilent.com/find/E6582A
www.agilent.com/find/E6583A

Ordering Information

E6581A GPRS Wireless Protocol Advisor
E6582A CDMA Wireless Protocol Advisor
E6583A W-CDMA Wireless Protocol Advisor

- A low-cost, standalone solution – with just the measurement you need
- Establishes a link using standard *Bluetooth™* protocol
- Fast functional test and performance test over the RF interface
- Additional features aid module calibration and diagnostics
- Qualified by the *Bluetooth SIG*
- 3 year standard warranty



The E1852B *Bluetooth* Test Set has the features needed to verify the functionality and performance of your *Bluetooth* devices, with the ability to control the device under test through its RF interface.

This low-cost standalone solution will establish a link with the device under test using standard *Bluetooth* protocol, supporting both normal and test modes allowing fast functional test and performance test. Key transmitter parameters of power, modulation, frequency error, frequency drift are measured, and also receiver sensitivity. Additional features such as RF analyzer and RF generator functions together with clock and data outputs aid module calibration and diagnostics.

Included with the test set is software for a PC-based graphical user interface, providing straightforward measurement set-up. Results are presented numerically and graphically and may also be saved to a log file making it easy to create defect reports or to capture results for further analysis. Automated test sequences are easily created and programming examples are provided. For simplified programming the N4019A *Bluetooth* Wireless Test Manager software is recommended.

During the development lifecycle, the E1852B can be used to assess the performance of different vendors' modules and help make an appropriate selection. As manufacturers move to integrate *Bluetooth* capability into their products, the E1852B will help verify the interoperability of the components and help get to a final design quickly.

During the pre-qualification phase, *Bluetooth* qualification tests can be complex and time-consuming. Including the E1852B for in-house pre-qualification testing enables designers to identify failures early in the development cycle and speed time-to-market.

In a manufacturing environment, the E1852B will establish a link with and control a *Bluetooth* device to ensure it is functional. It can also measure the performance of key parameters in loop-back and transmitter test mode to assure reliable interoperability with other *Bluetooth* devices. Test sequences can be automated for those repetitive or time-consuming measurements, ensuring product quality without compromising on throughput and costs.

Regular firmware updates are easily downloaded from the web to assure interoperability to the latest *Bluetooth* standards and to provide the latest features for the E1852B. Agilent provides worldwide application support to quickly get you up and running.

Specifications

Functionality

Test Mode with or without frequency hopping

Ability to act as a *Bluetooth* Master, perform *Inquiry* and establish a *Paged* connection in test mode *Bluetooth* Specification 1.1 with a *Bluetooth* device.

DUT Mode: Transmitter mode or loop-back mode, with or without data whitening

Transmitter Measurements: Provide the following results:

- Average power
- Peak power
- Frequency offset
- Frequency drift
- Frequency drift rate
- Frequency deviation
- Graphical results showing frequency vs time, power vs time, power vs channel number

Receiver Measurements:

- Number of test bits settable, up to 1.6 million
- Bit Error Rate
- Packet Error Rate

Results Averaging: 1 to 200

Poll Period: 1-255

Packet Types: DH1, DH3, DH5, HV3, AUX1

Packet Length: Variable, according to the *Bluetooth* specifications for each packet type supported

Packet Payload: 00000000, 11111111, 01010101, 00001111 and custom

Power Control: Instruct DUT (Device Under Test) to increase/decrease RF output power

Normal Mode

Ability to act as a *Bluetooth* Master, perform *Inquiry* and establish a *Paged* connection (*Bluetooth* Specification 1.1) with a *Bluetooth* device.

Transmitter Measurements:

- Power & Frequency measurement results based on the use of a zero length payload
- Graphical results showing frequency vs time, power vs time, power vs channel number

Receiver Measurements:

- Packet Error Rate

Results Averaging: 1 to 200

Poll Period: 1

Packet Payload: No payload present in this mode

Power Control: Instruct DUT (Device Under Test) to increase/decrease RF output power

RF-Analyzer

Transmitter measurements as described in Test Mode, but for use when no link is established (DH1, DH3, or DH5 packets and 01010101, 00110011 or 00001111 payloads only)

RF-Generator

Burst or continuous signal on any channel, with selectable power output and frequency offset. (01010101, 00110011, and 00001111 payloads supported)

Accessories

N4018A (*Bluetooth* Test Manager Run-Time License)

N4019A (*Bluetooth* Wireless Test Manager)

Key Literature & Web Link

www.agilent.com/find/E1852B

www.agilent.com/find/N4019A

Ordering Information

E1852B *Bluetooth* Test Set

E1852B

11

Wireless Test Manager Software

412

Bluetooth Wireless Test Manager

N4019A
N4018A

- Compatible with the E1852B *Bluetooth*™ Test Set
- Quick and easy optimization of *Bluetooth* module or device testing
- Test wizard reduces programming
- Automated, menu-driven device characterization improves product design
- Microsoft Visual Basic to customize test development



Agilent's N4019A *Bluetooth* wireless test manager is Windows® PC-based software that provides ready-to-use tests, test plans, test sequencing and menu-selectable hardware support for quick-and-easy automation of *Bluetooth* device calibration and test processes.

Applicable during manufacturing, integration, and development, the test manager software includes a test executive, tests specific to *Bluetooth*, an easy-to-use interface, and is compatible with a Microsoft® Visual Basic® development environment. Executable files can be created and called from other environments, so sequences created in the test manager can be invoked from other programs or test executives.

You can select a pre-defined Agilent test plan, customize an existing plan or create your own test plan. The test-development wizard simplifies this process so you can focus on test. Open code in Visual Basic gives test developers additional flexibility for developing custom tests, user interfaces, and automated handling routines.

Specifications

Test mode and normal mode connections are supported. Measurements include:

- Output Power
- Power Control
- Modulation Characteristics
- Initial Carrier Frequency Tolerance (ICFT)
- Carrier Freq Drift
- Sensitivity Single Slot
- Sensitivity Multi-Slot
- Max Input Level

Accessories

E1852B *Bluetooth* Test Set
N4018A *Bluetooth* Test Manager Run-Time License

Key Literature & Web Link

www.agilent.com/find/N4019A
www.agilent.com/find/E1852B

Ordering Information

N4019A *Bluetooth* Wireless Test Manager

For detailed configuration information, click the Wireless Test Manager Configuration Guide link in the Key Library Information section at <http://www.agilent.com/find/wtmanagers>

11

- Test/Capability
- Technician Benefit
- Subscriber Benefit

Test/Capability	Technician Benefit	Subscriber Benefit
Power Meter	Replaces the need to carry a separate power meter, simplifying maintenance and shortening site visits. Helps reduce CDMA pilot pollution with effective control of power.	Accurate power settings help networks operate in full capacity – reducing coverage holes and interference.
CW and CDMA Reverse Link Signal Generator	Makes it easy to examine the reverse link of the Network improves service quality from both the caller and receiver.	Improves service quality from both the caller and receiver.
CDMA Over-Air Test Tool	Provides fast measurements in less than five minutes. Enables time for proactive maintenance and makes pole top testing practical.	Problem areas can be identified without interrupting service.
Antenna Tester with Vector Network Analysis Capability • cable tests • swept insertion • swept gain • distance to fault	Lets technicians evaluate one of the primary BTS trouble spots in a matter of minutes. Offers the performance necessary to fully benchmark new installations at the time of initial system turn-on.	A complete picture of the antenna health can help improve voice quality – plus reduce the number of dropped calls.
Spectrum Analyzer	Provides necessary functionality so technicians don't need to carry a separate spectrum analyzer. Built-in masks and markers make it easy to use.	Quick interference detection leads to improved service.
T1 or E1	Reduces time needed to identify if problems are on the backhaul or air interface.	Fewer wireline problems mean reduced service problems and down time.
Channel Scanner for CDMA/UMTS/TDMA/GSM/AMPS	Eliminates the need for technicians to carry, manage and learn multiple test sets.	Increased productivity means improved service levels.
Internal GPS Receiver	Provides position location and enables independent verification of base station GPS receiver timing.	For CDMA networks, the internal GPS receiver helps reduce dropped calls by identifying the "island cell" effect – improving the quality of service.



The Agilent Base Station Test Set combines the most highly utilized wireless and wireline tools into one lightweight test set technicians can use for everyday 2G, 2.5G and 3G base station maintenance. This test set is the most functional one-box tool on available today – eliminating the need for technicians to carry, manage and learn multiple test tools. Incorporating your most frequently used tools into one easy-to-use box dramatically increases your technicians' productivity and decreases the time spent per cell site. In addition, you'll see reductions in your overall spending on equipment, tracking, training and calibration and maintenance.

Specifications

Specifications describe the instrument's warranted performance and are valid over the entire operating/environmental range unless otherwise noted. *Supplemental Characteristics are intended to provide additional information useful in applying the instrument by giving typical, but non-warranted performance parameters. These characteristics are shown in italics or labeled as "typical," "usable to," or "nominal."*

General Specifications

Unless otherwise noted the following specifications apply to all measurements/tools using Port 2

Frequency Accuracy:

Using Internal Time Base: $\leq \pm 1$ ppm with >15 minutes warm up

Internal Time Base aging: ± 1 ppm aging/year

With GPS lock for >15 minutes: $\leq \pm 0.01$ ppm

Input Frequency Range:

10 MHz to 2500 MHz

Usable to 500 KHz (specifications and typical values do not apply below 10 MHz)

Maximum Input Level: +20 dBm (0.1 W)

Maximum Input Power without Damaging Instrument: 100 W

Spectrum Analyzer/Tools

Input Frequency Range: 375 – 2500 MHz

Amplitude Accuracy: ± 1 dB

Resolution Bandwidth: 1 KHz to 500 KHz

Span: 10 KHz – 2.495 GHz

Reference Level Range: -100 dBm to +20 dBm

E7495A

Antenna/Cable¹

Frequency Range: 375 – 2500 MHz

Return Loss

With 5 averages:

Range >30 dB
VSWR <1.07

Distance to Fault

Range (m): 1 m to 300 m

Resolution: $(1.5 \times 10^8 * Vf) / (F2 - F1)$ in Hz where Vf is relative propagation velocity of cable (Typically 1% of measurement distance)

Insertion Loss Range: >80dB

Accuracy in Range 0 to 40 dB with 5 Averages:

Average Power Readout
0.1 dB in the mobile phone bands:
824 – 960 MHz
1710 – 2170 MHz

¹ For Antenna/Cable measurements, a short self-calibration procedure must be run prior to making the measurement. For more information about the calibration procedures and when they are needed, see sections 2 and 3 in the users manual or use the online help.

Accessories

RF Channel Analyzer Option 230

RF channel power: ± 1 dB

Adjacent channel power accuracy: ± 0.75 dBc

Signal Generator (CW) Option 500

Frequency Range: 375 – 2500 MHz

Output Level: -25 to -80 dBm

Level Accuracy: ± 1 dB

Phase Error: @ 30 KHz, offset 90 dBc

CDMA Reverse Link Signal Generator Option 510

Same as signal generator except for:

Output Level: -45 to -80

Level Accuracy: ± 2 dB

Power Meter Option 600

Accuracy

• Instrumentation:

Absolute: ± 0.02 dB (log) or $\pm 0.5\%$ (linear). Add the corresponding power sensor linearity percentage.
Relative: ± 0.04 dB (log) or $\pm 1.0\%$ (linear). Add the corresponding power sensor linearity percentage.

• Power Reference:

Power output: 1.00 mW (0.0 dBm) traceable to the U.S. National Institute of Standards and Technology (NIST).
Accuracy: $\pm 1.2\%$ worst case ($\pm 0.9\%$ rss) for one year.
SWR <1.06

Power Meter Option 600 with Agilent 8482A

Frequency Range: 100 KHz to 4.2 GHz

VSWR:

100 KHz to 0.3 MHz <1.60
0.3 MHz to 1 MHz <1.20
1 MHz to 2 GHz <1.10

Power Linearity: +10 dBm to +20 dBm; +2, -4%

Maximum Power: 300 mW average, 1 W peak, 30 W-us per pulse

T1 Analyzer Option 700

Features:

Receive level: (Line 1 and Line 2) +6 dB DSC to -36 DB DSX or

100 mv p-to-p to 12 v p-to-p

Receive frequency Display receive frequency (5 ppm)

(Line 1 and Line 2)

Loop back control Send CSU or NIU loop codes

CSU/NIU emulation Respond to CSU or NIU loop codes

Electrical Interface

Connectors, RX, TX: Primary and secondary ports

Output: Conforms to TR-TSY-000499, CCITT

Rec.G.703 AT&T Pubs CB113, CB119, CB132, CB143

PUB62508 and PUB62411 pulse shape specifications when terminated in 100 ohms and 0 dB line build-out is selected

Line build-out: 0 dB, -7.5, -15 dB

Input:

Terminate: DSX +6 dB to DSX -36 dB, 100 ohms

Monitor: DSX -14 dB to DSX -40 dB, 100 ohms

Bridge: DSX +6 dB to DSX -36 dB, >1000 ohms

Clock 1.544 MHz

Internal: ± 5 ppm

External: ± 300 ppm

Recovered: ± 300 ppm

Transmitter and Receiver

Framing: Unframed, D3/D4 & ESF

Channel formats: Full T1, 64 x 1

Test patterns: QRSS, all 0s, 1:7, 2 in 8, 3 in 24, all 1s,

T-1-Daly, 55 OCTET

Error injection

Type: BPV, frame, CRC, pattern (logic)

Error rate: Single

Alarm inject

Type: LOS, LOF, yellow, AIS, idle (CDI)

CDMA/CDMA2000 Tx Analyzer Option 200

Waveform quality (rho)

Estimated rho

Pilot time alignment (tau): ± 1 usec

Code domain power: ± 1.5 dB absolute, ± 0.5 dB relative

Carrier feedthrough

Pilot power

General

Display

Transflective VGA color LCD

Power

AC adapter

Voltage input 100 – 240 VAC 50/60 Hz

50 W

DC to DC adapter:

Input 9 – 18 Vdc

50 W

Battery life: >1.5 Hrs hours per battery

Interface Ports

Two RS 232

Two USB 1.1

One LAN Port 10 Base T

Built-in speaker

PCMCIA Card slot

Compact Flash memory

Stereo headphone jack

Agilent power sensor jack

General purpose input/output – TTL level

Physical Dimensions

Height: 11.6", 295 mm

Width: 14.5", 368 mm

Depth: 5.3", 135 mm

Weight (without batteries): 20 lbs, 9.1 kg

Inputs

Port 2 RF In: 50 ohm type N (Nominal)

Frequency reference: 50 ohm BNC (Nominal)

Even second: High impedance BNC (Nominal)

GPS antenna: SMA

Outputs

Port 1 RF Out/SWR: 50 ohm type N (Nominal)

Power reference: 50 ohm type N; SWR <1.06

Operating Temperature:

Specified Temperature Range: -10° to 50 °C; 14° to 122°F

Storage Temperature

-40° to 70°C; -40° to 158°F

Calibration

Cycle: 1 year

Warranty

Duration: 1 year

Key Literature & Web Link

Product Overview Link: <http://literature.agilent.com/litweb/pdf/5988-7186EN.pdf>

Photo Card Link: <http://literature.agilent.com/litweb/pdf/5988-5560EN.pdf>

Free Poster: Why are power measurements so important
Link: www.agilent.com/comms/posters_xpi

Main Product Web Page Link:
www.agilent.com/find/basestations

E7495A

Ordering Information**E7495A Base Station Test Set**

Includes one E7495A test instrument, one test instrument backpack, AC power pack, one battery, two 10 dB pads, 40 dB 100 Wattenuator, GPS Antenna, one 64 MB PCMCIA memory card, manuals necessary cables and adapters including: Two 7/16 DIN to Type N adapters, Open/Short and Load calibration kit; Basic test functionality includes spectrum analysis and antenna measurements.

Options

- E7495A-200 CDMAOne/CDMA2000 analyzer
- E7495A-210 CDMAOne/CDMA2000 over-air test
(requires option 200, recommend 810/811 or equivalent)
- E7495A-220 Channel Scanner
- E7495A-240 UMTS
- E7495A-500 CW signal generator
- E7495A-510 CW and CDMAOne reverse link generator
- E7495A-600 Power meter. For use with 8481A or 8482A power sensors
- E7495A-700 T1 test
- E7495A-710 E1 test
- E7495A-810 Cellular antenna and pre-selector filter for option 210
- E7495A-811 PCS antenna and pre-selector filter for option 210
- E7495A-820 Battery pack, external AC charger, DC car adapter
- E7495A-840 Transit case
- E7495A-51B Return to Agilent repair
- E7495A-50C Return to Agilent calibration
- E7495A-8482A Power Sensor

E6474A
E6473B

- Provides RF coverage and service performance measurements
- Client-server data architecture allows increased visibility into data measurements
- Controls multiple receivers and phones simultaneously
- Works with DSP-based receivers for BSIC and scrambling code scanning – including interference analysis (GSM), spectrum analysis and CW/Channel power measurements
- Provides comprehensive phone-based physical layer, layer 3 and QoS measurements
- Supports CDMAOne, CDMA2000, TDMA, iDEN, GSM, GPRS, UMTS and emerging technologies
- Scalability between indoor and outdoor measurement capability



The Agilent Wireless Network Optimization Platform is a comprehensive, single platform drive test system that optimizes and troubleshoots 2G, 2.5G and 3G wireless networks. This platform enables wireless service providers and network equipment manufacturers to proactively address challenges with wireless voice and data networks by quickly and accurately identifying problems.

11

Specifications

The E6474A Wireless Network Optimization Platform supports the following technologies:

- CDMA/CDMA2000
- GSM/GAIT/GPRS
- TDMA
- UMTS
- iDEN

In a given drive test system, up to 4 phones (non-data) and 2 receivers can be used simultaneously.

The E6474A Wireless Network Optimization Platform is completely scalable in that it can support:

- Both phone and receiver measurements
- Multiple technologies on one system
- Both indoor and outdoor measurements
- Both public Internet data testing or dedicated server data testing

The generic data testing within E6474A supports all technologies. The E6474A Wireless Network Optimization Platform can support up to 2 data devices simultaneously. In certain instances, more than 2 data phones can be supported. Please contact your local Agilent representative for more specific information. The following types of data tests and measurements are supported on E6474A:

Public Internet Data Testing

- Total Size
- Download time
- Avg. Application throughput

Dedicated server data testing (server can be placed anywhere on the network)

- Min., Max., and Avg. application throughput (uplink and downlink)
- Min., Max., and Avg. IP throughput (uplink and downlink)
- Bit error ratio
- Data fragmentation
- One way delay
- Roundtrip delay
- TCP and UDP data transfers

Accessories

Accessories for the E6474A Wireless Network Optimization Platform can be found under E6473B.

The following are the main components within E6473B:

- Agilent High Speed Direct Connect Hub (option 015)
- Agilent GPS DR (option 030 and 031)
- Direct connect hub kit (option 021-024)
- Walkabout upgrades (option 090-094)
- Pen tablet PC and associated accessories (option 33x)
- Test phones (option 7xx)
- Direct connect hub cables (option 8xx)

Note: Receivers to be used in conjunction with the E6474A Wireless Network Optimization Platform can be found under E645xC.

Key Literature & Web Link

Main Product Page Link: www.agilent.com/find/E6474A

Product Overview Link: <http://literature.agilent.com/litweb/pdf/5988-3558EN.pdf>

Photo Card: <http://literature.agilent.com/litweb/pdf/5988-7947EN.pdf>

GSM and GPRS Data Sheet: <http://literature.agilent.com/litweb/pdf/5988-5904EN.pdf>

UMTS Data Sheet: <http://literature.agilent.com/litweb/pdf/5988-8519EN.pdf>

Configuration Guide: <http://literature.agilent.com/litweb/pdf/5988-2396EN.pdf>

Ordering Information

Choose Required E6474A Technology Software

- CDMA (E6474A-100, 110, or 120)
- CDMA2000 – includes CDMA (E6474A-101, 111, 121, or 126)
- GSM (E6474A-200, 210, or 220)
- GSM 850 (E6474A-250 or 270)
- GPRS includes GSM (E6474A-600 or 620)
- UMTS (E6474A-300, 310, 320, or 315)
- iDEN (E6474A-400, 410, or 420)
- TDMA (E6474A-500, 510, or 520)

Choose Generic E6474A Software

- Multiple phone software license (E6474A-010)
- Real-time mapping license (E6474A-020)
- Indoor mapping license (E6474A-030)

Choose E6473B Agilent High Speed Direct Connect Hub (if required)

Agilent High Speed Direct Connect Hub (E6473B-015)

Choose E6473B Direct Connect Hub kit (if required)

- In-vehicle hub kit (E6473B-021)
- Portable carry pack hub kit (E6473B-022)
- Single receiver backpack hub kit (E6473B-023)
- Dual receiver backpack hub kit (E6473B-024)

Choose E6473B Direct Connect Hub Cables (if required)

- CDMA – E6473B-801, 802, 805, or 840
- CDMA2000 – E6473B-812, 816, 817, or 871
- GSM – E6473B-827
- GSM/GPRS – E6473B-825
- TDMA – E6473B-830
- iDEN – E6473B-860 or 865
- GAIT – E6473B-850

Choose E645xC Agilent Receiver (if required)

- E6450C, CDMA/TDMA PCS Band RF Receiver
- E6451C, GSM 900 MHz Band RF Receiver
- E6454C, 1.9 GHz CDMA/GSM Digital RF Receiver
- E6452C, CDMA/TDMA Cellular Band RF Receiver
- E6453C, 1800 MHz GSM/K-CDMA Digital RF Receiver
- E6456C, UMTS(WCDMA)/CDMA2000 IMT2000 1.9 GHz Band Receiver
- E6457C, Japan Cellular Band 800 MHz RF Receiver E7456C, iDEN band RF receiver

Choose Other Accessories – GPS DR or Pen Tablet PC(if required)

Korean URL www.agilent.co.kr/find/products

- Rugged probes mounted in service and test vehicles provide autonomous monitoring of your network
- Centralized database provides enterprise-wide connectivity, data collection, storage and binning of RF performance data
- System monitors and collects statistical data on a geographic bin-by-bin basis and also provides drill-down alarm data to immediately troubleshoot problems
- Provides GSM/GPRS phone-based measurement suite
- Reports full collection of parameters including Layer 3 messaging



Agilent's Air Interface Remote Monitoring System (RMS) is a new optimization solution designed to increase work force efficiency up to 60% by remotely monitoring and collecting GSM/GPRS network performance data. A series of remote probes are deployed in service and test vehicles throughout a network to collect RF, data throughput and call event data. The probes then send continuous streams of data back to a central server where reporting and trend analysis is performed via the user's web browser.

This way engineers no longer need to spend as much time driving to find problems, driving back to the office to analyze the data, driving back out to the site, and then starting the process all over again. Now engineers in the office can analyze data collected from the remote probes using a centralized server with an interactive web interface. With Agilent's Air Interface RMS, you can identify and troubleshoot network problems in hours, rather than days and expand networks without increasing workloads or resources.

Key Literature & Web Link

Main Product Page Link: www.agilent.com/find/RMS

Product Overview Link:

<http://literature.agilent.com/litweb/pdf/5988-6482EN.pdf>

Photo Card: <http://literature.agilent.com/litweb/pdf/5988-5640EN.pdf>

Data Sheet: <http://literature.agilent.com/litweb/pdf/5988-8447EN.pdf>

E6476A/
E6478A

E6482A

- Simulates networks at the deployment phase
- Provides tools to evaluate growth in the voice and data service offerings
- Manages interference by determining how network loading affects QoS by going beyond the typical interference prediction model with:
 - Forward and reverse link QoS predictions
 - Monte Carlo Simulations that predict BER, FER, QoS and much more
- Supports AMPS/TACS, iDEN/Tetra, TDMA, CDMAOne, CDMA2000, GSM, GPRS, UMTS and emerging technologies
- Provides an easy-to-use graphical user interface



11

Wizard Network Planning and Design Software is a high precision 2G, 2.5G and 3G network planning and design tool that helps wireless service providers plan for network growth and manage next generation technology migrations. Wizard's unique capability of modeling network conditions at the deployment phase helps reduce the typical design cycle up to 20%. Our planning tool is a catalyst to reduce your deployment costs and accelerate the delivery of your networks – including GSM, GPRS and UMTS networks.

Key Literature & Web Link

Main Product Page Link: www.agilent.com/find/Wizard
Product Overview Link: <http://literature.agilent.com/litweb/pdf/5988-0245EN.pdf>
Photo Card Link: <http://literature.agilent.com/litweb/pdf/5988-8580EN.pdf>
Configuration Guide: <http://literature.agilent.com/litweb/pdf/5988-7008EN.pdf>

Ordering Information

E6482A Wizard Annual Licenses

- E6482A-101 Wizard 2G Annual License
- E6482A-201 Wizard UMTS Annual License
- E6482A-301 Wizard CDMA2000 Annual License
- E6482A-401 Wizard 3G Annual License

E6482A Wizard Perpetual Licenses

- E6482A-102 Wizard 2G Perpetual License
- E6482A-202 Wizard UMTS Perpetual License
- E6482A-302 Wizard CDMA2000 Perpetual License
- E6482A-402 Wizard 3G License

E6482A Wizard Support Contracts

Note: These options are used in conjunction with previously purchased Wizard Perpetual Licenses (i.e. options 102, 202, 302, 402) only and should be purchased only after the first anniversary of the purchase of the perpetual license. One year of support is included with the initial purchase of any perpetual license.

- E6482A-103 Wizard 2G Support Contract
- E6482A-203 Wizard UMTS Support Contract
- E6482A-303 Wizard CDMA2000 Support Contract
- E6482A-403 Wizard 3G Support Contract

E6482A Wizard 2G to 3G Upgrade Licensing Options

Note: These options are only used to upgrade an existing Wizard 2G License (i.e. customer has already ordered E6482A-101 and it is still valid).

- E6482A-204 Wizard UMTS Upgrade
- E6482A-304 Wizard CDMA2000 Upgrade
- E6482A-404 Wizard 3G Upgrade

E6482A Wizard Additional Offerings

- E6482A-501 Microcell Model, Annual License
- E6482A-510 Microcell Model, Perpetual License
- E6482A-600 Cell Data and Channel Plan Conversion
- E6482A-601 Terrain and Clutter Conversion
- E6482A-602 Project Overlay Conversion

- A complete functional test solution customized to cope with your changing needs over time
- Optimized for device calibration and performance testing at the circuit board and assembled product level
- Support and test knowledge available anywhere in the world where you decide to manufacture
- The GS-8000 is designed to accommodate your reference design choices
- Fewer test decisions and investments reduce your cost of test per unit



The new Agilent GS-8000 Functional Test Solution is for customers wanting to succeed in the wireless appliance manufacturing marketplace. If your goal is to take a new wireless device from design to high volume manufacturing quickly or you are broadening the wireless products that you want to manufacture with the latest and greatest technology, then look no further. The GS-8000 is tailored just for you by our worldwide delivery teams to significantly drive down your cost of test and increase the speed at which you get these new products to market.

Keeping Up with Ever-Changing Technologies

The GS-8000 is designed to cope with your design and technology changes now and in the future. Whether these changes are protocol related (GSM/GPRS/CDMA and 3G Third Generation wireless technology) or user interface features (i.e. stereo audio) the GS-8000 is flexible and will adapt to your changing needs. A combination of these features designed in the Agilent solution will not only protect your investment, but will also give you an overall lower cost of test.

Agilent will Help you Protect your Investment

Agilent's relationships with key Reference Design Providers assure you that our solution copes with current and future designs for your marketplace. If you decide to use a reference design without modification, the GS-8000 system has been created to test the devices with minimal customization. If you need to change the reference design mechanical, electrical or firmware features, Agilent will provide low-cost and easy to change adaptations to your systems such as:

- Selecting different tests
- Test parameters
- Mechanical adaptation in the fixturing
- Update in protocols for reference designs

Local Support with Global Knowledge

Our local delivery team will work with you to tailor a solution to meet your needs and growing business environment. For example, we can customize the fixtures, device under test (DUT) calibration software, phone interface and work through non-standard measurements and test optimization problems with the help of our local team.

Specifications

Test Systems

The GS-8000 test system contains the Agilent 8960 wireless communication test set (a platform designed to support all major cellular protocols), power supplies, industrial PC, display, keyboard and modular interconnect panel. It is configurable with options for power, rack size, instrument set (one-up or two-up testing), multiplexer, digital multimeter and digital input/output.

Test Software

The GS-8000 test software contains a test development environment, a test execution environment, a system offset service, generic test applications, and reference test applications focused on wireless appliance manufacturing functional test.

- Using Agilent's TestExec SL 4.1.1, the test development environment provides the conditions and tools for the test developer to construct the test software for a particular application
- Built around an open component object model architecture and implemented in Visual Basic, the test execution environment provides configurable user interfaces and test cell management
- The system offset service provides the audio and RF path loss correction factors needed for accurate measurements
- Test applications provide support for specific phone protocol measurements using Agilent's 8960 Series10 wireless communications test set. The test applications provide generic test plans, which include tests and measurements for each protocol. More protocols will be added in the future
- Reference test applications provide robust test plans, device calibration routines, and tests and measurements for a specific reference phone design. This is accomplished in partnership with the reference design providers and allows us to provide test plans, tests, measurements and unique algorithms that optimize reference design test processes

Fixturing

Agilent offers a range of fixturing options for manual or automated device handling. The fixture provides excellent RF isolation and can provide automatic engagement of connections to the device under test.

System Summary

The GS-8000 functional test platform is a complete test solution tailored to your manufacturing needs now and for the future to keep up with changing technologies and market demand. With local support and test knowledge available anywhere in the world, Agilent will work with you to create a solution tailored to your needs and growing business environment.

Accessories

System characterization is key to facilitating accurate testing in the manufacturing process which can help improve yield. Accounting for the cable losses in the RF cables connecting the DUT to the test system is a major component of accurately measuring the RF signal from the DUT. The characterization cart available in the GS-8000 platform family solves this problem. The characterization cart is a cost effective solution containing a signal generator, power meter, and uninterruptible power supply (UPS). The characterization software available in the GS-8000 greatly simplifies measuring these losses in the system. Not only does it instruct the user on when and which cable connections to make for measuring the cable losses, it also automatically stores the data where the system offset service can retrieve it for use in the test applications.

Key Literature & Web Link

<http://www.agilent.com> Then type GS-8000 in Search Column GS-8000 Overview: 5988-2555EN

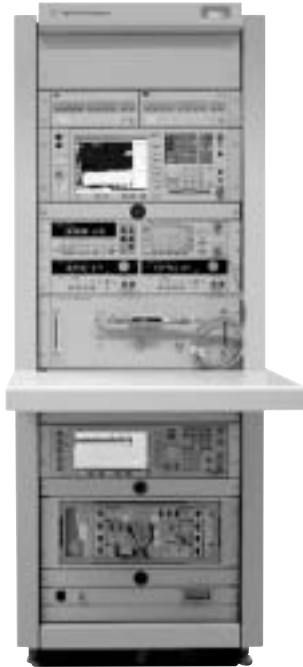
Ordering Information

N4041A 1-up Testing System
N4042A 2-up Testing System

Contact Agilent Technologies to configure a customized test system.

GS8300

- Automated 802.11 B receiver/transmitter test set
- Upgradeable to support the emerging standards of 802.11 a/g
- Multiple form factor support including PCMCIA, USB, Mini PCI
- Multiple fixture designs to support an number of RF shielding strategies
- Supports dual mode or dual band to cover 802.11 b/a/g
- Tailorable to meet specific customer needs
- Based on popular (or common) Golden Unit test strategy



Accessories

Hardware

ESA:

802.11a support E4407B

802.11b support E4405B

Switch Driver and Step Attenuator: 11713A

WLAN Test Set

Digital Multi Meter 34401A

Power Meter E4418B

Power Supply E3631A

WLAN Test Set

PC: Golden: DUT Controller

Industrial PC (IPC): System Controller

15" Flat Panel Display

Test Fixture

Optional

Signal Generator E4438C

Key Literature & Web Link

www.agilent.com/find/assist

GS8300/8600 WLAN Test Systems datasheet: 5988-8857EN

802.11 a/g Manufacturing Test Application Note: 5988-6788EN

Ordering Information

The GS8300 is tailored for the customer's specific needs. Please contact your local Field Engineer or WCSU representative to provide a custom quotation to meet you specific needs.

GS8300 is a Flexible Turnkey Manufacturing Solution Supporting a Wide Range of Chipsets

Manufacturing test strategy today includes more than just a test set. A test strategy must take into consideration the total integrated manufacturing solution. In addition, many customers require a flexible test strategy from design verification to manufacturing, local to distributed manufacturing.

The GS8300 WLAN manufacturing solution provides a full test system to meet the customer's needs. It is a turnkey solution that provides the instrumentation, test set, software, and fixturing required to fully support a total manufacturing test solution.

Agilent Worldwide Communication Solutions (WCS) provides the local expertise to fully integrate the system into your manufacturing environment. In addition, with our worldwide support we are currently support distributed manufacturing including multi-site-multi-vendor strategies.

- Reduce costs and accelerate time to market
- Flexibility: GSM, GPRS, W-CDMA, ...
- Extensibility and Scalability



System Overview

The system is a 2 M rack with integrated test equipment and software.

Base System:

- E5515C Wireless Test Set
- E4445A Spectrum Analyzer
- E4438C ESG Digital Signal Generator
- E8247C Microwave Generator
- 66319D DUT Power Supply
- RF Switching and Signal Routing
- E4418B Power Meter
- Industrial PC
- Wireless Test Manager

Optional:

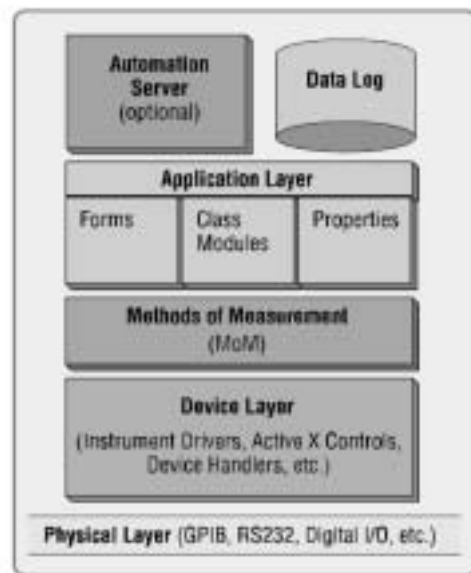
- 8664A RF Signal Generator
- TAS4500 Spirent RF Fading Simulator

Software Architecture

Overview

Wireless Test Manager (WTM) supports multiple technologies. Each WTM Application correlates to an E5515C Wireless Test Set Test Application (firmware). For example, the E6561A GSM/GPRS WTM Application correlates directly to the E5515C's E1992A GSM/GPRS Test Application. E6561A includes GSM850, 900, 1800 and 1900 support. Other phone formats follow the same correlation.

The software platform is designed to be easy to use with low complexity. An Automation Server is available for Operator Interface development. Datalogging is provided in XML or text formats. The output to the data log can be customized to meet the needs of the receiving database. The standard WTM User Interface is simply a form within the VB6.0 project. All of the class modules, code modules, and properties reside at the same architectural level, thus following object-oriented development design philosophies. This brings the control layer and the application layer together. The flatter structure gives simplicity and ease of use to the platform.



System Control

Example WTM User Interface Screens

Underlying the Application Layer is the heart of the software's functionality. Agilent provides superior measurement technology in the form of pre-defined code modules called Methods of Measurement (MoM). The MoM is a collection of pre-defined processes, which control a group of instruments thereby automating complex test scenarios. Each process contains all of the instrument control, DUT communication, and measurement evaluation required to produce reliable, accurate results.

GS8800
Z2049A

The Interface

WTM provides a simple User Interface that makes it very easy to use. The operator has complete program and configuration control from the various tabs on the UI.



Example WTM User Interface Screens

Two features provide good examples of WTM's fast development capabilities. You can create new tests by simply dragging and dropping pre-defined teststeps into the test plan window. Additionally, you can easily configure the parameters and specifications for these tests simply by selecting the teststep, and then entering the appropriate values.

Key Features and Benefits

Reduce Costs and Accelerate Time to Market

Pre-Conformance test reduces capital cost, and you can validate your design before full conformance testing. The lower system price permits wider deployment.

Flexibility

The GS-8800 supports:

- GSM
- GPRS
- W-CDMA
- cdmaOne
- cdma2000 1X

In the near future:

- 1xEVDO
- AMPS
- TDMA
- PDC
- PHS

Extensibility and Scalability

It is easy to add support for new formats. The GS-8800 scales to the GS-8000 for leverage and re-use in manufacturing.

Local Delivery and Global Support

Agilent can deploy a system solution globally, which is verified to conform to your exact specifications. We then tailor a system support package for your local sites to achieve the best in responsiveness and communication.

- Standard universal base unit, with a variety of configuration options
- High quality RF isolation provides an ideal environment to ensure repeatable and accurate measurements – essential for reducing your no-trouble-found (NTF) failures
- Standard software containing control drivers and diagnostic tools help simplify implementation, maintenance, and support processes. Production up-time is improved while lowering the support costs
- System design is greatly simplified due to built in communication paths with the device-under-test (DUT), direct and over-the-air RF paths, acoustic testing, switching, automation and control



Wireless Test Fixture

The Agilent wireless/WLAN test fixture will help you **improve time-to-volume** while **increasing your production flexibility**. The feature-rich Z2049A is an innovative flexible design with integrated system functionality. It provides well-defined custom device under test (DUT) nest tailoring that supports automated, as well as manual, loading at board and final test. Agilent's global service and support helps you quickly implement your test system solutions and cost effectively keep them running.

The Z2049A utilizes a standard base unit architecture and custom nest designs that are easily interchanged. This allows you to leverage the same base unit structure across device technologies, device form factors, board or final test, and production line implementations. By leveraging the same base unit, support costs and new product line development time can be reduced.

Specifications

Each wireless DUT is unique. This means a unique tailored nest must be developed for each DUT

Ordering Information

Contact Agilent Technologies to configure a customized test system.

- Fully automated, turn-key solution for testing power amplifiers and can be tailored to meet application specific needs
- Increase product yields while reducing cost of test thereby increasing profitability
- Increase production with high-system up time, ensured by Agilent's world-wide, locally delivered support
- Years of platform consistency unit to unit as, quick delivery to any site world wide as well as famous global support
- Automatic MCPA measurements for both the R&D and manufacturing environments
- Multiple radio formats including W-CDMA, cdmaOne, GSM, cdma2000



Solution for Production Testing of Power Amplifiers, RF Transistors, and Gain Modules

The Agilent GS-9200 is a system designed for manufacturers who are testing MCPA's (Multi-Carrier Power Amplifiers) and/or testing power amplifier components such as multi-carrier power amplifiers, RF power transistors, and gain modules. Agilent base station test systems help streamline the transition from R&D to Manufacturing with a test platform for Multi-Carrier Power Amplifier Testing. There are also custom options to support transistor, transceiver and full base station test.

Quickly ramp up multi-carrier power amplifier (MCPA) production with an automatic test system designed to increase product yields while reducing the overall cost of test. Agilent's base station test systems include everything needed to support production testing.

Making customers successful in today's wireless business market is our job, from defining a test solution to implementing production testing. Besides fast system delivery, Agilent will install our fully integrated, tailorable test systems in our customer's production area and provide two-day start-up assistance from an Agilent technical-consulting engineer. Technical consultants can help customers start testing their products and offer suggestions on DUT fixturing and test plans. If they need additional help, an Agilent engineer can discuss their needs and recommend a consulting-service package. Value Proposition:

- Ensure proper support of the test system, especially at remote manufacturing sites
- Improved throughput by reduced test time, better accuracy (tighter margins) and better uptime
- Frees up engineering resources in the test department for value added tasks
- Multi-standard platform
- Accelerates deployment and new product ramp-up with short lead time
- Reduced NRE when comparing to Built-to-Print equivalent

Specifications

GS-9200 Typical Performance Characteristics

- 85 dB dynamic range for complex signals such as four W-CDMA carriers with 64 channels each
- High-power network and spectrum analysis up to +25 dBm input and +50.8 dBm output
- 800 – 2,200 MHz frequency range covering most wireless bands
- Harmonics and spurious measurements up to 13 GHz
- High-power S parameter measurements
- Low residual EVM performance of 1.3% at 800 MHz and 1.8% at 2,200 MHz

GS-9200 Measurement Confidence

Network Measurements	
S11 parameter measurement confidence	±0.004 typical ¹ for 1.02 VSWR (–40 dB return loss)
S21 parameter measurement confidence	±0.1 dB ±1° typical for 50 dB range
S22 parameter measurement confidence	CW signal-source for DUT input, and DUT full-power output ±0.004 typical ¹ for 1.02 VSWR (–40 dB return loss)
DUT delay measurement confidence	Input to output ±0.1 ns typical for the 1 ns to 1 ums range
Additional Option	+32 (up to 40) dBm input power to DUT (with booster amp)

Spectrum Measurements	
ACLR (or ACPR) measurement confidence ²	±1 dB typical for single carrier, one active W-CDMA channel, and up to –60 dBc range ±1 dB typical for four carriers, each with one active W-CDMA channel, and ACLR up to –55 dBc range
SEM measurement confidence	±1 dB typical for W-CDMA and cdma2000 and BTS P _{out} <+50.8 dBm (120 Wrms)
EVM measurement confidence	±0.3% typical for W-CDMA in the 1 – 10% range

Power Measurements	
Power measurement confidence ³	For –50 to +20 dBm range P _{ave} ±0.2 dB typical Modulated power gain ±0.5 dB typical PAE ⁴ ±3% typical

Notes:

¹VSWR measurement accuracy improves with larger VSWR values.

²Assumptions are that the DUT takes an input of –20 to –10 dBm and produces 43 – 50 dBm output power, and the DUT delay-response variation is within 0.5 n sec for a 30 MHz span. Measurement range can be increased over the –60 or –55 dBc values, resulting in degraded measurements uncertainty.

³Assumption is that the DUT has better than 20 dB return loss at input and output ports.

⁴If a measured PAE is 10%, then the uncertainty is 10 ±0.3%.

Key Literature & Web Link

N1886A GS-9200 Overview 5988-6487EN
N1886A GS-9200 Datasheet 5988-8540EN

<http://systems.product.agilent.com/Base%20Station/Chunnel/chunnelB.html>

Ordering Information

Contact Agilent Technologies to configure a customized test system.

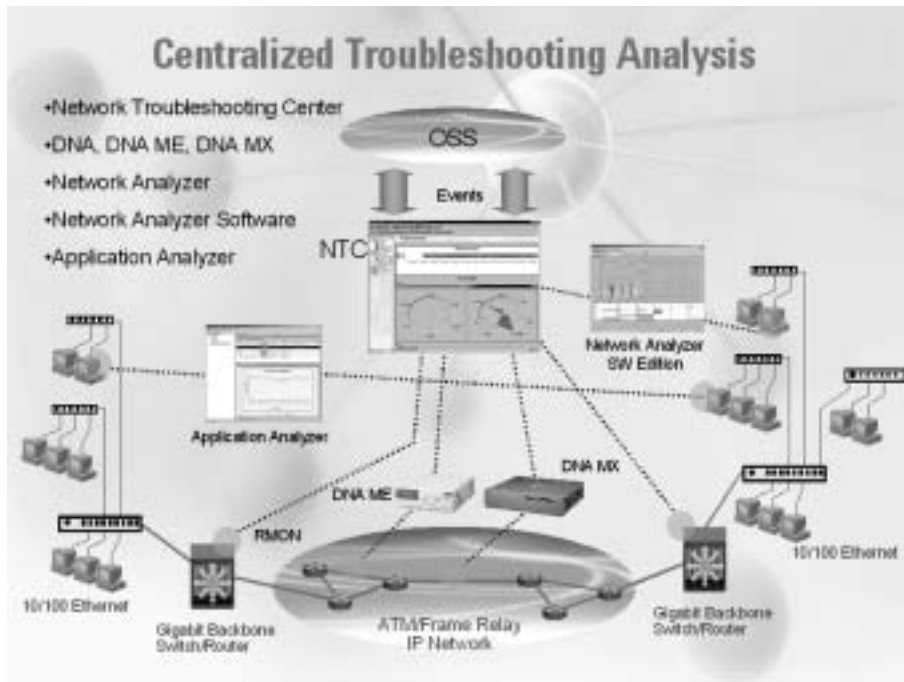
Wireline Network Analyzer	426
Network Advisor and Modules	429
IP Telephony Products	431
Optical Time Domain Reflectometer	433
Optical Hand Held Testers	434
Modular Network Tester	435
Transmission Test Sets	436
Optical/Transmission Tester	438
Serial BERT, ParBERT, OmniBERT	448
Signaling Advisor	457
Router Tester	459
Storage Area Network Tester	460

J6781A
J6800A
J6801A
J6802A
J6805A
J6840A
J6848A
J6835A

The Network Troubleshooting Center (NTC) places the power of multiple Agilent Network Analyzer platforms and other test agents in the hands of a single, centrally located individual or group. Together with the Network Analyzer product family, NTC provides a centralized troubleshooting solution that:

- Expedites problem resolution by providing aggregated network-wide views of performance across multiple LAN and WAN technologies
- Provides seamless integration between problem isolation and troubleshooting

- Enables rapid progression from problem detection and isolation to resolution with integrated RMON statistics analysis and advanced troubleshooting
- Eliminates the need for expert engineers/technicians at multiple locations, thus enabling a smaller workforce and reducing level
- Reduces training time and workflow interruptions by providing a common solution and interface for both centralized testing and dispatched testing; and for multiple LAN and WAN technologies
- NTC provides both remote access to , and aggregated data from, all of Agilent's Network Analyzer Hardware and Software platforms



Network-Wide Maintenance at your Fingertips

12

NTC along with the Network Analyzer products provide a complete solution for both centralized and dispatched troubleshooting in one package, eliminating the need for multiple tools. This solution works across multiple LAN and WAN technologies, including 10/100 Ethernet, Gigabit Ethernet, ATM, Frame Relay, and Packet over SONET. It provides analysis of all technologies with the same look and feel, so engineers need to learn only one tool.

J6781A Network Troubleshooting Center (NTC)

Features

- Provides aggregated views of RMON1/2 and MIB-II statistics from multiple data sources to present the overall health and performance of the entire network
- Offers one-click drill down from aggregated views to detailed views of individual LANs, WANs, switches, nodes, connections, protocols, and error types. Quickly isolate the location and nature of a problem
- Provides integrated RMON and advanced protocol analysis for seamless progression from problem isolation and troubleshooting
- Operates remote Network Analyzer platforms anywhere on the network
- Pinpoints problems with the drill down capabilities of RMON 1/2 and MIB II data
- Sets thresholds for notification of possible problems before they happen
- Sends events to the Network Management System
- Automates response to common events with the Policy Event Manager, forward SNMP traps or run customized scripts

J6800A Network Analyzer

Features

- Supports any available LAN or WAN/ATM LIM
- LIMs are hot-swappable and interchangeable
- Full-rate capture from any LIM up to 1 Gb/s
- 256 MB capture memory per LIM
- 32 real-time hardware capture filters
- Advanced auto-encapsulation detection (patent pending)
- Internal time-synchronization between acquisition systems
- Interfaces for external GPS receiver for global time-synchronization
- Agilent Control & Sync technology hardware provided to allow time-synchronization of one or more attached J6801A Distributed Network Analyzer

J6801A Distributed Network Analyzer

Features

- Distributed and dispatch use design
- One data acquisition system, identical to the data acquisition systems included in the J6800A Network Analyzer and J6802A Distributed Network Analyzer MX
- Controlled via TCP/IP from a standard PC running Network Analyzer Software, from a J6800A Network Analyzer, J6802A Distributed Network Analyzer MX, or from an Advisor E-series
- Can be daisy-chained from other J6801A Distributed Network Analyzers
- Interfaces for external GPS receiver for global time-synchronization
- Agilent Control & Sync technology provided for time-synchronization with adjacent J6800A Network Analyzer, J6801A Distributed Network Analyzer, or J6802A Distributed Network Analyzer MX
- Same footprint as standard laptop
- Built-in power supply
- Rack-mount kit available (J6771A)

J6802A Distributed Network Analyzer MX

Features

- Supports any available LAN or WAN/ATM LIM
- LIM is hot-swappable and interchangeable
- Full-rate capture from any LIM up to 1 Gb/s
- 256 MB capture memory per LIM
- 32 real-time hardware capture filters
- Advanced auto-encapsulation detection (patent pending)
- Interfaces for external GPS receiver for global time-synchronization
- Agilent Control & Sync technology hardware provided to allow time-synchronization of an attached J6801A Distributed Network Analyzer
- Software is supplied for accessing and controlling the J6802A Distributed Network Analyzer MX from a PC
- Rack-mount kit included

J6805A Distributed Network Analyzer ME

Features

- Two half duplex 10/100Base-TX test interfaces for half or Full duplex testing
- Local analysis and data storage
- Stand-alone operation
- Software is supplied for accessing and controlling the J6805A Distributed Network Analyzer ME from a PC
- Rack-mount kit available (J6775A)

J6840A Network Analyzer Software

Features

- Network Analyzer Software is remarkably flexible
- It runs in PCs as a software analyzer, using off-the-shelf network interface cards (NICs) as measurement interfaces for LAN (10/100/1000 Mb/s Ethernet, Token Ring or FDDI). For example, the 10/100 PC Cards (PCMCIA cards) found in most PC laptops can be used as the test interface for monitoring the LAN network traffic, even while this card is simultaneously providing the network connection for the PC to that LAN
- It provides off-line analysis allowing previously captured and saved LAN and WAN/ATM data to be re-analyzed using the full features available on-line for captured data
- It acts as the client software for the J6835A Network Analyzer Software Edition Agent
- It provides the base software for controlling the J6801A Distributed Network Analyzer hardware platform. A CD and one license key is supplied with the J6801A Distributed Network Analyzer to allow the software to be loaded and enabled on a PC

J6848A Report Center

Features

- The ultimate, graphical reporting tool for complete baselining and benchmarking LAN/WAN and ATM measurements
- Supports Advisor and Network Analyzer
- Interactive drill-down capability
- No MS Office needed

J6835A Network Analyzer Software Edition Agent

Features

- It allows the collection of LAN data in promiscuous mode and performs various analysis tasks
- It runs on PCs using off-the-shelf network interface cards (NICs) as measurement interfaces for 10/100/1000 Mb/s Ethernet and Token Ring LAN. For example, the 10/100 PC Cards (PCMCIA cards) found in most PC laptops can be used as the test interface for monitoring the LAN network traffic, even while this card is simultaneously providing the network connection for the PC to that LAN
- It acts as agent software for the Network Analyzer Software acting as a client
- It delivers the same measurements on the remote PC as Network Analyzer Software delivers from a NIC on the local PC

J6781A Network Troubleshooting Center (NTC)

Network-Wide Maintenance at your Fingertips

The Network Troubleshooting Center (NTC) places the power of multiple Agilent Network Analyzer platforms and other test agents in the hands of a single, centrally located individual or group. Together with the Network Analyzer product family, NTC provides a centralized troubleshooting solution that:

- Expedites problem resolution by providing aggregated network-wide views of performance across multiple LAN and WAN technologies
 - Provides seamless integration between problem isolation and troubleshooting
 - Enables rapid progression from problem detection and isolation to resolution with integrated RMON statistics analysis and advanced troubleshooting
 - Eliminates the need for expert engineers/technicians at multiple locations, thus enabling a smaller workforce and reducing travel
 - Reduces training time and workflow interruptions by providing a common solution and interface for both centralized testing and dispatched testing; and for multiple LAN and WAN technologies
- NTC provides both remote access to, and aggregated data from, all of Agilent's Network Analyzer hardware and Software platforms.

J6800A Network Analyzer

The Agilent Network Analyzer system is a breakthrough in test and measurement technology, bringing together the testing of all access technologies into a single architecture. This allows full and uniform testing of network and higher layer performance measurement and protocol analysis over any lower layer LAN or WAN technology. The system is designed for both dispatch and distributed testing currently at rates up to 1 Gb/s. Time synchronization of local and remote analyzers provides the means to deliver advanced quality of service measurements, essential for testing multi-service networks. (Available as software only, single port or dual port)

J6801A Distributed Network Analyzer

The J6801A Distributed Network Analyzer is an ultra light-weight solution that includes one data acquisition system that supports any LAN or WAN/ATM plug-in line interface module (LIM). Network Analyzer Software ships on a CD with the analyzer.

J6802A Distributed Network Analyzer MX

The Distributed Network Analyzer MX is a portable/rack mountable system that includes one data acquisition systems, supporting any LAN or WAN/ATM plug-in line interface module (LIM).

In addition, this analyzer includes a controller running Network Analyzer Software and has the following main features:

- 30 GB (or larger) hard disc drive (easily removable for high security situations)
- CD drive
- Two double-height PC Card slots (one fitted with supplied combo modem/Ethernet PC Card for telemetry)

The controller is used to control the acquisition system and to collect (and post-process) results. It is not used for real-time processing of measurements – this is all done in the data acquisition system and LIM, allowing the controller to handle multiple tasks simultaneously without impacting measurement performance. As this analyzer is designed to be controlled remotely, it has no keyboard or display but does include a 56 kb/s Modem/Fast Ethernet PC-card for telemetry.

J6781A
J6800A
J6801A
J6802A
J6805A
J6840A
J6848A
J6835A

12

J6781A
J6800A
J6801A
J6802A
J6805A
J6840A
J6848A
J6835A

J6805A Distributed Network Analyzer ME

The Distributed Network Analyzer ME is a portable/rack mountable system incorporating two half duplex 10/100Base-TX Ethernet network driver interface specification (NDIS) based test interfaces which allows testing of two half duplex or one full duplex connection(s). A built-in controller runs Network Analyzer Software. As this analyzer is designed to be controlled remotely, it has no keyboard or display but does include a Fast Ethernet telemetry port.

J6840A Network Analyzer Software

Network Analyzer Software is pre-loaded and runs on the embedded PC in the J6800A Network Analyzer and on the controller in the J6802A Distributed Network Analyzer MX and J6805A Distributed Network Analyzer ME platforms. It is also shipped on CD media with the J6801A Distributed Network Analyzer, together with a single-use license key to enable the software on the associated PC/laptop. License keys plus manuals and CD media for running the software on additional PCs can be purchased as the J6840A Network Analyzer Software product. For example, a second engineer can control an existing J6801A Distributed Network Analyzer from his/her PC, with the purchase and installation of the J6840A Network Analyzer Software Edition. The engineer can also use the software to perform LAN testing with an NDIS-based 10/100/1000 Mb/s Ethernet, Token Ring or FDDI NIC, and off-line analysis for LAN and WAN/ATM processing of data collected via any Network Analyzer family or Advisor product. Of course, the capabilities of the proprietary data acquisition systems out-perform standard NIC performance, but J6840A Network Analyzer Software operating with a NIC provides the same useful, extensive measurements.

J6848A Report Center

Report Center provides network baselining and benchmarking reports. This standalone Windows® application supports both the Network Analyzer product families and the Agilent Advisor.

Report Center provides interactive reports with variable display intervals, intelligent thresholds, zoom capabilities and multi-segment time correlation. Output is created in Adobe Acrobat and Rich Text Format.

J6835A Network Analyzer Software Edition Agent

Network Analyzer Software Edition Agent runs on a standard PC (400 MHz, 256 MB memory or better) running Microsoft Windows® 98, ME, 2000, XP or NT 4.0 (SP5 or greater). One or more of these software agents can be accessed and controlled from Network Analyzer Software acting as a client and running on a separate (remote) PC, or on the J6800A Network Analyzer.

Specifications

Line Interface Modules

J6811A STM-10/OC-3 LIM (SC-PC optical connectors – includes a pair of 10 dB attenuators)
J6813B E3/T3 (DS3) LIM (unbalanced 75 Ohm BNC connectors)
J6815B T1/E1 LIM (balanced 100 Ohm RJ-45 and WECO Bantam connectors)
J6816B E1/T1 LIM (balanced 120 Ohm DB-9 and RJ-45 connectors)
J6817B E1 BNC LIM (unbalanced 75 Ohm BNC connectors)
J6818A ATM25 LIM (RJ-45 connectors)
J6820A V-Series LIM (requires J6757A cable(s))
J6830A 10Base-T and 10/100BaseTX Ethernet LIM
J6831A 10/100Base-FX Ethernet LIM
J6832A 1000Base-X Ethernet LIM (includes pair of SX GBICs)

Software

J5425A Switch Advisor
J5434A SAN Network Analyzer
J5479A Voice Quality Tester (VQT) 10/100 Interface
J6842A 3G UMTS W-CDMA Test Software
J6844A Telephony Network Analyzer
J6845A 3G cdma2000 Test Software
J6848A Report Center
J6849A One-time Software Upgrades

Accessories

J1990A LAN Analyzer Tap
J6750A Alternative hard disk drive for the J6800A
J6751A Alternative hard disk drive for the J6802A
J6753A Additional combo 56 kb/s modem with 10/100Base-TX network interface PC-Card
J6757A Monitor/Simulate Cables (five cable options)
J6761A Deluxe wheely case for the J6800A (not suitable for airline bag checking)
J6762A Wheeled transit case for the J6800A
J6763A Transit carry case for the J6801A and J6805A
J6764A Wheeled transit case for the J6802A
J6771A Rack Mount Kit for the J6801A
J6775A Rack Mount Kit for the J6805A

Key Literature & Web Link

Key Library Information

Technical Specifications: Agilent Network Analyzer Family Technical Overview (5988-4231EN)

The Network Analyzer system is a breakthrough in test and measurement technology, bringing together the testing of all access technologies into a single architecture.

Data Sheet: Agilent Network Analyzer Family Data Sheet (5988-4176EN)

Agilent Technologies Network Analyzer Products

Configuration Guide: Agilent Network Analyzer Family Configuration Guide (5988-4248EN)

The Network Analyzer family consists of hardware and software analysis platforms.

Technical Overview: Agilent Network Troubleshooting Center Technical Overview(5988-8548EN)

The Network Troubleshooting Center is a software solution that provides single-user and multi-user access to information collected from one or more Agilent Network Analyzer platforms.

<http://www.agilent.com/comms/XPI>

Ordering Information

J6781A Network Troubleshooting Center
J6800A Network Analyzer
J6801A Distributed Network Analyzer
J6802A Distributed Network Analyzer MX
J6805A Distributed Network Analyzer ME
J6840A Network Analyzer Software
J6835A Network Analyzer Software Edition Agent

- Frame Relay LMI Expert, CIR & SLA
- ATM QoS & Policing
- WAN Active Testing (BERT, Traffic Generation)
- FR, ATM, ISDN emulation
- Async/Bisync, ISDN protocol analysis
- Packet over Sonet for OC-3/STM-1
- Token Ring, FDDI, ATM25, DDS4-Wire, BRI, J2, HSSI, OC-12
- Gigabit RFC 1944 Benchmark testing
- Active LAN Testing (Ping, ARP, Traffic generation and buffer replay)
- LAN Benchmarking
- 3G wireless protocol analysis
- 468 network protocol decodes
- IP telephony network analyzer
- Real-time LAN Expert analyzer
- Report Center



The Agilent Advisor WAN combines complete protocol analysis for WAN and ATM testing with a powerful and rugged personal computer – all in a lightweight, easy-to-carry package that offers the best combination of price and performance in the industry. In addition, this platform can easily grow to perform LAN, Voice Quality and 3G network Analysis.

With the introduction of the J2300E with its faster processor and extra memory, users will experience a significant improvement in performance, particularly when running multiple applications simultaneously. The Agilent Advisor WAN (J2300E) allows you to monitor all major WAN communication protocols from 50 bps to 155 Mbps: Packet over SONET/SDH, Frame Relay, ISDN, X.25, HDLC, SDLC, SNA, Sync/Async PPP, ATM-DXI and encapsulated LAN protocols running over the wide area network. V-Series interfaces, such as RS-232C/V.24, RS-449/422/423, V.10/V.11 and V.35, are already built into the platform; for high speed V-Series (to 8.192 Mb/s) a plug-in module is also available. Slide-in modules add test capability for ISDN BRI and PRI, T1, J2, E1, E3, T3 (DS3), STM-1e/EC-3, ATM25 AND UTP155.

Undercradles also add test capability for Ethernet, switched Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI and STM-4/OC-12 (622 Mbps ATM). In addition, the Advisor can be expanded for voice Quality Test through analog FXO and E&M interfaces as well as 3G CDMA2000 and UMTS UTRAN network decodes via advisor 3G wireless software. Advisor's 3G decode software can also support decode of the Radio Access network for 3G Iu and Iub interface so as to allow the NEM/SP trouble shoot problem from 3G's diversity handover and multi-diversity. It supports full line rate up to STM-1 and gigabit Ethernet interface which allow wireless customer to perform tentatively load test for 3G services.

Specifications

Key ATM Features and Functionality

- Handles ATM testing rates from 1.5 Mb/s to 622 Mb/s; ATM Interfaces including T1/E1, J2, E3/T3, STM-1/OC-3, STM-1e/EC-3, STM-4/OC-12, ATM25 (25.6 Mb/s UTP-3/5) and UTP155 are available as plug-in modules or undercradles
- Auto-discovers up to 1024 Virtual Channels on all ATM interfaces except J2 (up to 4096 on the STM-4/OC-12 interface) and gathers statistics on each
- Analyzes protocols including full rate capture with capture and display filtering and searching (e.g. set the capture filter to capture only ATM streams carrying IP traffic with specific IP addresses)
- Monitors, captures data, and decodes upper and lower layer protocols in real time
- Decodes and logs statistics for LAN encapsulated protocols over ATM, including Voice over IP decodes: H.323 series, IETF series (SIP, MGCP, SGCP, MEGACO), ITU-T T.38
- Finds Errors in capture file or buffer
- Decodes AAL-1, AAL-2, AAL-3/4, AAL-5
- AAL-1 5 CRC statistics
- Decodes Frame Relay over ATM
- Decodes ATM UNI, NNI (B-ISUP, B-ICI) and PNNI signaling
- Decodes IMA Control Protocol (ICP) cells
- Real-time and post-processing User Assisted LAN over ATM
- Emulates ATM UNI signaling – check call set-up procedures
- Emulates ELAN Join (LANE)
- Generates user-defined cell traffic from a cell table
- Retransmits captured traffic which has been copied and pasted to the cell table, modified (e.g. VPI-VCI and/or embedded IP addresses changed); the HEC and AAL-5 CRC-32 are automatically recalculated
- Generates ATM ICMP Echo (PING)
- Generates and analyzes OAM cells
- Tests ATM QoS performance to the ITU-T O.191 standard – measures cell loss, cell delay, cell delay variation, cell misinsertion and cell errors
- Generates ATM traffic shaped to traffic contracts
- Polices ATM traffic to traffic contracts
- Tests simultaneously on two different or similar ATM interfaces
- Tests simultaneously with other technologies (e.g. Frame Relay, Ethernet)
- Tests physical frame layer and cell layer bit error ratios (BER)
- Measures optical power
- Pulse amplitude measurement on T1, E1, E3, T3 and STM-1e/EC-3 ATM interfaces

Key WAN Features and Functionality

- WAN testing speeds from 50 b/s to 155 Mb/s
- Packet over SONET/SDH (PoS) analysis (IETF and Cisco)
- Built-in all major WAN interfaces into the instrument mainframe, including V.10/V.11, V.24/V.28/RS-232C, V.35, V.36/RS-449/422/423/530, X.21
- V-Series interface support up to 8.192 Mb/s
- Interfaces, including ISDN Basic Rate Interfaces (BRI) S/T/U and Primary Rate Interfaces (PRI), E1/T1 and E3/T3 Cells and Frames, Packet over SONET/SDH HSSI, DDS 4-wire, and High Speed V-Series (V.35, RS-449 and X.21 to 8.192 Mb/s) are available as slide-in modules
- Full-featured testing capability for all common WAN technologies, including Frame Relay, PPP (Sync, Async), ISDN, X.25, HDLC, SMDS, SNA, Async, Bisync, ATM DXI, and more
- Monitoring, data capturing, and decoding for upper and lower layer protocols in real time
- Decodes LAN encapsulated protocols over WAN, including Voice over IP decodes: H.323 series, IETF series (SIP, MGCP, SGCP, MEGACO), ITU-T T.38
- Real-time and post-processing User Assisted LAN over Frame Relay and HDLC, PPP, ATM, DXI capture/display filtering and searching
- Find Error in capture file or buffer
- Comprehensive bit error ratio testing (BERT)
- Asynchronous and Bisynchronous monitor and traffic generation
- Frame Relay analysis Voice and Fax over Frame Relay (FRF.11) decodes
- Auto LMI detection and decoding for ANSI, ITU-T or original LMI
- Auto LAN encapsulation over Frame Relay detection for RFC 1490/2427, Ethertype, FRF3.1, and RFC 2684/1483
- Service Level Agreement measurements according to FRF.13
- LMI Expert analysis
- CIR Measurements in all Frame Relay DLCIs
- Tests simultaneously on two WAN interfaces
- Tests simultaneously with other technologies (e.g. ATM, Ethernet)
- Signal Level measurement on T1, E1, E3, and T3
- SLIP Measurement

WAN

J2300E
J2294D
J2296D
J2298D
J2900A
J2908A
J2912B
J2914A
J3759B
J3762B
J5425A
J5457A
J6753A

ISDN

J2905B
J2286B
J4646A
J4647A
J4648A
J4649A

ATM

J2294D
J2296D
J2298D
J2900A
J2911A
J2912B
J2913B
J2914A
J3759B
J3762B
J3763A
J3764A
J3766A
J5457A

LAN

J3446E
J3447A
J2307A
J2524A
J2901A
J3444A
J3445A
J5492A

WAN

- J2300E
 - J2294D
 - J2296D
 - J2298D
 - J2900A
 - J2908A
 - J2912B
 - J2914A
 - J3759B
 - J3762B
 - J5425A
 - J5457A
 - J6753A
- Key General Features and Functionality**
- Other technologies covered include 10/100 Ethernet, Gigabit Ethernet, Token Ring, FDDI, RTP QoS, VoIP and more
 - LAN/WAN/ATM/VoIP under one handle
 - Real-time counters and triggers, with logging and CSV export capabilities of statistics to disk
 - Line-status monitoring
 - Commentators
 - Absolute, Delta and Relative Time
 - User bytes (skip bytes between layers)
 - Enhanced decode view with HEX to detail correlation
 - True multi-tasking capability with user friendly full 32 bit Microsoft Windows® user interface, so that monitoring, decoding, statistical analysis, and stimulus/response tests can be executed simultaneously
 - Context-sensitive on-line Help with measurement and troubleshooting guides, acronym list, index and glossary

ISDN

- J2905B
 - J2286B
 - J4646A
 - J4647A
 - J4648A
 - J4649A
- LAN over WAN, and LAN (over WAN) over ATM**
- Encapsulated LAN data is automatically extracted and decoded by the Agilent Advisor including complex encapsulated protocols. For unique encapsulation schemes, the user may specify the offset as well. Nearly 300 decodes exist for layer 3 and above; these are common to all underlying technologies (LAN, WAN and ATM). The Agilent Advisor provides an off-line LAN Expert Analysis tool. The off-line LAN Expert Analysis allows the user to examine Ethernet, Fast Ethernet, Gigabit Ethernet, ATM or WAN (HDLC or Frame Relay) encapsulated LAN frames on an Agilent Advisor or personal PC without Agilent Advisor hardware. The comprehensive set of protocol decodes include all of today's popular Protocol Stacks:

ATM

- J2294D
 - J2296D
 - J2298D
 - J2900A
 - J2911A
 - J2912B
 - J2913B
 - J2914A
 - J3759B
 - J3762B
 - J3763A
 - J3764A
 - J3766A
 - J5457A
- IBM/SNA
 - H.323 series, T.38
 - Novell
 - SIP, MGCP, SGCP, MEGACO
 - ISO
 - W-CDMA
 - TCP/IP
 - SUN
 - Apple Talk, Banyan, Cisco, DECnet, 3Com

LAN

- J3446E
 - J3447A
 - J2307A
 - J2524A
 - J2901A
 - J3444A
 - J3445A
 - J5492A
- Accessories**
- Manuals
 - Cable and connectors
 - Carrying case on wheel
 - PC empty undercradle
 - High speed acquisition undercradle
 - CD-ROM player
 - IP Telephony reporter
 - V-series, V.35, RS-449/V.36, V.11/X.21 monitor/simulate cables

Key Literature & Web Link

Features

Benefits of the Agilent Advisor
 Agilent invented the protocol analyzer as we know it today.

Products & Services

J2300E Agilent Advisor WAN
 The Agilent Advisor WAN combines complete protocol analysis for WAN and ATM testing with a powerful and rugged personal computer.

J3446E Agilent Advisor LAN – Fast Ethernet
 Agilent Advisor LAN is used to support and maintain Fast Ethernet and 10BaseT networks. Easy network connection and expert analysis.

Agilent Advantage Service Solution Packages
 Agilent provides technologies that help you design better communications products, deploy new technologies and deliver world-class communications services.

ATM Modules and Undercradles for Agilent Advisor
 A list of modules and undercradles for use with ATM network troubleshooting

Accessories
 Cables, connectors, cases and more for the Agilent Advisor

LAN Modules and Undercradles for Agilent Advisor
 A list of modules and undercradles for use with LAN network troubleshooting

Software Products

Complement Agilent Advisor LAN, WAN, and ATM protocol analyzers **Voice & Fax Solutions**
 The Agilent Advisor analyzes the most extensive list of VoIP protocols in the industry today.
WAN Modules and Undercradles for Agilent Advisor
 A list of modules and undercradles for use with WAN network troubleshooting

Key Literature & Web Link

Customer Success Stories
 Customer Success Stories for Agilent's network test solutions. Refer to Web Link

Program/Utility: Agilent Advisor Configuration Tool
 Use the Advisor Configuration guide below to learn more about your options in building an Advisor that meets all of your needs. Refer to Web Link

Technical Note: Network Troubleshooting Tips
 On this page we will share network troubleshooting tips and tricks with you. Some of these are specific to using Agilent products, some of them are product independent. Refer to Web Link

Product Overview : J5458A 3G UMTS W-CDMA Test Software
 3G UMTS W-CDMA Test Software (5988-1164EN)
Technical Specifications: J5458A 3G UMTS W-CDMA Test Software
 3G UMTS W-CDMA Test Software (5988-1165EN)

<http://www.agilent.com/comms/XPI>

Ordering Information

WAN

- J2300E WAN protocol analyzer
- J2294D E1/T1 DB-9/RJ45
- J2296D E1 BNC 75 ohms interface module
- J2298D E1/T1 RJ45/RJ48C/Bantam interface module
- J2900A Advisor High speed acquisition undercradle
- J2908A DDS 4-wire module
- J2912B OC-3/STM-1 module
- J2914A STM-1e/EC-3
- J3759B WAN DS3/E3 interface
- J3762B WAN HSSI interface module
- J5425A Switch advisor software
- J5457A High speed V-series interface
- J6753A Additional Combo 56 k Modem 10/100 NIC

ISDN

- J2905B ISDN BRI S/T and U interface
- J2286B E1/120 ohm, DB-9 to Siemens 3-Pin
- J4646A Unbalanced E1 primary rate ISDN
- J4647A Balanced E1 primary rate ISDN
- J4648A Bal. T1 primary rate ISDN 1/F module (Bantam/ RJ-48C)
- J4649A Bal. T1 primary rate ISDN 1/F module (Bantam/RJ45)

ATM

- J2294D E1/T1 DB 9/RJ45 interface module
- J2296D E1 BNC 75 ohms interface module
- J2298D E1/T1 RJ45/RJ48/Bantam
- J2900A High speed acquisition undercradle
- J2911A J2 interface module
- J2912B Agilent advisor OC3/STM-1 Plug in module
- J2913B UTP155 interface module
- J2914A STM 1-e/EC-3 plug in module
- J3759B WAN DS3/E3 interface module
- J3762B WAN HSSI interface module
- J3763A OC-12/STM-4 undercradle
- J3764A 622 mb/s single-mode I/F module
- J3766A Int Adv. 25.6 Mb/s ATM module
- J5457A High speed V-series interface

LAN

- J3446E 10/100 Ethernet
- J3447A 100 base FX interface module
- J2307A Lan Token ring undercradle
- J2524A FDDI undercradle
- J2901A LAN Gigabit ethernet undercradle
- J3444A Fast Ethernet undercradle
- J3445A 100 BaseFx interface
- J5492A LX GBIC module

VQT Key Features:

- Test Voice Clarity using PESQ: Perceptual Evaluation of Speech Quality
- Test Voice Clarity using PSQM+: Perceptual Speech Quality Measurement
- Test Voice Clarity using PAMS: Perceptual Analysis Measurement System
- Delay
- Echo
- Echo Doubletalk
- Signal Loss
- DTMF distortion
- Silence suppression analysis
- Test with over 150 different voice samples in 9 different languages
- Off-line clarity measurements on audio files, using PESQ, PSQM+, and PAMS
- Automated and Interactive testing
- Tone and Noise Generator
- Port Loopback
- Impulse response measurement
- Network Simulator
- Active logging of all test results and configurations, and full graphical viewing of saved test logs
- Bearer Path confirmation
- Single, repetitive, and continuous test modes
- End-to-end and round-trip measurements
- Graphical and numerical presentation of test results
- Audio monitor with Remote Audio Playback

IP Telephony Analyzer (J4618C) Features:

- Packet loss and jitter calculated for each individual RTP stream
- Audio played out from VoIP packets for codecs G.711, G.723, G.729a and G.729b
- Listen to audio with jitter or de-jittered
- Graphs the distribution of RTP packet loss and jitter values and over time
- Comprehensive, Expert Commentators for VoIP Signaling and Voice packet transport
- Automatic drill down to suspect packets surrounding an IP impairment
- Export information on all RTP packets to a spreadsheet
- Call Detail Records for each call or part call real-time decodes, filtering and analysis on LAN, WAN and ATM
- The most Extensive list of VoIP decodes available including recent drafts
- Simultaneous RTP and Expert analysis with decodes and statistics

Telephone Network Analyzer Features (J6844A):

- Predictive MOS
 - Non-intrusive voice quality scoring based on exclusive PsyVoIP technology from Psytechnics
 - Calculates MOS and R Factor scores, calibrated to PESQ on the Agilent VQT
- RTP Real-Time Analysis
 - Measures and graphs frame-by-frame packet loss and jitter
 - Simultaneous RTP and Expert analysis with decodes and statistics
- RTCP Statistics Monitor
 - Monitor RTCP reports for network performance and call stats for hundreds of VoIP calls
 - Correlated with RTP and MOS measurements for the same calls
- H.323 and SIP Expert Commentators
 - Built-in expert signaling diagnostics identifies signaling abnormalities and failures; highlights possible causes
 - Creates Call Detail Records for VoIP calls



J1981B
J6844A
J4618C

Agilent IP Telephony Analyzer (J4618C) and Agilent Telephone Network Analyzer (J6844A), is a Windows based software solution that adds Voice over IP analysis to the Telephony Network Analyzer. Those two product offers real-time troubleshooting for Voice over IP (VoIP) applications on LAN, WAN, and ATM networks. Expert analysis tracks each state of the VoIP call control and voice transport process and automatically detects errors and protocol anomalies.

Packets using RTP to transport voice or video are analyzed for errors. Sessions and participants are identified, and packet loss and jitter are measured for each stream or conversation. Each session can be selected for audio play out through the Analyzers' speakers. An automated feature allows instant drill down on the packets surrounding any point of high jitter or packet loss. In addition, detailed examination, packet by packet, is offered through clear and accurate decodes and real-time filtering. The Telephony Network Analyzer and IP Telephony Analyzer analyzes the most extensive list of VoIP protocols in the industry today, augmented now with the addition of MEGACO/H.248 Annex A and Annex B. RTP measurements; VoIP Expert analysis, packet decode and statistics are all measured simultaneously in real-time.

These analysis features allow users of Voice and Fax over IP networks and services to evaluate equipment such as gateways and gatekeepers and troubleshoot and optimize IP Telephony deployments. The Telephony Network Analyzer and IP Telephony Analyzer assists in identifying internetworking, interoperability, and performance problems. It is especially useful during multi-vendor network integration and performance assessment.

Agilent's Telephony Network Analyzer (J6843A) now offers breakthrough technology for non-intrusive voice quality testing, based on PsyVoIP technology from Psytechnics.

The VQT provides detailed scoring analysis that exposes the impairments to voice quality. By including testing for voice clarity, delay, echo, silence suppression, DTMF, and signal loss, all on one box, the VQT provides a total solution for testing voice quality on next generation networks.

The VQT is a distributed test solution that offers remote test control and testing among distant sites on a global network. The VQT Web-based Clients allow network professionals to remotely operate multiple Agilent VQT test systems anywhere on the network. This remote control capability drastically reduces costly, time-consuming travel requirements, and the need for trained staff working in multiple locations.

The VQT enables network engineers to tackle the toughest challenges in deploying IP Telephony and other Next Generation Network services:

- Delivering Toll Quality Voice
- Maintaining voice clarity among many VoIP impairments
- Minimizing end-to-end delay, to less than 150 msec
- Detecting and minimizing the effects of echo
- Troubleshooting voice quality problems in complex hybrid networks
- Transmitting DTMF tones across VoIP networks
- Balancing voice quality with network efficiency mechanisms, such as silence

J1981B
J6844A
J4618C

Specifications

Telephony Interfaces

Analog FXO

Number of Ports: 2
Connector: RJ11 modular jack
Line Impedances: 600, 900 ohms
Limit Loop Current: variable
Signaling: supports analog loop and ground start
Accuracy of Transmission or Reception of Sine Wave: ± 1 dBm under conditions: 300 Hz to 3400 Hz; -3 dBm to -50 dBm

Analog E & M

Number of Ports: 2
Connector: RJ45 modular jack
Line Impedances: 600, 900 ohms
Addressing: Delay-dial, Immediate-start, Wink-start
Signaling: Type I, II, III, V
Transmission: two-wire, four-wire operation
Accuracy of Transmission or Reception of Sine Wave: ± 1 dBm under conditions: 300 Hz to 3400 Hz; -3 dBm to -45 dBm

T1

Number of Ports: 2
Jack: RJ48C
Signalling: ISDN PRI and CAS
Framing: D4, ESF
Line Coding: AMI, B8ZS
Zero Bit Suppression: selectable B8ZS, ZCS, no suppression

E1

Number of Ports: 2
Jack: RJ48C
Impedance: 120 ohms (75 ohm converter available)
Signalling: ISDN PRI and CAS
Framing: CEPT G.703/G.704 Channel Associated Signaling
Line Coding: HDB3 or AMI (no zero code suppression)
Zero Bit Suppression: selectable B8ZS, ZCS, no suppression

Physical Dimensions

Height: 10.5"
Length: 7"
Width: 16"
Weight: 9.6 kg (21.1 lbs)

Platform

Processor: Pentium II, 400 MHz
Memory: 128 MB
Hard Disk Drive: 20 GB
External Drive: 1 LS-120 high capacity (120 MB) floppy drive
External Drive: 1 CD ROM 32X
Display Type: 14.1" XGA 1024 x 768
Network Interface Card: 10/100 Mbps
Built-in Mouse: Touchpad
External Mouse: Serial mouse
Keyboard: 1
External Video Output: 1
Audio Line Out: 1, stereo
Serial Ports: 2
Parallel Port: 1
PCMCIA Type II Slots: 2
Operating System: MS Windows, NT 4.0, SP 6a
Power: 115/230 V~, 50/60 Hz, 4/2A
Regulatory Compliances: UL/CUL, CE, C-Tick

Accessories

J1996A VQT phone adapter
J5426A VQT responder
J5480A 10/100 cardbus NIC for VQT

Key Literature & Web Link

Key Library Information

Data Sheets
VQT Portable Analyzer J1981B 5988-4041EN
<http://cp.literature.agilent.com/litweb/pdf/5988-4041EN.pdf>
VQT Network Server J1987B 5988-3045EN
<http://cp.literature.agilent.com/litweb/pdf/5988-3045EN.pdf>
VQT Phone Adapter J1996A 5988-3046EN
<http://cp.literature.agilent.com/litweb/pdf/5988-3046EN.pdf>
VQT Undercradle J4630A 5980-2091EN
<http://cp.literature.agilent.com/litweb/5980-2091EN.pdf>
Telephony Network Analyzer Technical Overview 5988-7901EN
<http://cp.literature.agilent.com/litweb/pdf/5988-7901EN.pdf>

VQT Ordering Information

J1981B VQT Portable Analyzer
J1987B VQT Rackmount Network Server

VQT Module Interfaces

200 VQT dual-port analog FXO and dual-port analog E/M interface
201 VQT dual-port T1 interface for VQT
202 VQT dual-port E1 interface for VQT
J5479A VQT 10/100 SIP and H.323 interface software license
J4630A VQT Undercradle for Advisor – Analog FXO/E&M

VQT Software

J1979A VQT Client software license
J1982A License to use PAMS voice clarity measurement
J1983A License to use PSQM voice clarity measurement
J1997A License to use PESQ voice clarity measurement
J5422A IP Telephony Reporter

Telephony Network Analyzer Ordering Information

J6844A Telephony Network Analyzer

IP Telephony Analyzer Ordering Information

J4618C IP Telephony Analyzer

- High dynamic range up to 45 dB. Multi mode and Single Mode modules (2- and 3-lambda)
- 13,000 traces in memory
- Locate and characterize splice and connector losses
- Multifiber testing for fast high-count cable qualification
- Perform power and loss measurement with the built-in light source and the power meter module
- Graphical representation of measurement results in event tables, showing loss and reflection, and pass/fail results
- Visual Fault Finder to check patch cords for light leakage
- Traffic Detection is standard
- No hard disk, sustains drops from 2 meters on solid ground



The Agilent Mini-OTDR is the best selling product in Agilent's portfolio of Optical Network Test Solutions for the installation, maintenance and operation of fiber networks.

The Mini-OTDR is designed to provide its users with the fastest tool available for installing and commissioning multiple fiber links and locating faults for fiber maintenance. This is accomplished through high measurement performance and an award winning simple user interface.

The Mini-OTDR starts making installation and commissioning easier before you even switch it on. We have trimmed the weight and size to make it easy to carry, put it in a rugged, weather-tolerant housing so you don't need to worry about conditions, and avoided using an internal hard-disk so it can take the rough and tumble of getting it where you need it. And when you get there, a user and task oriented interface offers productive support for qualifying large numbers of fibers in minimal time. The Mini-OTDR is intuitive to use, quick to measure and easy to integrate into your installation process. Keeping a network running or getting a fiber or cable back up takes more than speed and precision. Having the right application on hand makes the difference. Agilent's Mini-OTDR provides a selection of tools and features for experts and beginners alike that speed up preventive maintenance and repair.

Specifications

- **Sampling Space:** configurable 4000, 8000, 16000
- **Event Dead Zone:** 3 meters
- **Sampling Distance:** 8 cm. Detects a loss of 0.02 dB up to 80 Km
- **Start-km:** 0 – 400 km with configurable span of 100 meters
- **Linearity:** ± 0.05 dB/dB
- **Attenuation Dead Zone:** 10 meters
Multimode (up to 34 dB) and Single mode (from 30 to 45 dB) modules

Accessories

Manuals
RS232 Cable
Soft bag
CD ROM Service Information
Certificates
Power Cords and AC/DC adapter
Shoulder Belt
FC/PC connector

Key Literature & Web Link

Key Library Information

Brochure: E6000C Mini-OTDR

The Agilent Mini-OTDR is the best selling product in Agilent's portfolio of Optical Network Test Solutions for the installation, maintenance and operation of fiber networks (5988-2238EN)

Technical Specifications: E6000C Mini-OTDR Technical Data Sheet

The Agilent Technologies E6000C Mini-OTDR is produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control (5988-2302EN)

Data Sheet: E6031A Mini-OTDR Fiber Commissioning Bundle

E6031A Mini-OTDR Fiber Commissioning Bundle (5988-4419EN)

Data Sheet: E6032 Mini-OTDR Acceptance Test Bundle

E6032 Mini-OTDR Acceptance Test Bundle (5988-4420EN)

Data Sheet: E6033 Mini-OTDR Getting Started Bundle

E6033 Mini-OTDR Getting Started Bundle (5988-4421EN)

<http://www.otdr.com>

Ordering Information

E6000C mainframe with display options 006 or 003

E6003A OTDR 35 dB Module

E6003B OTDR 40 dB Module

E6008B OTDR 45 dB Module

E6013A OTDR 3-lambda Module

E6005A OTDR MM Module 34 dB

E6009A OTDR MM Module 23 dB

E6031A bundle

E6032A bundle

E6033A bundle

E6020A Fiber Break Locator (includes the mainframe already, E6000C not needed)

E6000C
E60xyA/B
modules +
bundles

Optical Hand Held Testers

434

Hand Held Optical Loss Test Set

N3970A
N3974A
N3977A

- Ideal HH product for physical quality check of fiber optic network links
- Very accurate loss measurement and continuity testing
- Extremely stable laser source
- No warm-up time
- Transmitter testing via the Power Meter
- Very long battery life (240 hours)
- Companion S/W for PC or LapTop reporting and documentation applications
- Data logging and pass/fail pre-configurable parameters



The Handheld Optical Power Meter N3970A, the Handheld Dual Laser Source N3974A and the Handheld Automated Optical Attenuator N3977A, three ergonomic and rugged devices for the installation, commissioning and maintenance of optical fiber. The Handheld Optical Power Meter N3970A is a high-end, user-friendly, wide dynamic range device featuring three percent overall accuracy, quick response time and no need for a warm-up period. The Handheld Dual Laser Source N3974A is a high-end instrument for painless field test of fiber optic systems and features ultra high stability and no need for a warm up period. The Handheld Automated Optical Attenuator N3977A is a high-end, user-friendly precision instrument for field-testing of fiber optical systems featuring very high productivity, power handling of up to +23 dBm, return loss of less than -40 dBm and low wavelength dependence.

Specifications

- 850 – 1650 nm spectrum for the N3970A
- Wide dynamic range (+5 to –70 dBm), high power Power Meter in summer '03
- Superb power accuracy (3%)
- No warm-up time for all the three HH products (unique on the market)
- Laser power stability ± 0.15 dB over 8 hours
- Attenuation range from 2.5 to 60 dB with Power handling up to +23 dBm
- Attenuator's return loss better than –40 dB

Accessories

Manuals
Soft carrying case
Support CD
FC, ST and SC interchangeable connectors

Key Literature & Web Link

Hand Held Testers Brochure (5988-1066EN)
Hand Held Testers Technical Data Sheet (5988-1067EN)

<http://ont.business.agilent.com>

Ordering Information

N3970A Power Meter
N3974A Laser Source
N3977A Attenuator

- Ergonomic Design
- Large, brilliant 10.4" color display, with touch screen functionality and cursor control
- USB & LAN ports for connectivity to your PC
- Safe, fast connector protection and inspection
- Secure and rugged data storage – either on the internal memory, floppy disk or PCMCIA CompactFlash® card
- Long Battery Operating Time
- On-line comprehensive Training and Support Tools
- Can accommodate 3 interchangeable modules
- Modules available: OTDR (different dynamic ranges), Optical Switch, Optical Spectrum Analyzer, Chromatic Dispersion module (from Summer 2003)
- Video Camera



The Agilent N3900A Modular Network Tester is a portable, lightweight, rugged test system for the installation, commissioning and maintenance of optical networks. Developed from customer feedback from installation and maintenance (I&M) technicians worldwide, its modular design delivers the measurements you need, when you need them. Snap-On measurement modules meet your test requirements for today's communication networks; the modular platform protects your investment, and lets you grow into your future measurement needs.

The Modular Network Tester can hold up to three modules to perform OTDR, WDM or dispersion measurements, and a 1 x 12 Optical Switch module. A video microscope camera can be connected to ensure clean, fast and safe connector inspection as the connector surface picture can be analyzed on the large 10" display. From the carrying case to the handles and tilt-stand, from the pop-up connector to your choice of interface, attention to detail and to your feedback provide the perfect fit for the way you work.

Specifications

- "Traffic Detection" Feature is built-in
- Both touch screen & hard keys modes are available and can be useable in parallel
- Pop-up connectors available on all modules
- 3 fast 'snap on' module-configuration in any sequence. Mainframe does not re-boot
- Video microscope on the USB interface of the mainframe
- Context-sensitive help function is built-in and always on-line
- All-wavelength OTDR acquisition by using 1 button
- OSA maximum dynamic range of 45 dB at 100 GHz channel spacing
- OSA minimum scanning resolution at 0.005 nm
- User-definable OTDR pulse widths
- OTDR backscatter linearity is ± 0.03 dB over 100 Km
- OTDR backscatter loss accuracy ± 0.03 dB/dB
- User-definable "Start" – "Stop" trace zooming has minimum span in 100-meter steps
- Configurable 64,000 measurements points, 8 cm sample spacing
- 170 Mb solid-state memory with no hard-disk in the unit

Accessories

Manuals
RS232 Cable
Soft bag
CD ROM Service Information
Certificates
Power Cords and AC/DC adapter
Shoulder Belt
SC/ and FC/PC connector

Key Literature & Web Link

Data Sheet: Agilent N3900A Modular Network Tester

The Agilent Modular Network Tester is produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control (5988-5066EN)

Data Sheet: N3910AM, N3910AL, N3911AL, N3914 AL OTDR Test Engines for Modular Network Tester

Agilent OTDRs are produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control (5988-5067EN)

Data Sheet: N3940A Optical Switch Module for Modular Network Tester

Agilent OTDRs are produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control (5988-5068EN)

Data Sheet: Agilent N3988A USB Video Microscope Camera for Modular Network Tester

The Universal Serial Bus (USB) Video Microscope Camera N3988A is used together with the Agilent N3900A Modular Network Tester, for the inspection of optical connectors such as on patch cords or patch panels (5988-5069EN)

Brochure: N3900A Modular Network Tester

N3900A Modular Network Tester (5988-5065EN)

<http://csgsales.comms.agilent.com/authenticate.asp>

Ordering Information

N3900A Mainframe
N3910AM OTDR 40 dB Module
N3910AL OTDR 45 dB Module
N3911AL OTDR 43 dB Module (with 1625 nm lambda)
N3914AL OTDR 43 dB Module (3-lambda solution)
N3940AA 1:12 Switch Module
N3988A Microscope
N3935A Optical Spectrum Analyzer

N3900A
Modular
Network
Tester +
N39xyA
modules

J2126A
J2127A

- Global test coverage (SDH/SONET, T-carrier, PDH, Ethernet)
- Fully integrated all-rates testing:
 - Optical: 52 Mb/s to 10 Gb/s
 - Electrical: 52/155 Mb/s; DS1/3; 2/8/34/140 Mb/s
 - Ethernet: 10/100 M (8 ports); 1 GbE (2 ports)
- Full range of standard and concatenated SDH/SONET mappings
- All standard error and alarm measurements, plus:
 - optical power, electrical level, pulse mask, line frequency
 - protection switching time, pointer movements, delay
- Signal Wizard – unique “simultaneous all-paths” testing technology (TUs, AUs)
- Multi-rate/Multi-port Ethernet testing:
 - simultaneous full-bandwidth testing on all ports
 - physical layer and layer 2
 - automated RFC2544
 - operates simultaneously with SDH/SONET/T-carrier/PDH testing
- Powerful remote testing application provided as standard
- Modular architecture – protects your investment:
 - flexible configurations
 - easy modular upgrades
- Compact, rugged and portable
- 2-year calibration cycle; 3-year standard warranty



Designed to deliver Extreme Productivity Improvements (XPI)

12

The J2126A and J2127A transmission test sets tackle your need for fast and efficient testing in today’s increasingly complex networks based on next-generation SDH/SONET transmission systems. Their full-integrated design combines “all-rates” test coverage (including Ethernet) with the most comprehensive range of standard and innovative test tools available today – ensuring that you always have immediate access to the required test capability when you need it.

Three multi-rate product platforms enable you to tailor the solution that best meets your current test requirements – all-rates to 622 Mb/s; all-rates to 2.5 Gb/s (with or without Ethernet); all-rates to 10 Gb/s (with or without Ethernet); Ethernet-only. And their modular design ensures that your initial investment is protected, by allowing you to add cost-effective upgrades in future.

Designed for both routine and complex field test applications, the J2126/7A transmission test sets provide the broad range of measurement tools that are needed to quickly identify problems in your network – error and alarm measurements, signal quality measurements, network performance measurements.

XPI – Today you’re expected to do more with less – provide results faster with fewer resources, increase network performance, boost return-on-investment (ROI), rapidly roll out new services – in other words, deliver Extreme Productivity Improvements (XPI). Agilent XPI solutions help you drastically cut the time and cost of installing, commissioning and maintaining your communications networks. Together with Agilent, gain the Extreme Productivity Improvements that your business demands!

Signal Wizard – A unique test tool specifically designed to meet the challenges associated with testing next-generation SDH/SONET transmission systems (multi-services provisioning platforms, MSPP and high bandwidth cross connector). With two key-presses, this essential tool enables you to quickly identify any error or alarm conditions that are present in **any** AU (up to 192) or TU (up to 5376) channels in the received line signal. In addition, it provides the information needed to quickly identify costly provisioning errors in networks containing these highly configurable and complex multi-service provisioning platforms.

Signal Wizard Functions:

- Discovers the line rate and channel structure of any valid input signal (including those containing mixed AU/STS and TU/VT channel types)
- Simultaneously monitors all channels for errors, alarms and pointer activity
- Shows the type of traffic carried in each channel
- Provides path trace listing and searching tools to simplify routing tests
- Discovers the rate, framing and channel structure of a DS_n/PDH signal (either as a native line signal or as a payload within SDH/SONET) – scans all channels in the DS_n/PDH signal for alarms
- On exit, allows the receiver and transmitter to be automatically configured to match the settings discovered in a selected channel (including the test pattern)

Ethernet Testing

Cut the cost of testing without compromising results integrity – special designed ethernet testing tool for transmission engineers.

With eight 10/100Base-T plus two 1000Base-SX or LX test ports, this option supports testing of multi-rate, multi-port Ethernet transmission systems. And with its 1 GbE interfaces provided via “hot plug-in” GBIC modules, you have the ability to quickly configure the unit to match the requirements of the system under test.

Tests can be run simultaneously on all ten port – enabling you to test up to ten times faster, while also applying more realistic “traffic loading” to the system under test. This ability to load multiple ports enable you to test a system under typical operating conditions, and in consequence, ensures that you can have full confidence in the results you obtain. To further reduce your test time, Ethernet testing can be carried out at the same time as SDH/SONET or DS_n/PDH testing.

Ethernet Measurements

The Ethernet testing option quickly and easily provides the three most fundamental measures of data-circuit performance – Data Throughput, Frame Loss and Latency. These measurements can be run manually or under the control of a fully automated RFC2544 test sequence. Additional factors that can affect the quality of service you provide to your customers can also be measured, including:

- Errored Frames
- Out-of-Sequence Frames
- Broadcast and Multi-cast Frames
- Runt Frames
- Jumbo Frames

Specifications

Optical	J2126A	J2127A
Line Rates	STM-1/4/16 OC/1/3/12/48	STM-0/1/4/16/64 OC1/3/12/48/192
Wavelength	1310 nm, 1550 nm 1310/1550 nm	1310 nm, 1550 nm, 1310/1550 nm
Electrical Line Rates	STM-0/1 (STS-1/3); DS1, DS3, 2/8/34/140 Mb/s	
Clock References	Internal/External BITS/MTS	
Payload Mappings	All standard and concatenated payload mappings	
Test Patterns	PRBS/WORD	
Measurements	Error Count, Error Ratio, G821/826/828, M2100/2101/2101.1/2110/2120 Optical Power, Electrical Level, Line Frequency, Pulse Mask, Pointers, Delay, Service Disruption	
Errors and Alarms	Generation and Measurement for all signal types	
Ethernet	10/100BASE-T (8 ports; RJ-45 connectors) 1000BASE-SX/LX (2 ports; plug-in GBIC modules)	
Ethernet Measurements	Throughput, Frame Loss, Latency, Automated RFC2544, plus many more (including Frame Capture)	
Ethernet Test Configurations	End-to-End, Loopback (via "cable loopback" or via Agilent's unique "active loop-through" mode)	

Accessories

Recommended Accessories

Carrying cases:

J7286A: Hard transit case (J2126A)

J7287A: Hard transit case (J2127A)

J7288A: Soft carrying case (J2126/27A)

J7289A: Hard transit case (J2127A 6 slots)

J7290A: Soft carrying case (J2127A 6 slots)

Rack Mount Kit

J7291A: Rack-mount kit for the J2126/27A test sets. Compatible with standard 19-inch EIA racks and all variants of the J2126/27A test set chassis

Adapters and Cables

J7281A: DCC port converter cable: 9-pin miniature D-type (J2126/27A compatible) to 37-pin D-type (RS449, female)

J7283A: FC/PC connector (exchangeable)

J7284A: SC connector (exchangeable)

J7285A: ST connector (exchangeable)

Additional Documentation

J7280A – Printed manuals includes: User Manual, Remote Control Manual, Quick Start Guide and Verification Manual

Key Literature & Web Link

Brochure, p/n 5988-7946EN
Technical Specs, 5988-2570EN
Config Guide, 5988-2569EN

www.agilent.com/comms/XPI

Ordering Information

J2126A Multi-rate testing to STM-16/OC-48

J2126A Scalable 2.5 Gb/s transmission test set

J2126A-100 1310 nm Tx/Rx (52 Mb/s to 2.5 Mb/s)

J2126A-101 1550 nm Tx/Rx (52 Mb/s to 2.5 Gb/s)

J2126A-102 1310/1550 nm Tx/Rx (52 mb/s to 2.5 Gb/s)

J2126A-103 Delete 2.5 Gb/s operation

J2126A-190 FC/PC connectors (exchangeable)

J2126A-191 SC connectors (exchangeable)

J2126A-192 ST connectors (exchangeable)

J2126A-W50 Warranty extended to 5 years

J2127A Multi-rate testing to STM-64/OC-192

J2127A Scalable 10 Gb/s transmission test set

J2127A-100 1310 nm Tx/Rx (52 Mb/s to 2.5 Mb/s)

J2127A-101 1550 nm Tx/Rx (52 Mb/s to 2.5 Gb/s)

J2127A-102 1310/1550 nm Tx/Rx (52 mb/s to 2.5 Gb/s)

J2127A-111 1550 nm Tx/Rx (10 Gb/s) – High Sensitivity

J2127A-120 1310 nm Tx/Rx (10 Gb/s) – Short Reach

J2127A-121 1550 nm Tx/Rx (10 Gb/s) – Short Reach

J2127A-103 Delete 2.5 Gb/s operation

J2127A-323 Ethernet Testing (8*10/100 M; 2*1GbE)

J2127A-325 1000Base-SX (850 nm) GBIC modules (two)

J2127A-326 1000Base-LX (1310 nm) GBIC modules (two)

J2127A-190 FC/PC connectors (exchangeable)

J2127A-191 SC connectors (exchangeable)

J2127A-192 ST connectors (exchangeable)

J2127A-W50 Warranty extended to 5 years

J2126A

J2127A

86100B

- Modular platform with 100 Mb/s to 40 Gb/s compliance waveform testing
- Easy to use through a simple user interface
- Fast measurement throughput
- Accurate and repeatable measurements
- Compatible with Agilent 83480A-series and 86100A-series modules

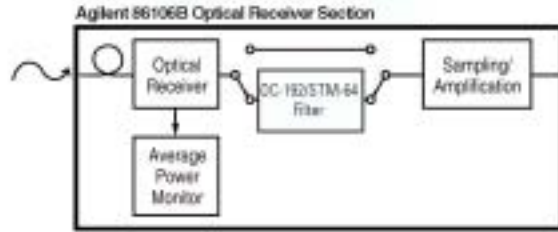


Accurate eye-diagram analysis is essential for characterizing the quality of transmitters used from 100 Mb/s to beyond 10 Gb/s. The Agilent Infiniium DCA was designed specifically for the complex task of analyzing digital communications waveforms. Compliance mask and parametric testing no longer require a complicated sequence of setups and configurations. If you can press a button, you can perform a complete compliance test. The important measurements you need are right at your fingertips, including:

- Industry standard mask testing with built-in margin analysis
- Extinction ratio measurements with improved accuracy and repeatability
- Eye measurements – crossing %, eye height and width, “1” and “0” levels, jitter, rise or fall times and more

The key to accurate measurements of lightwave communications waveforms is the optical receiver. The Infiniium DCA has a broad range of precision receivers integrated within the instrument.

- Built-in photodiodes, with flat frequency responses, yield the highest waveform fidelity. This provides high accuracy for extinction ratio measurements
- Standards-based transmitter compliance measurements require filtered responses. Filters are automatically and repeatably switched in or out of the measurement channel remotely over GPIB or with a front panel button. The frequency response of the entire measurement path is calibrated, and will maintain its performance over long term usage
- The integrated optical receiver provides a calibrated optical channel. Optical signals are accurately displayed in optical power units
- An accurate optical power meter is built within the module. Switches or couplers are not required for an average power measurement. Signal routing is simplified and signal strength is maintained



The integrated optical channel can be used as a fully calibrated SONET/SDH/ Gigabit Ethernet or Fibre Channel reference receiver or a wide-bandwidth receiver.

Eye-Diagram Mask Testing

The Infiniium DCA provides efficient, high-throughput waveform compliance testing with a suite of standards based eye-diagram masks. The test process has been streamlined into a minimum number of keystrokes for testing at:

- **STM-1/OC-3:** 2x Gigabit Ethernet 2500
- **STM-4/OC-12:** 10 Gigabit Ethernet
- **STM-16/OC-48:** Fibre Channel 1063
- **STM-64/OC-192:** 2x Fibre Channel 2125
- **STM-256/OC-768:** 10 Gigabit Fiber Channel
- **Gigabit Ethernet 1250:** XAUI

Other eye-diagram masks are easily created through scaling those listed above or by creating custom masks.

Perform these mask conformance tests with convenient user-definable measurement conditions, such as mask margins for guardband testing, number of waveforms tested, and stop/limit actions.

Waveform Analysis

The Infiniium DCA provides the optimum tool for digital transmission waveform analysis. Eye-diagram waveforms are quickly and conveniently examined with a wide range of automated measurements, such as rise and fall times, jitter, eye width and height, crossing percentage, 1-level, 0-level, and signal-to-noise. Extinction ratio measurements have been improved to yield higher accuracy and repeatability.

Integrated optical reference receivers simplify testing of optical waveforms. Built-in filtering provides calibrated reference receivers for compliance test. For fundamental device characterization, the filters are easily switched out, resulting in a wide-bandwidth receiver. This allows the raw performance of high-speed lasers to be accurately measured.

Measurement Speed

Measurement speed is achieved with both fast hardware and a user friendly instrument. In the lab, don't waste time trying to figure out how to make a measurement. With the uncomplicated Infiniium DCA you don't have to relearn a measurement each time you use it. In manufacturing, it is a battle to continually reduce cost per test. Solution – fast PC-based processors and optimized software, resulting in high measurement throughput and reduced test time.

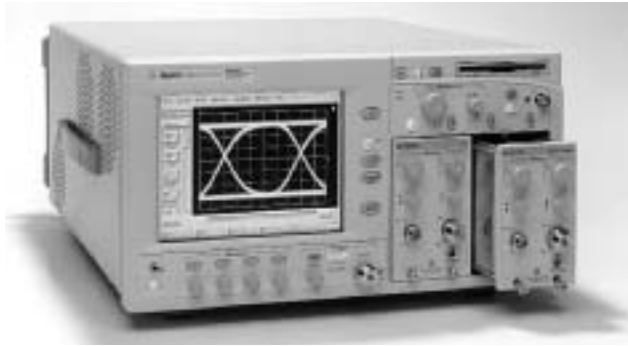
The 86100B has a CPU that is three times faster than the 86100A. New software enables simultaneous eye analysis on four channels, significantly improving overall throughput.

Three Instruments in One

For basic oscilloscope operation there is easy front panel access with that familiar analog look and feel. A Windows® – based system let's you easily navigate through the user-interface. The Infiniium DCA can be viewed as three high-performance instruments in one. It's a general-purpose oscilloscope. It's a digital communications analyzer. It's a time domain-reflectometer. Just select the instrument mode and start making measurements.

Configurable to Meet Your Needs

The Infiniium DCA supports a wide range of plug-ins for testing both optical and electrical signals. Select plug-ins to get the specific bandwidth, filtering, and sensitivity you need.



Built-in Information System

The Infiniium DCA has an on-line manual providing immediate answers to your questions about using the instrument. Links on the measurement screen take you directly to the information you need. There is no need for a large paper manual consuming your shelf space.

Internal Hard, Floppy Disk, and CD-ROM Drives

Use the internal 10 GB hard drive or 3.5 inch MS-DOS® compatible floppy drive to store instrument setups, waveforms, or screen images. Images can be stored in formats easily imported into various programs for documentation and further analysis.

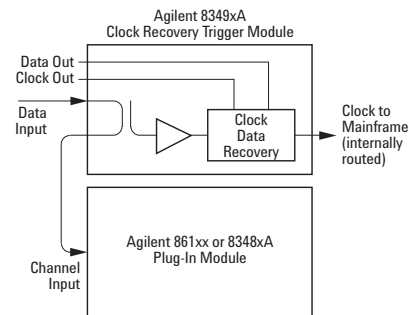
Use the built-in CD-ROM drive to upgrade the system software and to install printer drivers.

Powerful Display Modes

Use gray scale and color graded trace displays to gain insight into device behavior. Waveform densities are mapped to color or easy-to-interpret gray shades. These are infinite persistence modes where shading differentiates the number of times data in any individual screen pixel has been acquired.

Internal Triggering Through Clock Recovery

Very high-speed oscilloscopes are not capable of triggering directly on the signal under test. Typically an external timing reference is used to synchronize the oscilloscope to the test signal. In cases where a trigger signal is not available, clock recovery modules are available to derive a timing reference directly from the waveform to be measured. The Agilent 8349x series of clock recovery modules cover the four most popular transmission media used today – electrical lines, multimode, and single-mode fiber. A built-in coupler reduces external hardware requirements. All four modules have excellent jitter performance to ensure accurate measurements. Each clock recovery module is designed to synchronize to a variety of common transmission rates.



Improved Autoscaling

Autoscaling has been significantly improved to provide quick horizontal and vertical scaling of both pulse and eye diagram waveforms.

Gated Triggering

A trigger gating port allows easy external control of data acquisition for circulating loop or burst-data experiments. Use TTL-compatible signals to control when the instrument does and does not acquire data.

Easier Calibrations

Calibration of your instrument has been simplified by placing all the performance level indicators and calibration procedures in a single high-level location. This provides greater confidence in the measurements made and saves time in maintaining equipment.

Stimulus Response Testing Using the Agilent N490xA Bit Error Ratio Tester

Error performance analysis represents an essential part of digital transmission test. The Infiniium DCA and Agilent N490xA Bit Error Ratio Tester error performance analyzer come together to create a powerful test solution where two instruments together can perform measurements that would otherwise be impossible.

Transitioning from the Agilent 83480A to the Infiniium DCA

The Infiniium DCA has been designed to be a virtual drop-in replacement for the Agilent 83480A digital communications analyzer and Agilent 54750A wide-bandwidth oscilloscope. All modules used in the Agilent 83480A and 54750A can also be used in the Infiniium DCA.

Module Specifications – 86101A, 86102A, 86102U

86101A
86102A
86102U

Multimode and Single-Mode Optical/Electrical Modules	86101A	86102A	86102U
Optical Channel Specifications			
Optical Channel Unfiltered Bandwidth	2.85 GHz (3 GHz typical)	10 GHz	15 GHz
Wavelength Range	750 – 860 nm		
Calibrated Wavelengths	850 nm		
Sensitivity (smallest average power for mask test)	–17 dBm	–13.5 dBm	–7.5 dBm
Transition Time (10% to 90%, calculated from TR=0.48/BW)	160 ps	35 ps	25 ps
RMS Noise			
Typical	1.5 μ W	3.4 μ W	14 μ W
Maximum	2.5 μ W	5.5 μ W	20 μ W
Scale Factor (per division)			
Minimum	5 μ W	5 μ W	20 μ W
Maximum	100 μ W	100 μ W	500 μ W
dc Accuracy (single marker, referenced to average power monitor, < 50 μ W/division)	$\pm 6 \mu\text{W} \pm 0.4\%$ of full scale $\pm 3\%$ of (reading-channel offset)		$\pm 25 \mu\text{W} \pm 2\%$ of (reading-channel offset), 12.4 GHz $\pm 25 \mu\text{W} \pm 4\%$ of (reading-channel offset), 20 GHz
dc Offset (referenced two divisions from screen bottom)	+0.2 mW to –0.6 mW		+1 mW to –3 mW
Average Power Monitor (specified operating range)	–30 dBm to –2.2 dBm	–30 dBm to 0 dBm	–27 dBm to +3 dBm
Factory Calibrated Accuracy	$\pm 5\% \pm 100 \text{ nW} \pm$ connector uncertainty, 20°C to 30°C		
Maximum Input Power			
Maximum Non-destruct Average Power	0.4 mW (–4 dBm)		2 mW (+3 dBm)
Maximum Non-destruct Peak Power	10 mW (+10 dBm)		
Fiber Input	62.5/125 μ m, user selectable connector		
Input Return Loss (HMS-10 connector fully filled fiber)	20 dB		
Electrical Channel Specifications			
Electrical Channel Bandwidth	12.4 and 20 GHz		
Transition Time (10% to 90%, calculated from TR=0.35/BW)	17.5 ps, 20 GHz		
RMS Noise			
Typical	0.25 mV, 12.4 GHz; 0.5 mV, 20 GHz		
Maximum	0.5 mV, 12.4 GHz; 1 mV, 20 GHz		
Scale Factor			
Minimum	1 mV/division		
Maximum	100 mV/division		
dc Accuracy (single marker, referenced to average power monitor)	$\pm 0.4\%$ of full scale $\pm 2 \text{ mV} \pm 1.5\%$ of (reading-channel offset), 12.4 GHz $\pm 4\%$ of full scale $\pm 2 \text{ mV} \pm 3\%$ of (reading-channel offset), 20 GHz		
dc Offset (referenced two divisions from screen bottom)	$\pm 500 \text{ mV}$		
Input Dynamic Range (relative to channel offset)	$\pm 400 \text{ mV}$		
Maximum Input Power	16 dBm $\pm 2 \text{ Vdc}$		
Nominal Impedance	50 ohm		
Reflections (for 30 ps rise time)	5%		
Electrical Input	3.5 mm (male)		

Module Specifications – 86103A, 86103B, 86106B

Multimode and Single-Mode Optical/Electrical Modules	86103A	86103B	86106B
--	--------	--------	--------

Optical Channel Specifications

Optical Channel Unfiltered Bandwidth	2.85 GHz (3 GHz typical)	10 GHz	28 GHz
Wavelength Range	1000 – 1600 nm		
Calibrated Wavelengths	Single-mode: 1310/1550 nm; Multimode: 1310 nm		
Sensitivity (smallest average power for mask test)	-20 dBm	-15 dBm	-7 dBm
Transition Time (10% to 90%, calculated from TR=0.48/BW)	160 ps	35 ps	18 ps
RMS Noise			
Typical	1 μ W	2.2 μ W	10 μ W (filtered) 18 μ W (unfiltered)
Maximum	1.5 μ W	3.7 μ W	15 μ W (filtered) 30 μ W (unfiltered)
Scale Factor (per division)			
Minimum		5 μ W	20 μ W/division
Maximum		100 μ W	500 μ W/division
dc Accuracy (single marker, referenced to average power monitor, <50 μ W/division)		$\pm 6 \mu\text{W} \pm 0.4\%$ of full scale $\pm 3\%$ of (reading-channel offset)	$\pm 50 \mu\text{W} \pm 4\%$ of (reading-channel offset)
dc Offset (referenced two divisions from screen bottom)		+0.2 mW to -0.6 mW	
Average Power Monitor (specified operating range)		-30 dBm to 0 dBm	-27 dBm to +3 dBm
Factory Calibrated Accuracy			
Single-mode		$\pm 5\% \pm 100 \text{ nW} \pm$ connector uncertainty, 20°C to 30°C	
Multimode		$\pm 10\% \pm 100 \text{ nW} \pm$ connector uncertainty, 20°C to 30°C	N/A
Maximum Input Power			
Maximum Non-destruct Average Power		0.4 mW (-4 dBm)	
Maximum Non-destruct Peak Power		10 mW (+10 dBm)	
Fiber Input		62.5/125 μ m, user selectable connector	
Input Return Loss (HMS-10 connector fully filled fiber)		20 dB	30 dB

Electrical Channel Specifications

Electrical Channel Bandwidth		12.4 and 20 GHz	18 and 40 GHz
Transition Time (10% to 90%, calculated from TR=0.35/BW)		17.5 ps, 20 GHz	19.5 ps or less, 18 GHz 9 ps or less, 40 GHz
RMS Noise			
Typical		0.25 mV, 12.4 GHz 0.5 mV, 20 GHz	0.25 mV, 18 GHz 0.5 mV, 40 GHz
Maximum		0.5 mV, 12.4 GHz 1 mV, 20 GHz	0.5 mV, 18 GHz 1 mV, 40 GHz
Scale Factor			
Minimum		1 mV/division	
Maximum		100 mV/division	
dc Accuracy (single marker, referenced to average power monitor)		$\pm 0.4\%$ of full scale $\pm 2 \text{ mV} \pm 1.5\%$ of (reading-channel offset), 12.4 GHz $\pm 4\%$ of full scale $\pm 2 \text{ mV} \pm 3\%$ of (reading-channel offset), 20 GHz	$\pm 0.4\%$ of full scale $\pm 2 \text{ mV} \pm 1.5\%$ of (reading-channel offset), 18 GHz $\pm 4\%$ of full scale $\pm 2 \text{ mV} \pm 3\%$ of (reading-channel offset), 40 GHz
dc Offset (referenced two divisions from screen bottom)		$\pm 500 \text{ mV}$	
Input Dynamic Range (relative to channel offset)		$\pm 400 \text{ mV}$	
Maximum Input Power		16 dBm $\pm 2 \text{ Vdc}$	
Nominal Impedance		50 ohm	
Reflections (for 30 ps rise time)		5%	
Electrical Input		3.5 mm (male)	2.4 mm (male)

Module Specifications – 86109A, 86109B

86109A

86109B

High Bandwidth, Single-Mode Optical/Electrical Modules	86109A	86109B
Optical Channel Specifications		
Optical Channel Unfiltered Bandwidth	30 GHz	40 GHz ¹
Wavelength Range	1000 – 1600 nm	
Calibrated Wavelengths	1310 nm/1550 nm	
Sensitivity (smallest average power for mask test)	N/A	
Transition Time (10% to 90%, calculated from TR=0.48/BW optical)	16 ps	12 ps (FWHM) ²
RMS Noise		
Typical	18 μ W	15 μ W (30 GHz) 50 μ W (40 GHz)
Maximum	30 μ W	30 μ W (30 GHz) 70 μ W (40 GHz)
Scale Factor		
Minimum	20 μ W/division	
Maximum	500 μ W/division	1 mW/division
dc Accuracy (single marker, referenced to average power monitor)	$\pm 50 \mu\text{W} \pm 4\%$ of (reading-channel offset)	
dc Offset (referenced two divisions from screen bottom)	+1 mW to –3 mW	
Average Power Monitor (specified operating range)	–27 dBm to +3 dBm (2 μ W to 2 mW)	
Factory Calibrated Accuracy	$\pm 5\% \pm 100 \text{ nW} \pm$ connector uncertainty, 20°C to 30°C change	
Maximum Input Power		
Maximum Non-destruct Average Power	2 mW (+3 dBm)	10 mW (+10 dBm)
Maximum Non-destruct Peak Power	10 mW (+10 dBm)	50 mW (+17 dBm)
Fiber Input	9/125 μ m, user selectable	
Input Return Loss (HMS-10 connector fully filled fiber)	30 dB	
Electrical Channel Specifications		
Electrical Channel Bandwidth	18 and 40 GHz	26.5 and 50 GHz
Transition Time (10% to 90%, calculated from TR=0.35/BW)	19.5 ps, 18 GHz 9 ps, 40 GHz	13.2 ps, 26.5 GHz 7.0 ps, 50 GHz
RMS Noise		
Typical	0.25 mV, 18 GHz; 0.5 mV, 40 GHz	0.75 mV, 26.5 GHz
Maximum	0.5 mV, 18 GHz; 1.0 mV, 40 GHz	1.5 mV, 50 GHz
Scale Factor		
Minimum	1 mV/division	
Maximum	100 mV/division	
dc Difference (single marker, referenced to average power monitor, 50 μ W/division)	$\pm 0.8\%$ of full scale $\pm 1.5\%$ of delta, 18 GHz $\pm 0.4\%$ of full scale $\pm 3\%$ of delta, 40 GHz	
dc Offset (referenced two divisions from screen bottom)	$\pm 500 \text{ mV}$	
Input Dynamic Range (relative to channel offset)	$\pm 400 \text{ mV}$	
Maximum Input Power	16 dBm $\pm 2 \text{ Vdc}$	
Nominal Impedance	50 ohm	
Reflections (for 20 ps rise time)	5%	
Electrical Input	2.4 mm (male)	

¹Specified with 8-point moving average in frequency response.²FWHM (Full-Width Half Max) as measured from optical pulse with 700 fs FWHM, 5 MHz repetition rate and 10 mW peak power.

86111A
86111U
86113A
86115B
86112A

Module Specifications – 86111A, 86111U, 86113A, 86115B

Dual Optical Modules	86111A	86111U	86113A	86115B
Optical Channel Specifications				
Optical Channel Unfiltered Bandwidth	2.85 GHz (3 GHz typ.)	15 GHz	2.85 GHz (3 GHz typ.)	28 GHz
Wavelength Range	750 – 860 nm			
Calibrated Wavelengths	850 nm			
Sensitivity (smallest average power for mask test)	-17 dBm	-7.5 dBm	-20 dBm	-7 dBm
Transition Time (unfiltered) (10% to 90%, calculated from TR=0.48/BW optical)	160 ps	32 ps	160 ps	18 ps
RMS Noise				
Characteristic	1.5 µW	14 µW	1.5 µW	10 µW filtered 8 µW unfiltered
Maximum	2.5 µW	20 µW	2.5 µW	15 µW filtered 30 µW unfiltered
Scale Factor				
Minimum	5 µW	20 µW	5 µW	20 µW
Maximum	100 µW	500 µW	100 µW	500 µW
dc Accuracy (single marker, referenced to average power monitor)	±6 µW ± 0.4% of full scale, ±3% of (reading channel offset)	±25 µW ± 2% of (reading channel offset)	±6 µW ± 0.4% of full scale, ±3% of (reading channel offset)	±50 µW ± 4% of (reading channel offset)
dc Offset (referenced two divisions from screen bottom)	+0.2 mW to -0.6 mW	+1 mW to -3 mW	+0.2 mW to -0.6 mW	+1 mW to -3 mW
Average Power Monitor (specified operating range)	-30 dBm to -2.2 dBm	-27 dBm to +3 dBm	-30 dBm to 0 dBm	-27 dBm to +3 dBm
Factory Calibrated Accuracy				
Single-mode	±5% ± 100 nW ± connector uncertainty, 20°C to 30°C			
Multimode	±10% ± 100 nW ± connector uncertainty, 20°C to 30°C			N/A
Maximum Input Power				
Maximum Non-destruct Average Power	0.4 mW (-4 dBm)	2 mW (+3 dBm)	0.4 mW (-4 dBm)	2 mW (+3 dBm)
Maximum Non-destruct Peak Power	10 mW (+10 dBm)			10 mW (+10 dBm)
Fiber Input	62.5/125 µm, user selectable connector			9/125 µm, user selectable connector
Input Return Loss (HMS-10 connector fully filled fiber)	20 dB			30 dB

Module Specifications – 86112A, 83484A

12

Dual Electrical Channel Modules	86112A
Electrical Channel Bandwidth	12.4 and 20 GHz
Transition Time (10% to 90%, calculated from TR=0.35/BW)	28.2 ps, 12.4 GHz; 17.5 ps, 20 GHz
RMS Noise	
Typical	≤0.5 mV, 12.4 GHz
Maximum	≤1 mV, 20 GHz
Scale Factor	
Minimum	1 mV/division
Maximum	100 mV/division
dc Accuracy (single marker, referenced to average power monitor)	±0.4% of full scale ± 2 mV ± 1.5% of (reading-channel offset), 12.4 GHz ±0.4% of full scale ± 2 mV ± 3% of (reading-channel offset), 20 GHz
dc Offset (referenced two divisions from screen bottom)	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV
Maximum Input Power	16 dBm ± 2 Vdc
Nominal Impedance	50 ohm
Reflections (for 30 ps rise time)	≤5%
Electrical Input (connectors)	3.5 mm (male)

Module Specifications – 54754A

54754A
83491A
83492A
83493A
83494A

TDR Module	54754A
Electrical Channel Bandwidth	12.4 and 18 GHz
Transition Time (10% to 90%, calculated from TR=0.48/BW)	28.2 ps, 12.4 GHz; 19.4 ps, 18 GHz
RMS Noise	
Typical	0.25 mV, 12.4 GHz; 0.5 mV, 18 GHz
Maximum	0.5 mV, 12.4 GHz; 1 mV, 18 GHz
Scale Factor	
Minimum	1 mV/division
Maximum	100 mV/division
dc Accuracy (single marker, referenced to average power monitor)	±0.4% of full scale or marker reading (whichever is greater) ±2 mV ± 1.2% of (reading-channel offset)
dc Offset (referenced two divisions from screen bottom)	±500 mV
Input Dynamic Range (relative to channel offset)	±400 mV
Maximum Input Power	1.6 dBm ± 2 Vdc
Nominal Impedance	50 ohm
Reflections (for 30 ps rise time)	≤5%
Electrical Input (connectors)	3.5 mm (male)
TDR Step Rise Time	
Oscilloscope/TDR Performance	40 ps nominal
Normalized Characteristics	Adjustable from larger of 10 ps or 0.08 x time/division. Maximum: 5 x time/division
TDR Step Flatness	
Oscilloscope/TDR Performance	≤±1% after 1 ns from edge; ≤±5% ns from edge
Normalized Characteristics	≤0.1%
Low Level	0.00 V ± 2 mV
High Level	+200 mV ± 2 mV

Module Specifications – 83491A, 83492A, 83493A, 83494A

Clock Recovery Single Mode, Multimode and Electrical Modules	83491A	83492A	83493A	83494A
Channel Type	Electrical	Multimode Optical	Single-Mode Optical	Single-Mode Optical
Clock Recovery Phase Locked Loop Bandwidth				
Internal Path Triggering		50 to 70 kHz		80 kHz
External Output		4 to 5 MHz		9 MHz
Data Rates (Mb/s)	155, 622, 1063, 1250, 2125, 2488, 2500		155, 622, 1250, 2488, 2500	155, 622, 2488, 9953
Tracking/Acquisition Range		± 0.1%		0.03%
Internal Splitter		50/50		10/90
Output Jitter		< 0.0125 UI RMS		155, 622, 2488-0.02 U1RMS 9953-0.03 U1RMS
Input Power for Clock Recovery	-10 dBm to +3 dBm	750 to 860 nm, -10 to +3 dBm, 1000 to 1600 nm, -13 to +3 dBm	-20 dBm to +3 dBm	-12 dBm to +3 dBm (155, 622, 2488 Mb/s) -8 dBm to +3 dBm (9953 Mb/s)
Input/Output Connectors	APC 3.5 mm, 50 ohm	FC/PC, 62.5/125 μm	FC/PC, 9/125 μm	FC/PC, 9/125 μm
Auxiliary Recovered Clock and Regenerated Data Outputs		Type N with SMA adapters		
Input Return Loss	dc – 1250 MHz, 20 dB 1250 – 2500 MHz, 15 dB	20 dB	28 dB	28 dB
Input Insertion Loss	dc – 1250 MHz, 7 dB 1250 – 2500 MHz, 15 dB	5 dB maximum	1.5 dB maximum	1.5 dB maximum

12

86100B

Ordering Information

For the most up-to-date ordering information, please contact your Agilent sales representative or visit our web site at:

www.agilent.com/comms/dca

86100B Infiniium DCA Mainframe, Wide Bandwidth Digital Oscilloscope
86100B-001 12 GHz Trigger Bandwidth

Optical/Electrical Modules

86101A 3 GHz Optical Channel; Multimode, Amplified (750 to 860 nm)

20 GHz Electrical Channel

86101A-201 OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s)

86101A-202 Fibre Channel (1.063 Gb/s), Gigabit Ethernet

(1.25 Gb/s)

86102A 10 GHz Optical Channel; Multimode, Amplified (750 to 860 nm)

20 GHz Electrical Channel

86102A-201 2X Fibre Channel (2.125 Gb/s), 3X Fibre Channel

(3.187 Gb/s)

86102A-202 2X Gigabit Ethernet/OC-48/STM-16 (2.488 Gb/s),

XAU (3.125 Gb/s)

86102A-203 VSR (2.72 Gb/s and 3.32 Gb/s)

86102U 15 GHz Optical Channel; Multimode, Unamplified (750 to 860 nm)

20 GHz Electrical Channel

86102U-201 Gigabit Ethernet (1.25 Gb/s), 2X Gigabit Ethernet/

OC-48/STM-16 (2.488 Gb/s)

86102U-202 2X Gigabit Ethernet/OC-48/STM-16 (2.488 Gb/s),

XAU (3.125 Gb/s)

86102U-203 XAU (3.125 Gb/s) and 10 Gigabit Ethernet

(10.3125 Gb/s)

86103A 3 GHz Optical Channel; Multimode, Amplified (1000 to 1600 nm)

20 GHz Electrical Channel

86103A-201 OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s)

86103A-202 Fibre Channel (1.063 Gb/s), Gigabit Ethernet

(1.25 Gb/s)

86103B 10 GHz Optical Channel; Multimode, Amplified (1000 to 1600 nm)

20 GHz Electrical Channel

86103B-201 OC-12/STM-4 (622 Mb/s), OC-48/STM-16

(2.488 Gb/s)

86103B-202 Fibre Channel (1.063 Gb/s), Gigabit Ethernet

(1.25 Gb/s)

86103B-203 2X Fibre Channel (2.125 Gb/s), 2X Gigabit

Ethernet/OC-48/STM-16 (2.488 Gb/s)

86105B 15 GHz Optical and 20 GHz Electrical Plug-in Module

86105B-101 9953, 10312, 10519, 10664 and 10709 Mbit/s filters

86105B-102 155, 622, 2488, 2500 2666, 9953, 10312, 10519, 10664

and 10709 Mbit/s filters

86105B-103 1063, 1250, 2488, 2500, 9953, 10312, 10519, 10664 and

10709 Mbit/s filters

86106B 28 GHz Optical Channel; Single-Mode, Unamplified (1000 to

1600 nm) 40 GHz Electrical Channel

86106B-410 OC-192/STM-64 (9.953 Gb/s), 10 Gigabit Ethernet

(10.3125 Gb/s), OC-192/STM-64 FEC (10.664 Gb/s, 10.709 Gb/s)

86109A 30 GHz Optical Channel; Single-Mode, Unamplified (1000 to

1600 nm) 40 GHz Electrical Channel

86109B 40 GHz Optical Channel; Single-Mode, Unamplified (1000 to

1600 nm) 50 GHz Electrical Channel

86116A 55 GHz Optical Channel; Single-Mode, Unamplified (1000 to

1600 nm) 65 GHz Electrical Channel

86116B 65 GHz Optical Channel; Single-Mode, Unamplified (1480 to

16200 nm) 80 GHz Electrical Channel

Dual Optical Channel Modules

86111A Dual 3 GHz Optical Channels; Multimode, Amplified (750 to 860 nm)

86111A-201 OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s)

86111A-202 Fibre Channel (1.063 Gb/s), Gigabit Ethernet

(1.25 Gb/s)

86111U Dual 15 GHz Optical Channels; Multimode, Unamplified (750 to 860 nm)

86111U-201 Gigabit Ethernet (1.25 Gb/s), OC-48/STM-16

(2.488 Gb/s)

86111U-202 OC-48/STM-16 (2.488 Gb/s), XAU (3.125 Gb/s)

86111U-203 XAU (3.125 Gb/s), 10 Gigabit Ethernet (10.3125 Gb/s)

86113A Dual 3 GHz Optical Channels; Multimode, Amplified (1000 to

1600 nm)

86113A-201 OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s)

86113A-202 Fibre Channel (1.063 Gb/s), Gigabit Ethernet

(1.25 Gb/s)

86113A-301 OC-3/STM-1 (155 Mb/s), OC-12/STM-4 (622 Mb/s),

OC-48/STM-16 (2.488 Gb/s)

86115B Dual 28 GHz Optical Channels; Single-Mode, Unamplified 1000 to 1600 nm)

86115A-101 OC-192/STM-64 (9.953 Gb/s)

86115A-410 OC-192/STM-64 (9.953 Gb/s), 10 Gigabit Ethernet

(10.3125 Gb/s), OC-192/STM-64 FEC (10.664 Gb/s, 10.709 Gb/s)

Dual Electrical Channel Modules

86112A Dual 20 GHz Electrical Channels

86117A Dual 50 GHz Electrical Channels

86117B Dual 65 GHz Electrical Channels

86118A Dual 70 GHz Electrical Remote Heads

TDR/TDT Module

54754A Single-ended or Differential TDR Module with dual 18 GHz

TDR/Electrical Channels

Trigger Module

86107A Precision Timebase Reference Module

86107A-020 10 and 20 GHz Clock Input Capability

86107A-040 10, 20, and 40 GHz Clock Input Capability

Clock Recovery Modules

The following modules provide a recovered clock from the data signal for triggering at standard telecommunications and enterprise data rates.

83491A Electrical Signals. Data Rates (Mb/s) 155, 622, 1063, 1250, 2125, 2488, 2500

83492A Multimode Optical. Data Rates (Mb/s) 155, 622, 1063, 1250, 2125, 2488, 2500

83493A Single-Mode Signals. Data Rates (Mb/s) 155, 622, 1250, 2488, 2500

83494A Single-Mode Signals. Data Rates (Mb/s) 155, 622, 2488; (Gb/s) 9.953

83494A-103 Single-Mode Signals. Data Rates (Mb/s) 155, 622,

2488; (Gb/s) 10.3125

83494A-106 Single-Mode Signals. Data Rates (Mb/s) 155, 622,

2488, 2666; (Gb/s) 10.664

83494A-107 Single-Mode Signals. Data Rates (Mb/s) 155, 622,

2488, 2666; (Gb/s) 10.709

Optical Connectors Options for All Optical Modules

81000AI Diamond HMS-10 Connector
81000FI FC/PC Connector
81000KI SC Connector
81000SI DIN Connector
81000VI ST Connector

Warranty Options for All Modules

Model-W30 3 Years of Customer Return Repair Service
Model-W32 3 Years of Customer Return Calibration Service
Model-W50 5 Years of Customer Return Repair Service
Model-W52 5 Years of Customer Return Calibration Service

Accessories

86100B-AX4 Rack Mount Flange Kit
86100B-AXE Rack Mount Flange Kit with Handles
86100B-UK6 Commercial Calibration Certificate with Test Data
10086A ECL Terminator
11667B Power Splitter, dc to 26.5 GHz, APC 3.5 mm
11667C Power Splitter, dc to 50 GHz, 2.4 mm
11742A-K01 50 GHz dc Blocking Capacitor
11898A 1.5 Meter Remote Extender Module
54006A 6 GHz Passive Probe
54007A 3.5 mm RF Accessory Kit
54008B 24 ns Delay Line
54121-68701 RF Accessories Kit
54701A 2.5 GHz Active Probe
83430A Lightwave Digital Source (2.5 Gb/s)
83433A 10 Gb/s Lightwave Transmitter
83434A 10 Gb/s Lightwave Receiver
83440B/C/D Optical-to-Electrical Converters (6/20/32 GHz)
83446A Lightwave Clock/Data Receiver (2.5 Gb/s)
83480A-K16 Switch Matrix
83480A-K17 Rimm Fixture
8490D-020 2.4 mm 20 dB Attenuator
86101-60005 Filler Panel
C3751-60201 Mouse
E2610-68700 Keyboard
N1020A 6 GHz TDR Probe Kit
N1025A 1 GHz Active Differential Probe

Adapters for Electrical Modules

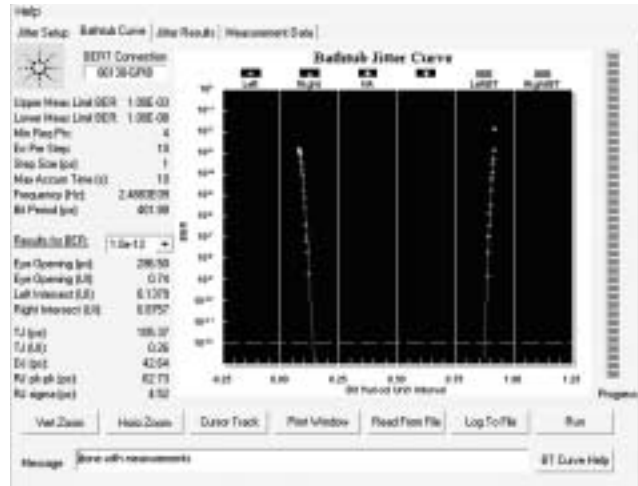
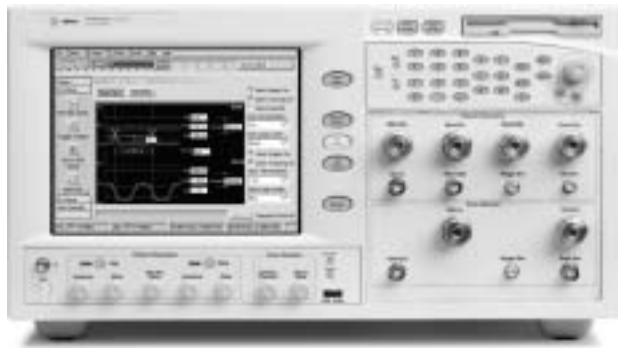
11900B 2.4 mm (f-f) Adapter
11901B 2.4 mm (f) to 3.5 mm (f) Adapter
11901C 2.4 mm (m) to 3.5 mm (f) Adapter
54124-24101 2.4 mm Termination
5061-5311 3.5 mm (f-f) Adapter
1250-1158 SMA (f-f) Adapter
1810-0118 3.5 mm Termination

Firmware and Software

Firmware and software upgrades are available. Please contact your Agilent sales representative or visit our web site at:
www.agilent.com/comms/dcaupgrade

N4906A

- 3.6 Gb/s Bit Error Ratio Tester with Bathtub Jitter and Q Factor applications
- Agilent Infiniium-like user interface simplifies setup tasks and provides faster access to both basic and advanced features
- Precise waveform shapes ensure that you're driving your device with the best possible stimulus signals



Automatically measure Total Jitter (TJ), Random Jitter (RJ), and Deterministic Jitter (DJ)

Simplifying BER Test with a Familiar Graphical Approach

The Agilent N4906A Serial BERT is a 3.6 Gb/s general-purpose bit error ratio tester designed for high-speed digital components and systems.

Leveraging the look and feel of the popular Agilent Infiniium oscilloscopes, the N4906A helps new users set up accurate measurements in less time and view them in more revealing ways. To set up test patterns, for instance, simply select an industry-standard pattern from the built-in library or edit it as needed using simple cut and paste commands.

Bathtub Jitter and Q Factor Software Included with the N4906A

BERT Scan, or Bathtub Jitter, is a test method for measuring jitter that some applications use as a standard of reference. BER is measured versus sample time and this generates a graph known as the bathtub curve. The Serial BERT's software automates the bathtub curve and Q Factor measurements and builds a database such that the test data is easily manipulated and analyzed through a friendly user interface.

Ordering Information

N4906A 3.6 Gb/s Serial BERT

Clock Source – E4422B 4 GHz synthesized signal source

- Ideal for testing high-speed digital communication ports, components, chips or modules up to 45 Gb/s
- Up to 64 parallel input and output channels at rates up to 13.5 Gb/s
- Capability to test devices up to OC-768
- Generate complex sequences & analyze data in real-time
- Modular, flexible and scalable design to fit your application needs



The ParBERT 81250 parallel bit error ratio tester provides extremely fast parallel BER testing for high-speed digital communication ports, components, chips or modules. Application Examples:

- Mux/Demux testing up to OC-768
- FEC device testing
- Multiple transmitter/receiver testing
- Characterization of SAN (Storage Area Network) ICs
- 10 GbE testing
- True differential Input and Output (SFI-4, SFI-5, Xaui, LVDS)
- Stimulus and analysis of frame based data (10GbE, SFI-5, SONET/SDH (stimulus only))

ParBERT 81250 is a modular, flexible, and scalable platform with a very comprehensive software and measurement suite, which is designed to fit your application needs.

The system generates pseudo random word sequences (PRWS), user-defined and standard PRBS up to $2^{31}-1$ on parallel lines. You can analyze bit error ratios with user-defined data, PRBS or mixed data in real-time. This enables fast parallel BER measurements – ideal for testing devices with several channels in parallel e.g. multiplexer/demultiplexer devices or SERDES.

ParBERT 81250 offers data generation and analysis with sequencing and looping so you can really stress your DUT with full parametric capabilities on every channel. Sequences can contain memory based (up to 32 Mbit) and/or PRBS/PRWS data. The system can generate data packets with header and payload, react on control signals from the DUT and offers auto-synchronization.

The ParBERT 81250 can analyze the data from the device under test with the expected data in real-time. You can view the bit error ratio whilst the measurement is running.

ParBERT 81250 can generate and analyze single-ended, low voltage and differential signals – including true differential, so you can test devices based on logic technologies such as LVDS, ECL and PECL.

The new 13.5G ParBERT Generator and Analyzer modules are the latest enhancement to the powerful ParBERT platform. With enhanced Jitter generation and analysis capabilities and its broad frequency range, the new modules are the ideal solution for testing 10 GbE and up to OC-192 devices. The new 13.5G ParBERT modules are working with the new E4809A clock module only.

- 81250A
- E4832A
- E4835A
- E4838A
- E4861B
- E4862B
- E4863B
- E4810A
- E4811A
- N4872A
- N4873A
- E4868B
- E4869B
- E4875A

Specifications

Data Modules

	E4832A	E4861A	E4861B
Maximum Frequency	675 MHz	2.7 Gb/s	3.35 Gb/s
Front End Slots per Module	4	2	2
Memory Depth per Channel	2 Mbit	8 Mbit	up to 16 Mbit
Works with Following Front Ends..	E4838A, E4835A	E4862A, E4863A, E4864A, E4865A	E4862B, E4863B
Segments PRBS, PRWS	User defined patterns and PRBS $2^n - 1, n = 7, 9, 10, 11, 15, 23, 31$		
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around a start sample delay		

Data Generator Front Ends

	E4838A	E4864A	E4862A	E4862B
Maximum Frequency	675 MHz	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Outputs	1, differential	1, differential or single ended	1, differential or single ended	1, differential or single ended
Data Format	NRZ, DNRZ, RZ, R1	NRZ, DNRZ clock: duty cycle 50% + 10% typ	NRZ, DNRZ clock: duty cycle 50% + 10% typ	NRZ, DNRZ, RZ, R1
Transition Times (20% – 80%)	0.5 to 4.5 ns (10% – 90%); (0.35 ns typical)	90 ps typical @ ECL, LVDS (110 ps typical @ Vpp max.)	90 ps typical @ ECL, LVDS (110 ps typical @ Vpp max.)	<75 ps (60 ps typical)
Amplitude/Resolution	<0.1 to 3.5 Vpp/10 mV	0.05 to 1.8 Vpp/10 mV	0.05 to 1.8 Vpp/10 mV	0.05 to 1.8 Vpp/10 mV

Data Analyzer Front Ends

	E4835A	E4865A	E4863A	E4863B
Maximum Frequency	675 MHz	1.65 Gb/s	2.7 Gb/s	3.35 Gb/s
Inputs	2, differential or single ended	1, differential or single ended	1, differential or single ended	1, differential or single ended
Impedance	50 Ω (100 Ω differential if termination voltage is switched off)	50 Ω (100 Ω differential if termination voltage is switched off)	50 Ω (100 Ω differential if termination voltage is switched off)	50 Ω (100 Ω differential if termination voltage is switched off)
Input Threshold	–2.0 to +4.5 V	–2.0 to +3.0 V	–2.0 to +3.0 V	–2.0 to +3.0 V

Dedicated Modules

	N4872A	N4873A	E4866A with N4868A	E4667A	E4868B	E4869B
Description	13.5 Gb/s Generator Module	13.5 Gb/s Analyzer Module	10.8 Gb/s Generator Module with Booster Module	10.8 Gb/s Analyzer Module	43.2 – 45 Gb/s Mux Module	43.2 – 45 Gb/s DeMux Module with CDR
Maximum Frequency	13.5 Gb/s	13.5 Gb/s	10.8 Gb/s	10.8 Gb/s	43.2 Gb/s (with E4861A + E4862A) 45 Gb/s (with E4861B + E4862B)	43.2 Gb/s (with E4861A + E4863A) 45 Gb/s (with E4861B + E4863B)
Outputs/Inputs	1, differential or single ended	1, differential or single ended	1, differential or single ended	1, differential or single ended	differential	differential
Data Format	NRZ, DNRZ	—	NRZ	—	NRZ	—
Transition Times (20% – 80%)	<25 ps (10% – 90%)	—	<20 ps (15 ps typical)	—	9 ps typical	—
Amplitude/Resolution	0.05 to 2.0 Vpp/5 mV	—	1.0 to 2.5 V/10 mV	—	0.5 to 2.0 V single ended/10 mV	—
Memory Depth per Channel	up to 64 Mbit	—	up to 32 Mbit	—	128 Mbit	—
Impedance	—	50 Ω (100 Ω differential if termination voltage is switched off)	—	50 Ω (100 Ω differential if termination voltage is switched off)	—	50 Ω
Input Threshold	—	–2.0 to +3.0 V	—	–2.0 to +3.0 V	—	±400 mV
Segments PRBS, PRWS	User defined patterns and PRBS 2 ⁿ – 1, n = 7, 10, 11, 15, 23, 31 (HW based)		User defined patterns and PRBS 2 ⁿ – 1, n = 7, 9, 10, 11, 15, 23, 31		User defined patterns and PRBS 2 ⁿ – 1, n = 7, 9, 10, 11, 15, 23, 31 (pure PRBS)	
Auto-Synchronization	On PRBS and memory based data by: – Bit synchronization with or without automatic phase alignment – Automatic delay alignment around a start sample delay					—

	E4810A	E4811A
Description	3.35 Gb/s electrical-optical Generator Module	3.35 Gb/s electrical-optical Analyzer Module
Maximum Frequency	3.35 Gb/s	3.35 Gb/s
Wavelength	830 – 860 nm 850 nm typical	750 – 1610 nm calibrated at 850 nm
Transition Times (20% – 80%)	<100 ps	—
Average Output Power Level	>–3 dBm	—
Extinction Ratio Range, Resolution, Accuracy	5 to 10 dB, 0.5 dB, ±1 dB	—
Analog Bandwidth	—	>6 GHz
Sensitivity (smallest average power for mask test)	—	–9 dBm
Other Electrical Specifications	same as E4861B, E4862B	same as E4861B, E4863B

Clock Modules

	E4805B	E4808A	E4809A
Frequency Range	1 kHz to 667 MHz	170 kHz to 675 MHz	20.8 MHz to 13.5 GHz
Resolution	1 Hz	1 Hz	1 Hz
Accuracy	±50 ppm with internal PLL reference	±50 ppm with internal PLL reference	±50 ppm with internal PLL reference
Clock Jitter	<10 ps rms (5 ps typical)	<10 ps rms (5 ps typical)	~2ps rms

Accessories

See Ordering Information

Key Literature & Web Link

Agilent ParBERT 81250 Parallel Bit Error Ratio Tester, Product Overview (5968-9188E)
Need to Test 40 Gb/s, Brochure (5988-2038EN)

www.agilent.com/find/ParBERT

Ordering Information

81250A Parallel Bit Error Ratio Tester
81250A-013 IEEE 1394 PC link to VXI (Firewire)
81250A-014 External PC for IEEE 1394 (firewire) link to VXI
81250A-015 Notebook Controller P4, 256 MB Ram, 20 GB HDD, Windows 2000, IEEE1394
81250A-149 Mainframe
81250A-150 1st Expander Frame
81250A-151 2nd Expander Frame
81250A-152 Expander Frame with IEEE 1394 connection – for Firewire controller only
81250A-020 Rack
E4875A ParBERT 81250 User Software
E4805B 2.7 GHz Central Clock Module
E4808A 10.8 GHz High Performance Central Clock Module
E4809A 13.5 GHz Central Clock Module
E4838A 333 kHz – 675 MHz Data Generator Front End
E4835A Two 333 kHz – 675 MHz Data Analyzer Front Ends
E4832A 675 MHz Module for 4*E4838A, 2*E4835 or 2*E4838 + 1*E4835
E4862A 334 MHz – 2.7 Gbit/s Generator front end
E4863A 334 MHz – 2.7 Gsa/s Analyzer front end
E4861A 2.75 Gbit/s Module for 2 front ends
E4864A 1.65G Generator Front-end
E4865A 1.65G Analyzer Front-end
E4861B 3.35 Gbit/s Generator/Analyzer Module

E4862B 3.35 Gbit/s Generator Front End	81250A
E4863B 3.35 Gbit/s Analyzer Front End	E4832A
E4866A 9.5 Gbit/s – 10.8 Gbit/s Data Generator	E4835A
E4867A 9.5 Gbit/s – 10.8 Gbit/s Data Analyzer	E4838A
N4869A Cable kit: 3 cables (SMA) and phase shifter 50 ps	E4861B
N4870A Cable kit: 2.4 mm matched pair, 10 ps	E4862B
N4868A Booster module with differential/2 single ended outputs	E4863B
N4868A-001 add 1 differential/2 single ended outputs	E4810A
N4872A 13.5 Gb/s Generator Module	E4811A
N4873A 13.5 Gb/s Analyzer Module	N4872A
N4910A 2.4 mm Matched Cable Pair	N4873A
E4868B 43G Multiplexer Module	E4868B
E4869B 43G Demultiplexer Module	E4869B
E4810A 3.35 Gbit/s Optical-Electrical Generator Module	E4875A
E4810A-001 Optical Output 850 nm	
E4811A 3.35 Gbit/s Optical-Electrical Analyzer Module	
E4811A-001 Optical input calibrated at 850 nm	
81250A-ACCS Accessories	
15432B 250 ps transition converter	
15433B 500 ps transition converter	
15434B 1 NS transition converter	
15438A 2 NS transition converter	
15440A Adapter kit: 4* SMA(m) adapters	
15441A Cable kit 10* SMA(m) to SCl-connector	
15442A Cable kit 4* SMA(m) to SMA(m)	
15443A Matched Cable Pair	
15444A PC accessories (keyboard,mouse, 17" monitor)	
15445A External CD-ROM	
15446A 8-Line trigger input for TTL signals	
15447A Deskew probe	
81250A-AX4 Rack Flange Kit for one frame	
15448A Pogo cables kit: 4* SMA(m) and 2 Pogo adapter	
15449A DUT board 50 Ohm impedance	
81250A-OPTCONNECT Optical Connectors	
81000AI Connector interface Diamond HMS-10	
81000FI Connector interface FC/PC/SPC	
81000GI Connector Interface NEC D4	
81000VI Connector interface ST	
81000KI Connector interface SC	
81250A-DOC Documentation	
81250A-0B1 Tutorial CD ROM and Installation Guide	
R1380A-101 Productivity assistance	

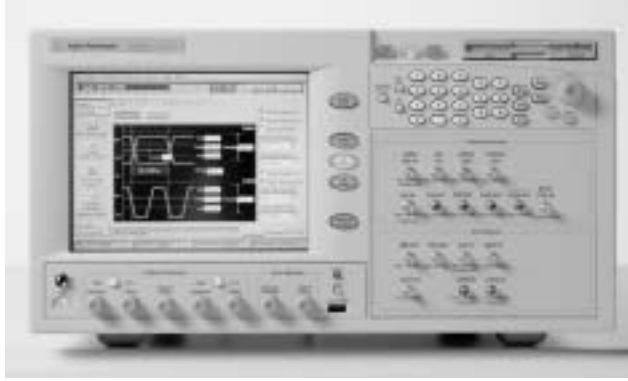
Serial Bit Error Ratio Tester

452

Serial BERT 13.5 Gb/s (N4901A) and 7 Gb/s (N4902A)

N4901A
N4902A

- Operating from 150 Mb/s up to 13.5 Gb/s or 7 Gb/s (N4902A)
- Superior ease-of-use concept with an intuitive user interface
- Excellent pulse performance
- True differential data generation and analysis capability
- Enhanced Jitter capabilities
- Integrated Clock Data Recovery
- Application oriented software suite



Serial BERT 13.5 Gb/s & 7 Gb/s are frequency agile and easy-to-use Serial Bit Error Ratio Test solutions with a very comprehensive software and measurement suite, which is designed to fit your application needs. In addition to the industry-leading usability concept, the Serial BERT 13.5 Gb/s & 7 Gb/s help to lower overall cost-of-test through a comprehensive set of features and capabilities such as true differential data generation and analysis capabilities, enhanced Jitter functionality and an integrated clock data recovery.

The Serial BERT 13.5 Gb/s & 7 Gb/s are the ideal solutions for R&D and Manufacturing engineers in the computation and communication industry, who are designing, characterizing and testing components, chips and modules for up to OC-192, 10GbE, Backplane, Common Electrical Interfaces (CEI), high-speed communication ports and 10G FC applications.

With the superior pulse performance, low intrinsic jitter and true differential capabilities, the Serial BERT 13.5 Gb/s & 7 Gb/s are the cost efficient and versatile high performance solutions addressing numerous technologies (e.g. LVDS, ECL,...) and applications in the datacom and telecom market.

In order to ensure long-term security of capital invested, the N4902A Serial BERT 7 Gb/s is upgradeable to the N4901A Serial BERT 13.5 Gb/s.

Typical Specifications

Pattern Generator:

Operation Range

- Internal clock: 500 Mb/s – 13.5 Gb/s or 7 Gb/s (N4902A)
- External clock: 150 Mb/s – 13.5 Gb/s or 7 Gb/s (N4902A)

Data Output

1, differential or single-ended

Output Amplitude

0.05 V_{pp} – 2.0 V_{pp}

Jitter

<7 ps pp

Transition Time

<25 ps

Cross Point Adjust

20% – 80%

Error Detector:

Operation Range

- Internal clock: 500 Mb/s – 13.5 Gb/s or 7 Gb/s (N4902A)
- External clock: 150 Mb/s – 13.5 Gb/s or 7 Gb/s (N4902A)

Data Input

1, differential or single-ended

Delay adjust

1.5 ns

Clock Data Recovery

- 3G range: 2.45 to 3.21 GHz
- 6G range: 4.9 to 6.42 GHz
- 10G range: 9.9 to 10.9 GHz (N4901A only)

Sensitivity

<50 mV

Accessories

N4910A 2.4 mm Matched Cable Pair

Key Literature & Web Link

www.agilent.com/find/N4900_Series

Ordering Information

N4901A Serial BERT 13.5 Gb/s

N4901A-100 Pattern Generator & Error Detector

N4901A-200 Pattern Generator only

N4901A-300 Error Detector only

N4902A Serial BERT 7 Gb/s

N4902A-100 Pattern Generator & Error Detector

N4902A-200 Pattern Generator only

N4902A-300 Error Detector only

12

- All optical jitter and wander testing, 52 Mb/s to 10.71 Gb/s, including ITU-T G.709 OTU-2
- Exceeds ITU-T O.172 specification for jitter and wander measuring equipment, providing more margin for device designs
- Fully programmable user masks for jitter tolerance and jitter transfer measurements
- External modulation input and demodulated output
- Unique parallel measurement filter architecture speeds testing and event correlation



Agilent OmniBER OTN Jitter Analyzer

Eliminate Inconsistent Jitter Test Results

When making jitter measurements, you need to have confidence in your test results. Agilent's J7231B OmniBER OTN Jitter Analyzer now provides high-accuracy jitter testing up to 10 Gb/s for both SONET/SDH and ITU-T G.709 optical channel line rates, including OTU-2 at 10.71 Gb/s. Exhibiting ultra-low and stable intrinsic jitter characteristics, it significantly exceeds the test equipment specification ITU-T O.172, giving you extra margin to develop and test components, line cards and systems to the Telcordia GR-253 and ITU-T G.783 standards. The J7231B is also able to detect and measure short jitter transients, ensuring that no potential problem goes unnoticed.

Reduce Jitter Test Times by Up to a Factor of Five

For rapid jitter measurements, the OmniBER OTN Jitter Analyzer has five digital filters, each with their own peak detector for parallel measurement processing. This leads to better correlation of events, and more consistent results. And, it's available at all optical rates.

A Single-Box Solution for all your Jitter Testing

The OmniBER OTN Jitter Analyzer offers jitter/wander generation, jitter/wander measurement, plus automatic jitter tolerance measurements to check the ability of your device's clock circuits to recover incoming bit sequences correctly in the presence of jitter. The analyzer also provides automatic jitter transfer measurements to assess jitter amplification. This is vital in line systems where systematic jitter gain can accumulate to cause transmission errors.

Furthermore, the analyzer's jitter masks are more flexible than ever, and are ideal for design applications through to production where tailor-made masks can be applied.

Key Capability

Optical Interfaces

Transmitter and receiver cover all rates from 1.5 Mb/s through 10 Gb/s (DS1 to OC-192/STM-64). In addition, the transmit and receive interfaces support optical channel functionality at 10.71 Gb/s (OTU-2) to ITU-T G.709

Flexible Signal Levels

Structure SONET/SDH up to 10 Gb/s (OC-192/STM-64). Unframed PRBS capability at all rates

Output Triggers for Transmitter and Receiver Alarms and Errors

Generation of Mixed Mappings

Error and Alarm Generation

Alarm Stress Test

OTU-2 Frame Capture

Ordering Information

J7231B OmniBER OTN Jitter Analyzer

J7231B-004 Mainframe – Side mounted connectors

J7231B-005 Mainframe – Rear mounted connectors

J7231B-104 52-2488 Mb/s multi-rate optics 1310 nm

J7231B-105 52-2488 Mb/s multi-rate optics 1550 nm

J7231B-106 52-2488 Mb/s multi-rate optics 1310/1550 nm

J7231B-108 10 Gb/s optics 1550 nm

J7231B-112 ITU-T G.709 OTU-2 testing at 10.71 Gb/s

J7232A

- Provides comprehensive generation and analysis of data over SONET/SDH structures including:
 - Ethernet payload analysis
 - GFP and LAPS encapsulation procedures
- Provides support for the arbitrary concatenations of STS-6c/AU-4-2c, STS-9c/AU-4-3c and STS-24c/AU-4-8c
- Simulates realistic network conditions using mixed payload mappings



Agilent OmniBER OTN 2.5 Gb/s Communications Performance Analyzer

Ensure Standards Compliance for your Next Generation SONET/SDH Products

As telecom and datacom networks merge, next-generation bandwidth-efficient devices need to be created for the network. This, of course, presents new test challenges to ensure standards compliance and data (eg. Ethernet) over SONET/SDH transport interoperability.

A range of tests are also needed to verify the basic operation of the network element, such as error free transmission, basic error and alarm handling, and the correct configuration of specific operating characteristics such as individual payload mapping/de-mapping, path provisioning and protection switching. This job is made more difficult by the need to track and correctly interpret the new and evolving standards such as the ITU-T G.7041 for Generic Framing Procedure (GFP) and the ITU-T X.86 for Link Access Procedure for SDH (LAPS).

Industry's First Compliant SONET/SDH Test Capability for Ethernet Payloads, GFP and LAPS

The J7232A OmniBER OTN 2.5 Gb/s analyzer is the industry's first analyzer to test the mapping of Ethernet into SONET/SDH according to ITU-T G.7041 GFP and ITU-T X.86 LAPS encapsulation procedures. The analyzer also supports the new data over SONET/SDH arbitrary contiguous concatenations of STS-6c/AU-4-2c, STS-9c/AU-4-3c and STS-24c/AU-4-8c.

This comprehensive combination of data over SONET/SDH, encapsulation and concatenation support means you can comprehensively test next generation SONET/SDH devices and equipment. The independent verification of your devices and equipment against the new standards provides greater confidence of interoperability with other vendors data over SONET/SDH equipment.

Key Capability

Transmitter and receiver cover all rates from 1.5 Mb/s through 2.5 Gb/s (52 Mb/s to 2.5 Gb/s optical interfaces)
Access to all relevant GFP/LAPS bytes
Stress test capability for ITU-T G.7041 and ITU-T X.86
Complete test coverage for contiguous and arbitrary concatenation of STS-3c/AU-4, STS-6c/AU-4-2c, STS-9c/AU-4-3c, STS-12c/AU-4-4c, STS-24c/AU-4-8c and STS-48c/AU-4-16c

Ordering Information

J7232A OmniBER OTN Communications, Performance Analyzer

J7232A-004 Mainframe – side mounted connectors

J7232A-005 Mainframe – rear mounted connectors

J7232A-012 PDH/T Carrier test (1.5 – 140 Mb/s)

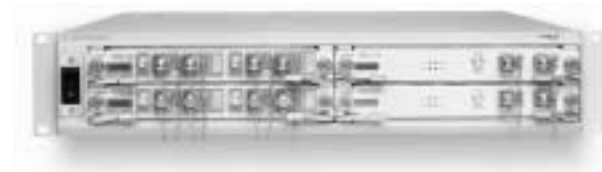
J7232A-104 52 – 2488 Mb/s multi-rate optics 1310 nm

J7232A-105 52 – 2488 Mb/s multi-rate optics 1550 nm

J7232A-106 52 – 2488 Mb/s multi-rate optics, 1310/1550 nm

J7232A-320 Data over SONET/SDH test support (eg. GFP/LAPS and Ethernet payload analysis)

- Measure BER and inject error/alarm bursts on all SONET/SDH channels, on all ports, simultaneously
- Generate fully mixed SONET/SDH, multi-channel, payload structures, including support for next generation SONET/SDH mappings of STS-6c/AU4-2c, STS-9c/AU-4-3c and STS-24c/AU-4-8c
- Stimulate and measure (automatic protection) switch times on all channels and on all ports simultaneously
- Verify (post protection switched) path connectivity on all channels and on all ports simultaneously



Agilent OmniBER XM Network Simulator

Uncompromising System Verification

Agilent's OmniBER XM network simulator transforms system verification testing, reducing time-to-market and improving quality, by enabling you to accurately re-create (stimulate and measure) real network conditions for the first time. Uncompromised testing of today's and tomorrow's network elements – whose integrated functionality present a new set of challenges – the OmniBER XM allows tests to be conducted simultaneously through the tester's multi-channel, multi-port, multi-user test capability. Contained in a compact, modular, scalable and low cost form factor, the OmniBER XM provides true network simulation, enabling you to discover your network element's behavior before your customers do!

Thoroughly and Quickly Verify BER Switching and Connectivity Performance of Next Generation Equipment

The OmniBER XM network simulator can generate realistic SONET/SDH network signals using mixed payloads, with errors and alarms on up to 192 channels simultaneously. This replicates real network conditions to truly stress-test network elements, and increases the effectiveness of verification test. The OmniBER XM simultaneously measures each SONET/SDH channel for relevant errors, alarms, and bit error ratio (BER), and includes intrusive thru-mode capability. Next generation equipment APS operation (Automatic Protection Switching) can also now be thoroughly characterized with switching times, and correct connectivity, of all channels able to be measured simultaneously.

The OmniBER XM network simulator uses industry standard SCPI commands and TeL drivers as its application programming interface. Alternatively, log on with any application programming interface that sends and receives ASCII command strings over TCP/IP.

Key Capability

- Automatic discovery of payload structure to quickly setup your equipment to make measurements
- Simultaneous multi-channel service disruption measurements – vital when evaluating path protection switches
- Simultaneous multi-channel error and alarm injection in terminal mode and thru mode
- Error and alarm burst capability to accurately verify the performance monitoring capability of your network elements
- Simultaneous multi-channel connectivity check to test circuit provisioning in seconds

Ordering Information

- J7241A OmniBER XM OC-192/STM-64, Transceiver Module 1550 nm
- J7242A OmniBER XM OC-192/STM-64, Transceiver Module 1310 nm
- J7244A OmniBER XM Up to OC-48/STM-16, Dual Transceiver Module 1550 nm
- J7245A OmniBER XM Up to OC-48/STM-16, Dual Transceiver Module 1310 nm
- J7247A OmniBER XM Up to OC-12/STM-4, Dual Transceiver Module 1310 nm
- J7263A OmniBER XM 4 Slot Chassis
- J7258A OmniBER XM High Performance System, Controller (rack-mountable)
- J7259A OmniBER XM System Controller (rack-mountable)

J7230C

- Simulates realistic network conditions using structured SONET/SDH and optical channel signals from STS-1/AU-3 to STS-768c/AU-4-256c
- Offers ITU-T G.709 compliant OTU-3 testing with powerful in-depth FEC analysis
- Provides overhead overwrite for both SONET/SDH and ITU-T G.709 optical channel at 40/43 Gb/s
- Ensures device under test conformance to both ITU-T G.709 (OTN) and Telcordia GR-253/ITU-T G.707 standards with a single instrument



Agilent OmniBER OTN 40 Gb/s Communications Performance Analyzer

Structured SONET/SDH and G.709 Optical Channel Test to 43 Gb/s

Agilent's OmniBER OTN 40 Gb/s communications performance analyzer is the first to enable you to develop and qualify 40 Gb/s and 43 Gb/s line-cards, modules and systems to ITU-T G.709 (OTN) and Telcordia GR-253/ITU-T G.707 (SONET/SDH) industry standards in a single box.

It's equipped with all the standard telecom line rates from 52 Mb/s to 43 Gb/s, including 10.71 Gb/s (OTU-2) and 43 Gb/s (OTU-3) optical channel, making it the complete solution for testing SONET/SDH and next generation G.709 OTN devices and equipment.

What's more, its leading edge capability includes OTU-3 enhanced forward error correction (FEC) analysis, overhead overwrite and intrusive thru-mode for both SONET/SDH and optical channel at 40 Gb/s and 43 Gb/s. Capability that is as indispensable as it is convenient.

Optimized to Test Mixed Payloads, Error Thresholds, and Overhead Bytes

The analyzer's ability to generate structured SONET/SDH and optical channel signals and apply these to aggregation devices allows you to quickly validate device operation for conformance to Telcordia and ITU-T standards. It's extensive SONET/SDH and ITU-T G.709 test capability includes all-channel measurements down to STS-1/AU-3 for fast design confirmation and confidence in the performance of the device under test. Unframed signals up to OC-768/STM-256 can also be generated. And with direct access to overhead bytes, you can stress test devices in termination and thru-mode to verify interoperability between network elements.

Key Capability

Optical Interfaces

Transmitter and receiver cover all rates from 52 Mb/s through 40 Gb/s. In addition, the transmit and receive interfaces support optical channel functionality at 10.71 Gb/s (OTU-2) and 43 Gb/s (OTU-3) to ITU-T G.709

Flexible Signal Levels

Structure SONET/SDH up to 43 Gb/s (STS-768c/AU-4-256c). Unframed PRBS capability at all rates. Optional optical channel at 10.71 Gb/s (OTU-2) and 43 Gb/s (OTU-3) to ITU-T G.709

Output Triggers for Transmitter and Receiver

Generation of Mixed Mappings

Error and Alarm Generation; Alarm Stress Test

OTU-2 and OTU-3 Frame Capture

Overhead Sequence Generation and Capture

Text Set-up and Monitoring of Optical Channel and SONET/SDH

Overhead labels

Ordering Information

J7230C OmniBER OTN Communications Performance Analyzer

J7230C-004 Mainframe – side mounted connectors

J7230C-005 Mainframe – rear mounted connectors

J7230C-104 52 – 2488 Mb/s multi-rate optics 1310 nm

J7230C-105 52 – 2488 Mb/s multi-rate optics 1550 nm

J7230C-106 52 – 2488 Mb/s multi-rate optics 1310/1550 nm

J7230C-108 10 Gb/s optics 1550 nm

J7230C-112 ITU-T G.709 OTU-2 testing at 10.71 Gb/s

J7230C-113 ITU-T G.709 OTU-3 testing at 43 Gb/s

J7230C-118 SONET/SDH optical testing at 40 Gb/s (1550 nm)

with structured test to 52 Mb/s

- **General Feature Summary**
 - Dedicated software for Cellular, PCS/GSM, GPRS, UMTS, cdma2000 and SS7 signaling networks
 - Windows 98® based operation
 - Multitasking applications (protocol analysis, statistics, call trace)
 - Real-time or post-capture analysis
 - Connect to up to 16 duplex physical bearers (E1 or T1, DS0, V.35, RS-232, RS-449)
 - Analyze up to 32 duplex signaling links (8, 16, 32, 48, 56, and 64 kb/s)
 - Analyze full duplex Ethernet/Fast Ethernet GSM sub-rate signaling (8, 16, 32 Kb/s) and TRAU decode support
 - Analyze ATM signaling links, including Iu, Iub and Iur for W-CDMA UMTS (E1/T1 ATM and STM-1/OC-3 ATM)
 - Monitor up to 4 full rate GPRS Gb duplex bearers
 - Monitor up to 3 full rate high speed SS7 bearers
- **Monitoring Features**
 - Graphical call trace with filters and alarms
 - User-configurable columnized traffic overview and columnized color coded, protocol decodes
 - Graphical (or tabular) time-based statistics with thresholds
 - Automatic message and sequence validation
 - Point code interpretation
 - Storage of captured data and configurations to disk
 - Timestamping up to 12 microsecond resolution
 - Remote Control
 - Network Analyzer protocol analyzers, acceSS7 monitoring system and Agilent 37900D signaling test set
 - Export data to CSV file for further 'off-site' analysis
- **EmuLite Features**
 - Automatic test creation – copy messages and their sequence from call trace
 - Graphical editor – quickly create messages – no more programming
 - Intelligent protocol field-based editor – correctly build complex signaling messages – not just in hex
 - Intelligent built in test manager – easily manage the execution of tests
 - Graphical analysis tools – instantly identify failed tests and why they failed
 - Easily verified network element responses
 - Test all non-IP based GPRS interfaces
 - Test SS7, GSM, GPRS, IS-41, CDMA, ISDN plus many more



37907A
E7577A
E7578A
E7571A
E7572A
E7573A
E7574A
E7575A

The Signaling Advisor provides detailed test and analysis capabilities for signaling on modern wireless and wire-line telephone networks such as SS7, Cellular, PCS, GSM and GPRS networks. It provides robust and reliable measurements and analysis that go beyond decoding and filtering data.

The Signaling Advisor mainframe is a robust dispatched troubleshooting tool. Add any appropriate optional decodes and link interface modules, and you are ready to test across multiple links involving different protocol standards for example, at access network interfaces. At the core of each Signaling Advisor, the intuitive graphical user interface makes measuring and understanding results easier for signaling engineers, enabling them to check performance and trouble-shoot problems in signaling systems quickly and accurately.

A range of link interface modules (LIMs) provide the physical interface to network equipment. Each LIM connects to one type of physical interface (e.g., E1 or T1), providing access to all signaling links on up to four bidirectional bearers. The mainframe supports two LIMs (eight bidirectional bearers). An optional undercradle expands capacity to four LIMs (16 bidirectional bearers).

The architecture of the software and mainframe makes it easy for you to keep up with changing technologies and data rates, minimizing the need to replace equipment. Simply add a LIM or decode to bring your instrument in line with new needs.

EmuLite is a software option which allows the Signaling Advisor to be upgraded to a fully integrated monitor and emulation solution. EmuLite creates and executes tests faster through use of its graphical message and sequence editors. This allows engineers more time to diagnose signaling problems without the need for programming.

37907A
E7577A
E7578A
E7571A
E7572A
E7573A
E7574A
E7575A

Specifications

37907A Signaling Advisor Mainframe
Number of LIM slots available: 2
Processing capacity: Up to 32 duplex signaling links (64 kb/s at 1 erlang)
Telephone handset connector: RJ11
Physical dimensions: L x W x H (mm): 310 x 310 x 100
Weight: 7 kg
Volume: 10 liters
Power: 100 – 120 Vac ± 10%, 220 – 240 Vac ± 10%, 50 – 60 Hz, 110 VA max.

Operating Conditions

- **Temperature:**
 - **Operating:** +5°C to +40°C (+41°F to +104°F)
 - **Non-operating:** –25°C to +60°C (–13°F to +140°F)
- **Humidity:**
 - **Operating:** 20% to 80% relative humidity
 - **Non-condensing To 40°C. Storage:** 10% to 90% relative humidity to 60°C
- **Altitude:**
 - **Operation:** 4,575 meters (15,000 feet); Storage 15,250 meters (50,000 feet).

Safety Conditions

This instrument is designed for indoor use. Safety class I

Specifications for Mainframe

Integrated PC (minimum specification)
Processor: Intel Pentium or equivalent.
Clock speed: 400 MHz (min).
RAM: 256 MB.
Hard disk: 6 GB IDE (min).
Floppy drive: 3.5 inch, 1.44 MB DOS format.
Display: 10.4 inch LCD color SVGA (active matrix TFT).
Pointing device: Integrated mouse (external serial mouse also supplied as standard).
Operating system: MS Windows98
External interfaces
Video output: SVGA, 800 x 600 resolution
Printer: Parallel port
Serial: RS-232-C
PCMCIA PC cards: Slots for one type III or two type II

Accessories

Manuals
 Cable and Adapters
 Vendor variants protocol support kits

Key Literature & Web Link

37907A Signaling Advisor
 2/2.5G Mobile and SS7 test equipment dedicated to testing and analyzing the signaling paths that control today's complex fixed and mobile telecommunication networks. Refer to Web Link
37908A Software for the 37907A Signaling Advisor Mainframe
 The SS7 Signaling Advisor is a software application designed to run on a dedicated mainframe. Refer to Web Link
Product Roadmap: Signaling Advisor Product Overview
 The Agilent Technologies Signaling Advisor is a comprehensive and powerful test and troubleshooting instrument. It enables the user to find problems in today's complex wireless and wire-line telephone networks faster. (5988-4930EN)
Configuration Guide: Signaling Advisor Configuration Guide
 The Signaling Advisor family consists of a series of solutions targeted at key signaling applications (SS7, GSM/GPRS and cellular/PCS). (5988-4929EN)
Technical Specifications: Signaling Advisor Technical Specifications
 The Signaling Advisor is a software application designed to run on a dedicated mainframe. The resulting instrument simplifies assessment of signaling performance and trends. (5988-5330EN)
Product Note: Emulite Product Note
 Creating Emulation Tests in a Graphical Environment (5988-0944EN)
Product Note: Configuring the Signaling Advisor
 The Agilent Technologies Signaling Advisor is a flexible, easy to use protocol analyzer that can help make a significant difference to your test methods. (5988-3017EN)
<http://www.agilent.com/comms/XPI>

Ordering Information

37907A Signaling Advisor mainframe
E7577A Link expansion undercradle
E7578A Fast Ethernet Undercradle for 10/100 Mb/s Ethernet
E7571A E1 balanced link interface module
E7572A E1 unbalanced link interface module
E7573A T1 link interface module
E7574A V.35 link interface module
E7575A DS0/DS0A link interface module

- Generate wire-speed traffic between multiple combinations of test ports
- Easy to perform comparative throughput, latency and loss measurements between streams in real time
- Protocol emulation that easily exceed the performance of your system under test
- Use RouterTester's automated conformance test suites to rapidly gain confidence in protocol implementations



RT 2 Slot Chassis

Agilent Technologies' RouterTester 900 is the industry's most scalable and realistic multi-port traffic generation, protocol emulation and performance-analysis test system for verifying the performance of data networking devices. RouterTester 900 offers unparalleled IPv4 and IPv6 traffic generation and analysis capabilities over a wide range of interfaces, including POS, ATM and Ethernet. RouterTester 900's automated test tools and easy to use GUI make it simple to configure realistic traffic, build large test configurations and perform QoS measurements quickly on your system under test SUT.

Specifications

RouterTester System Elements

System Controller: A number of system controllers are available depending on performance requirements. The controller provides an easy-to-use Windows™ environment.

RouterTester 900 Chassis: Users can easily daisy chain up to 30 racks of RouterTester Chassis to create the industry's highest density of test ports. A smaller, lightweight chassis is also available for portable or desktop testing.

Routing Test Cards: The Agilent Routing Test Cards are designed to fully integrate powerful traffic generation and analysis capabilities with realistic emulation of routing and signaling protocols including BGP, OSPF, ISIS and RIP and the latest MPLS protocols, including RSVP-TE, LDP/CR-LDP, L2oMPLS (Martini), VPLS, and Multicast.

Packet Test Cards: Agilent Technologies' Packet Test Cards are designed specifically for packet blasting test applications. They provide highly scalable traffic generation and analysis capabilities for verifying the performance of data networking devices and do not support routing or signaling protocols.

Agilent's Automated QuickTest Script Library: Based on test cases published in "The Journal of Internet Test Methodologies", the QuickTest script library contains automated tests that will help you perform in-depth performance analysis quickly and easily.

Key Literature & Web Link

For more information, visit our web site:
www.agilent.com/comms/routertester

Ordering Information

A RouterTester system consists of:

Chassis

Interface cards

Software (including protocol emulation and conformance) options

PC Controller

For details of the options in each category please contact your local Agilent representative.

E7900A
 E7912A
 E7922A
 E7906A
 E7919A
 E7920A
 E7907A
 E7917A
 E7909A
 E7317B
 E7318B
 E7849A

1730B

- Expandable, modular system architecture
- User-controlled, multi-port Fibre Channel traffic generation at full wire speed with extensive parametric controls over both data and fabric service plane
- Time-correlated traffic generation and measurement
- Real-time measurement and analysis
- Test customization and automation



The Agilent 1730 Series SAN test system ensures that the components in a Fibre Channel SAN solution work together properly.

The SAN test system is a scalable and comprehensive solution that provides the controlled Fibre Channel traffic generation and measurement environment necessary for testing performance and robustness of complex SAN systems before deployment. The 1 Gb/s or 2 Gb/s Fibre Channel configurable Ports can stimulate and measure your system with a wide range of traffic conditions, including line speed data traffic, deterministic error conditions and disruptive port state events.

Storage Area Network Equipment Test Challenges

12

Subsystem Design and Debug

Test your Design Subsystems

Parametric control of traffic generation helps test the robustness of hardware and embedded software.

Identify Elusive Design Problems

With the help of user-definable traffic generation, advanced triggering capabilities, and protocol analysis, detecting and reproducing problems is quick and easy.

Emulate Multi-Protocol Layers

Testing at different Fibre Channel protocol layers with user-definable control traffic can accelerate validation tasks.

Functional Test

Measure Conformance to Network Standards and Performance Requirements

Realistic SAN traffic conditions in the test environment help to ensure system conformance with network standards.

Update Regression Tests

An automated test environment using a standard scripting language minimizes the effort required for maintaining regression test suites.

Identify Performance Boundary Conditions for Each Functional Block

Stressing a device under test (DUT) with complex SAN traffic helps to identify possible breaking points.

System Integration and Validation

Analyze the Causes of Fabric Failure

The ability to configure data, fabric controller, and fabric server traffic in a synchronized fashion to create specific traffic conditions saves time and resources.

Integrate Multi-Vendor Components

Integration requires intensive interoperability and scalability tests using full-rate data traffic, error injection, fabric controller stressing, fabric server stressing, and more.

Validate Large-Scale Fabric Configurations

Ensuring that the expandability of your test environment is aligned with your customer's scalability requirements reduces this challenge.

Manufacturing and Production Test

Increase Test Efficiency

A friendly graphical user interface (GUI) and a configurable, automated functional test suite greatly improve testing efficiency.

Technical Specifications

Physical Interface

Number of Ports

Four independent Fibre Channel ports per test card, four test cards per chassis

Line Rate

1.0625 or 2.125 Gigabits/second (Gb/s), Full Duplex with configurable inter-frame gap; Industry Standard SFP Interface. Shipped with 850 nM SFP

Measurement System

Measurements

24 real-time measurements including Throughput, Latency, Dropped frames, Disparity, B2B

Result Types

- Cumulative: measurements are reported from the start of the measurement interval
- Sampled: measurements are reported from the most recently completed sampling interval

Measurement Clock Resolution

10 ns resolution; ± 0.5 ppm/year clock drift; 3 ppm maximum difference between cards

Measurement Interval

Range: 1 second to 7 days

Display Sampling Interval

Range: 1 second to 1 hour

Test Card Synchronization

All measurements are synchronized across all test cards within the SAN test system

System Capability

16 test ports per 2U test chassis; 20 test chassis in up to 3 test racks maximum

Capture Memory

32 MB per port

Buffer to Buffer Credit

Adjustable from 1 to 256

Measurement System Traffic Generation

Rate

Full line speed rate

Classes of Service

Class 2 and Class 3 traffic, plus additional traffic capabilities

Traffic Profiles

15

Traffic Streams per Port

256

Oversized Frame

Oversized frames will be captured in the trace buffer, but they will be cut off at 2136 bytes and flagged as oversized and invalid

Inter-Frame Gap

Adjustable from 3 to 1000

Minimum Frame Length

Transmitted: 24 bytes; Received: 24 bytes

Error Generation

Aborted Frame, CRC Error, Oversized Frame, Wrong SOF, Wrong EOF

Fabric Service Test

- Zone test
- Name server performance
- Name server command coverage
- State change notification

Programming Languages

Tcl/Tk with graphical interface

Mechanical Specifications**Physical (per card)**

- Width: 8.11 inches/206 mm
- Depth: 12.32 inches/313 mm
- Height: 1.18 inches/30 mm
- Weight: 875 g

Electrical (per card)

Power consumption: 32 W typical; 110 W maximum (8 W per port)

Environmental

- Operating temperature: 0°C to 40°C
- Storage temperature: -40°C to 70°C
- Humidity: 50% to 95% relative humidity at 5°C to 40°C

Instrument Test Card Front Panel LED Indicators**Status**

Four-digit display to indicate card status and numeric identification

LASR

Red when output laser is on

SGNL

Green when a port state machine has gone to active state (link up)

System Controller***Host Controller**

650 MHz Pentium® III or faster

Minimum System

At least 256 MB memory

Requirement

At least 400 MB free hard-drive space. 10BaseT/100BaseT LAN connection (100BaseT recommended for large port count)

*Several system controllers are available, depending on performance requirements.

Key Literature

Agilent Technologies 1730 Series Storage, Area Network (SAN) Test Solutions, Color Brochure, 5988-6806EN
Storage Area Network (SAN) Test System, Data Sheet, 5988-7227EN

Ordering Information**Test Cards**

1730A Agilent SAN test card (traffic generation and analysis) 4 ports, 1 Gb/s Fibre Channel. Includes 850 nM SFP

1730B Agilent SAN test card (traffic generation and analysis) 4 ports, 1 and 2 Gb/s Fibre Channel. Includes 850 nM SFP

Chassis

E7900A 4-slot, 2U-high chassis (same as the Agilent Router 900 chassis)

Controller**E7891C-120**

Portable laptop system controller

Pentium 1 GHz, 256 MB RAM, 1 LAN port, includes switch

SW instant ignition for 1730x

E7892C-120

Standard 1U rackmount server controller

Pentium 1.13 GHz, 512 MB RAM, 2 LAN cards, includes switch

SW instant ignition for 1730x

E7893C-120

High-performance 1U rackmount server controller

Pentium 1.13 GHz twin processor, 2 GB RAM, 2 LAN cards, includes switch

SW instant ignition for 1730x

Option AQ2 15 inch flat panel display, 1024 x 768

Software License

1731A PC controller software and license (Necessary to operate software on the Controller)

1732A Software Enhancement Service (one year of software upgrades)

Accessories

E7900-64207 Chassis-to-chassis cable (Required for multi-chassis configuration)

E7900-64208 Rack-to-rack cable (Required for multi-rack configuration)

E7900-80002 Transit case

1730B

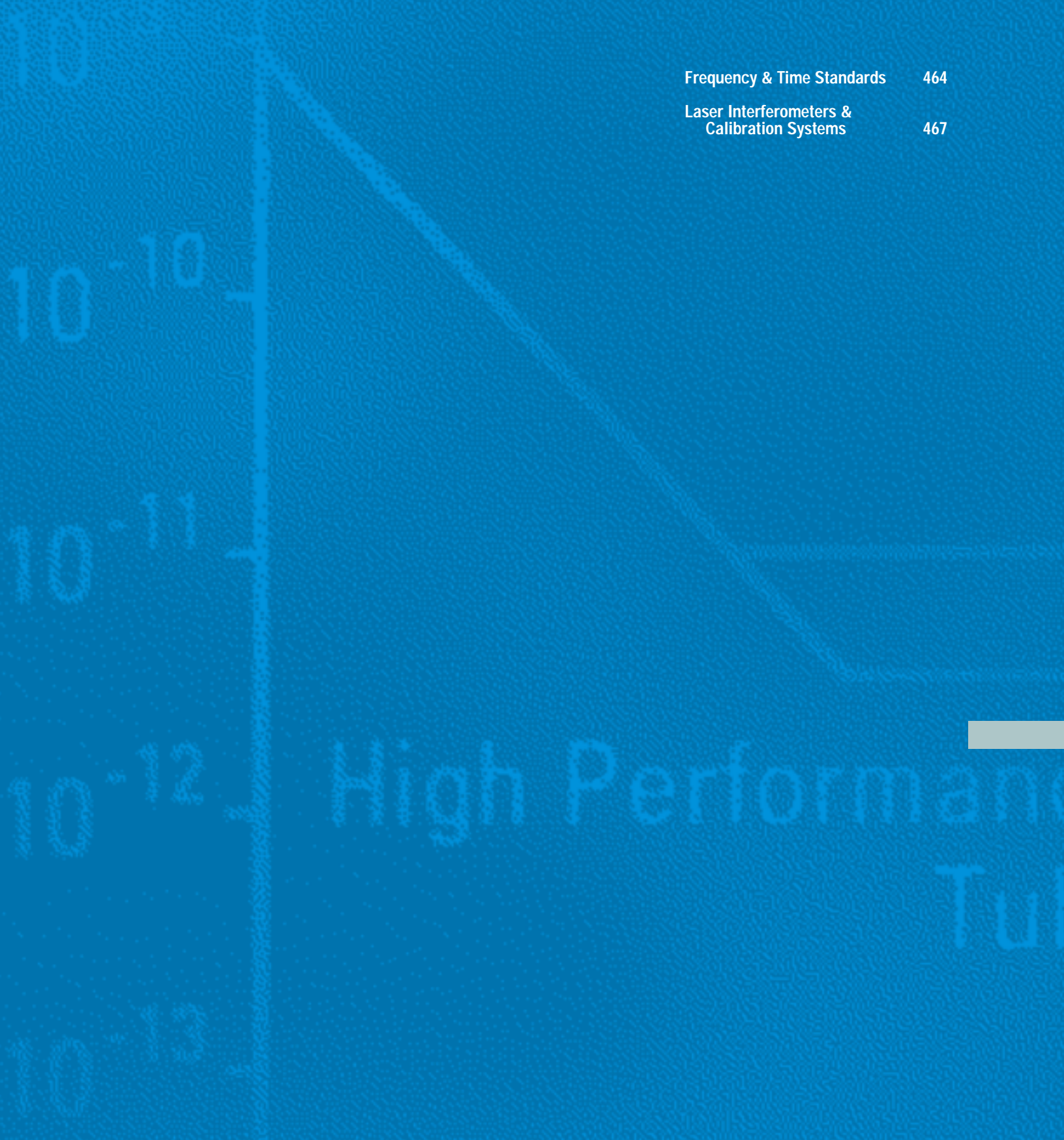
Frequency & Time Standards 13

Instruments & Systems

463

Frequency & Time Standards 464

Laser Interferometers & Calibration Systems 467



Agilent Keeps the World's Time

Agilent's industry-leading Caesium primary frequency standards set and keep the world's time and frequency at national timekeeping bureaus and standards labs around the globe. As published by BIPM, over 80% of Universal Time Coordinated (UTC) is defined by Agilent primary frequency standards.

Timing/Frequency Sources

Different levels of precise time and frequency are provided by sources ranging from GPS and caesium clocks to Rubidium and quartz clocks.

Caesium: Generally, the more expensive the frequency source, the better its accuracy and stability. Caesium-based oscillators for example, maintain accurate frequency indefinitely without the need for calibration. Because of this, caesium oscillators are applied to the most critical applications as primary reference clocks at the top of a network's hierarchy. By using caesium-based oscillators, networks and labs gain independence from other potentially less-reliable timing references. Agilent's extremely stable and accurate caesium based clock is the model 5071A Primary Frequency Standard.

Oscillator Continuum

	Caesium	Rubidium	Quartz	Quartz w/GPS
Long-Term Accuracy	$\pm 7 \times 10^{-12}$ for life of cs. beam tube	$\pm 3 \times 10^{-11}$ /mo.	$\pm 5 \times 10^{-10}$ /day	$< 1 \times 10^{-12}$ /day avg. when locked to GPS
Long-Term Aging	N/A	1×10^{-12} /day	1×10^{-10} /day	N/A
Oscillator Reliability (MTBF)*	120,000 – 150,000 hrs.	50,000 – 150,000 hrs.	>500,000 hrs.	>500,000 hrs.

*Mean time between failures

Rubidium: Rubidium-based oscillators are lower cost than caesium and have excellent short-term stability (ability to consistently produce accurate time and frequency), but require frequent access to a primary reference signal to maintain calibration.

Quartz: High-quality quartz oscillators are extremely reliable, inexpensive and have excellent short-term stability. However the effects of aging and temperature on signal stability have made quartz oscillators less accurate over time than either caesium or rubidium.

Standards Labs

Agilent frequency standards and clocks provide accurate frequency, time interval and timekeeping capabilities to compare against national standards in timekeeping, R&D, and standards labs.

Agilent's Caesium-beam frequency standards are used in labs where the goal is a very high-accuracy primary frequency standard. Agilent quartz oscillators are used in virtually every frequency-control application, including atomic standards. The excellent short-term stability and spectral purity of the quartz oscillators contributes to the high quality of the output signal. For less demanding applications where some long-term drift can be tolerated, quartz oscillators are used as independent frequency sources.

Agilent's own standards lab in Santa Clara, California maintains an ensemble of three high-performance Agilent caesium-beam standards. The ensemble enhances its intrinsic accuracy through GPS links to both the US Naval Observatory (USNO) and the US National Institute of Standards and Technology (NIST).

- Accuracy: $\pm 5 \times 10^{-13}$
- Settability: $\pm 1.0 \times 10^{-9}$
- "Flicker floor": $\leq 5.0 \times 10^{-15}$ typical
- Fast warmup
- No adjustments before or during operation
- Remote operation



5071A

5071A Primary Frequency Standard

The Agilent 5071A primary frequency standard delivers unsurpassed accuracy and stability for both laboratory and field applications. Its improved caesium-beam tube reduces the effects of Ramsey pulling. New beam optics use caesium more efficiently. The combined results – increased accuracy and stability, and increased tube life – ensure a lower cost of ownership.

Because of its sophisticated programming and microprocessor control, the 5071A is extremely easy to use. Startup is simple and requires no adjustments. A logical menu structure simplifies front-panel operations, selections, and status reporting.

The 5071A can be operated and maintained anywhere. All controls are remotely programmable, status can be checked remotely, and no adjustments or alignments are necessary during operation. An internal battery provides 45 minutes of backup in case of a power failure.

Unmatched Accuracy and Stability

The 5071A uses Caesium II technology to double the accuracy of its predecessor, the 5061B. Caesium II technology includes a new caesium tube and redesigned microprocessor controlled electronics. The improved accuracy ensures that any 5071A-001 can power up to within 5×10^{-13} of the accepted standard for frequency. This is achieved under full environmental conditions typically in 30 minutes or less.

Caesium II technology brings a new level of stability to the caesium clock. The 5071A is the first caesium standard to specify its stability for averaging times longer than a day. It is the first standard to specify a "flicker floor" – the point at which the standard's stability does not change with longer averaging. The standard 5071A has a flicker floor better than 5 parts in 10^{14} .

The Hewlett-Packard Co. started producing caesium-based frequency sources in 1964. These products are now produced by Agilent Technologies, which was formed from the Hewlett-Packard Test and Measurement Group. The exceptional accuracy and stability of the 5071A are a result of this long experience and are characterized by improved reliability, significantly greater stability, and exceptional accuracy. Backing up the reliability is a ten-year warranty on the standard long-life caesium tube and a five-year warranty for the optional high-performance tube.

Ease of Use

Startup and operation of the 5071A are extremely simple. Once connected to an ac or dc power source, the instrument automatically powers up to its full accuracy specifications. No adjustments or alignments are necessary during power-up or at any time during the lifetime of the caesium tube.

Intuitive menus logically report status and facilitate control of the instrument. These menus – Instrument State, Clock Control, Instrument Configuration, Event Log, Frequency Offset, and Utilities – are accessible via the front-panel LCD display and keypad.

High-Performance Tube: 5071A-001

For the most demanding operations, the 5071A-001 high-performance caesium-beam tube offers increased performance. Accuracy is two times better than the standard long-life tube, and stability is superior as well. The high-performance tube allows a flicker floor of better than 1×10^{-14} , and recent measurements at NIST show the flicker floor is typically as low as 5×10^{-15} .

Telecommunications Options

The 5071A primary frequency standard may be optionally equipped to provide output frequencies, impedances, and signal formats required of a Primary Reference Clock in modern telecommunication networks. Configurations are available for both DS1 and CEPT standards. The 5071A can also be equipped to operate from a 48 Vdc central office battery.

Clock rates of 1.544 and 2.048 Mb/s are available. Impedance choices and signaling formats for all current ITU-T specifications are available. The 5071A with 2.048 Mb/s options are ITU-T G.811 compliant. All features found in a standard 5071A are retained when a 1.544 or 2.048 Mb/s option is installed. This includes both programmable 5/10 MHz outputs and the 1 MHz and 100 kHz outputs. The 1 PPS output and sync are only available on the front panel of the instrument.

The 5071A-048 equips the frequency standard to operate from 48 Vdc power. Two independent 48-volt power sources may be supplied. The power sources must be of the same polarity but either polarity may be used. The frequency standard draws power from the source with the higher voltage. Upon a source failure, the frequency standard will automatically switch to the other source – ensuring uninterrupted operation. The 5071A-048 automatically uses power from a 48 Vdc source if one is present. The instrument will use ac power if the dc source fails or no dc source is available. The internal battery normally supplied with the 5071A is not available when 5071A-048 is installed.

Specifications

Accuracy and Stability

Full Environmental Range

- Conditions (any combination of):
 - Temperature: 0 to 50 °C
 - Humidity: 0 to 80% (40 °C maximum)
 - DC Magnetic Field: 0 to 2 gauss
- Warmup Time (typical):
 - 15 minutes to normal operating status
 - 30 minutes to full specs

Settability

- Resolution: 6.3×10^{-15}
- Range: $\pm 1.0 \times 10^{-9}$

Frequency Change Due to Environment: $\pm 1 \times 10^{-13}$ ($\pm 8 \times 10^{-14}$ Option 001)

Accuracy: $\pm 1 \times 10^{-12} \pm 5 \times 10^{-13}$ (Option 001)

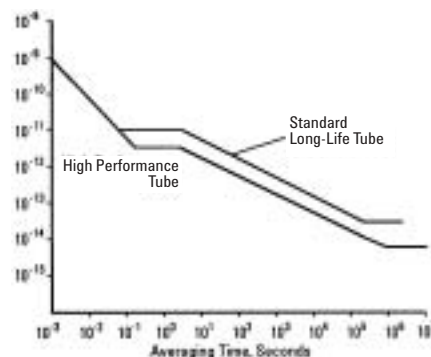
Flicker Floor:

- $\leq 5.0 \times 10^{-14}$ ($\leq 1.5 \times 10^{-14}$ typical)
- $\leq 1.0 \times 10^{-14}$ (Option 001 $\leq 5.0 \times 10^{-15}$ typical)

Reproducibility: $\leq 5.0 \times 10^{-13}$

Frequency Stability (5/10 MHz Outputs)

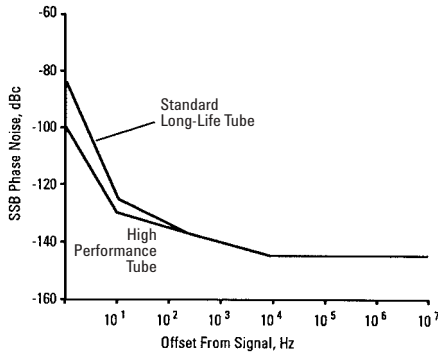
Time Domain Stability (Allan Deviation)



5071A

Averaging Time (seconds)	$\sigma y(2, \tau)$	Standard Long-Life Caesium-Beam Tube	High-Performance Caesium-Beam Tube (Option 001)
10^{-2}		$\leq 7.5 \times 10^{-11}$	$\leq 7.5 \times 10^{-11}$
10^{-1}		$\leq 1.2 \times 10^{-11}$	$\leq 1.2 \times 10^{-11}$
10^0		$\leq 1.2 \times 10^{-11}$	$\leq 5.0 \times 10^{-12}$
10^1		$\leq 8.5 \times 10^{-12}$	$\leq 3.5 \times 10^{-12}$
10^2		$\leq 2.7 \times 10^{-12}$	$\leq 8.5 \times 10^{-13}$
10^3		$\leq 8.5 \times 10^{-13}$	$\leq 2.7 \times 10^{-13}$
10^4		$\leq 2.7 \times 10^{-13}$	$\leq 8.5 \times 10^{-14}$
10^5		$\leq 8.5 \times 10^{-14}$	$\leq 2.7 \times 10^{-14}$
5 days		$\leq 5.0 \times 10^{-14}$	$\leq 1.0 \times 10^{-14}$

Frequency Domain Stability



Offset from Signal	Standard Long-Life Caesium-Beam Tube	High-Performance Caesium-Beam Tube (Option 001)
10^0	≤ -85	≤ -100
10^1	≤ -125	≤ -130
10^2	≤ -135	≤ -135
10^3	≤ -140	≤ -140
10^4	≤ -145	≤ -145
10^5	≤ -145	≤ -145

Sinusoidal Output Characteristics (all located on rear panel)

Parameter	Ports 1 and 2 ¹	1 MHz, 100 kHz
Amplitude into 50 Ω load	>1 V rms	>1 V rms
Isolation between ports	>110 dB (typ.)	not specified
Harmonic and sub-harmonic signals (typical)	<-40 dBc	<-40 dBc
Non-harmonic distortion	<-80 dBc	not specified
Connector type	N	BNC
Source impedance (nominal)	50 Ω	50 Ω

¹Each output can be set to either 5 or 10 MHz from the front panel or by remote command.

Internal Standby Battery (nominal values)

Capacity: 45 minutes at 25°C from full charge
Charge Time: 16 hour maximum from fully discharged state
Charge Source: AC input power only

Remote System Interface and Control

RS-232-C (DTE configuration): Complete remote control and interrogation of all instrument functions and parameters

- Interface Circuits: Optically isolated
- Software Command Set: SCPI, version 1990.0
- Connector: 9-pin male rectangular D subminiature type

Status Output: Logic output for externally monitoring normal and abnormal operation (user-defined)

- Output: TTL open collector with internal pull-up resistor
- Circuit Sink Capability: Up to 10 mA
- Connector: BNC on rear panel

Environmental and Physical

Temperature

- Operating: 0°C to 55°C
- Non-operating: -40°C to +70°C

Size: 133.4 mm H x 425.5 mm W x 523.9 mm D (5.25 in x 16.75 in x 20.63 in)
Weight: 30 kg (65 lb)

Ordering Information

- 5071A Primary Frequency Standard
- 5071A-001 High performance caesium beam tube
 - 5071A-046 Do not include internal 45 minute battery backup
 - 5071A-300 Delete display and keyboard
 - 5071A-104 1.544 Mbps, 100 Ohm balanced superframe
 - 5071A-105 1.544 Mbps, 100 Ohm balanced ESF
 - 5071A-220 2.048 Mbps, 120 Ohm balanced CCS
 - 5071A-221 2.048 Mbps, 120 Ohm balanced CAS
 - 5071A-222 2.048 Mbps, 120 Ohm balanced CAS/CRC4
 - 5071A-270 2.048 Mbps, 75 Ohm unbalanced CCS
 - 5071A-271 2.048 Mbps, 75 Ohm unbalanced CAS
 - 5071A-272 2.048 Mbps, 75 Ohm unbalanced CAS/CRC4
 - 5071A-048 48 Vdc power for telecommunications (battery backup not available)
 - 5071A-H03 NIST 77110C characterization
 - 5071A-H08 NIST 77120C characterization
 - 5071A-0BW US – English assembly level service documentation
 - 5071A-908 Rackmount flange kit for use without handles
 - 5071A-913 Rackmount flange kit for use with supplied handles

- PC-compatible and VMEbus electronics
- Resolutions to 0.3 nm, data rates to 10 MHz
- PC servo-axis board for closed-loop positioning
- Multi-axis measurements for greater control
- Wavelength-of-light compensation
- Remote sensing with fiber-optic receivers



PC-compatible laser interferometer electronics provide open- or closed-loop positioning and speed integration into the lowest-cost industry-standard backplane.



The 10897B High Resolution Laser Axis Board for VMEbus provides the highest position resolution available from Agilent and allows easy, cost-effective integration into this popular, 32-bit industry-standard backplane.

Precision Positioning Systems

10897B

Laser interferometer precision positioning systems – composed of electronic and optical components – provide very precise position or distance information for dimensional measurements and motion control. When built into manufacturing and inspection equipment, a laser interferometer system reports the position or controls the motion of a product platform with more accuracy than any other method.

Precision laser positioning systems improve product quality and reliability, increase manufacturing consistency for increased production yields, and allow the production of precision products that would otherwise be impossible to manufacture. Laser interferometer positioning systems are vital in many applications:

- Integrated-circuit fabrication, inspection, and repair
- Manufacture of high-capacity disk drives
- Precision machine tools
- Manufacture or calibration of other measurement scales
- Mechanical parts inspection/measurement
- Custom test and measurement
- Precise plotting
- Mechanical vibration analysis
- Antenna testing

System Components

Agilent precision positioning systems combine Michelson interferometry with a two-frequency HeNe laser. Agilent's patented two-frequency design provides greater stability and reduced noise sensitivity, and extends the measurement range – up to 40 m (130 ft), or 80 m (260 ft) in certain circumstances. Three subsystems make up a laser interferometer system:

Laser: Supplies a monochromatic light source (or beam)

Optics: Directs the beam and generates the interference pattern

Electronics: Detects and counts the light and dark interference fringes, processes the data, and outputs distance information

Agilent offers the components needed to configure laser interferometer positioning systems for a broad range of applications and other requirements. All systems support the same laser sources, and optics, and are primarily differentiated by the receivers and electronics.

Interferometer Electronics

Agilent interferometer electronics offer a choice of backplane (interfacing characteristics), output formats, and environmental compensation options. Table 1 on page 469 summarizes the Agilent products based on these differentiators.

The Agilent product line offers interferometer electronics tailored for a variety of customer needs. For interfacing to industry-standard backplanes, the VMEbus provides a high-performance alternative and PC products provide the lowest-cost solution. Both are popular industry standards and offer system configuration flexibility.

Each of the electronics alternatives supports the complete range of lasers and optics. In addition, the 10780C receiver, 10780F remote receiver, E1708A remote dynamic receiver, and E1709A high sensitivity dynamic receiver work with all electronics.

1070x A/B
1071x A
1072x A
1073x L/R



The 10737L and 10737R Compact Three-Axis Interferometers improve positioning accuracy of lower-cost equipment too compact to use the 10735A or 10736A.

Optics

The optics tailor each interferometer system for the physical layout and measurement requirements of each application.

10702A Linear Interferometer: The basic optic for linear measurements

10706A/B Plane-Mirror Interferometers: Commonly used with multiaxis stages

10716A High-Resolution Interferometer: A plane-mirror interferometer with twice the resolution of the 10706A/B

10715A Differential Interferometer: A plane-mirror interferometer for differential measurements

10705A Single-Beam Interferometer: Physically smaller for confined spaces or low-mass, non-contact measurements

10719A, 10721A One- and Two-Axis Differential Interferometers: For optimized accuracy and repeatability with IC fabrication equipment; the position of the wafer stage is directly referenced to the optics column

10735A, 10736A Three-Axis Interferometers: Can be used in pairs to make 5 precise measurements (x, y, pitch, roll, and yaw) simultaneously for IC fabrication

10737L/R Compact Three-Axis Interferometers: Multiaxis measurements for precise control of smaller, lower-cost equipment

See the table for a summary of Agilent reflector products and the configurations supported with Agilent optics.

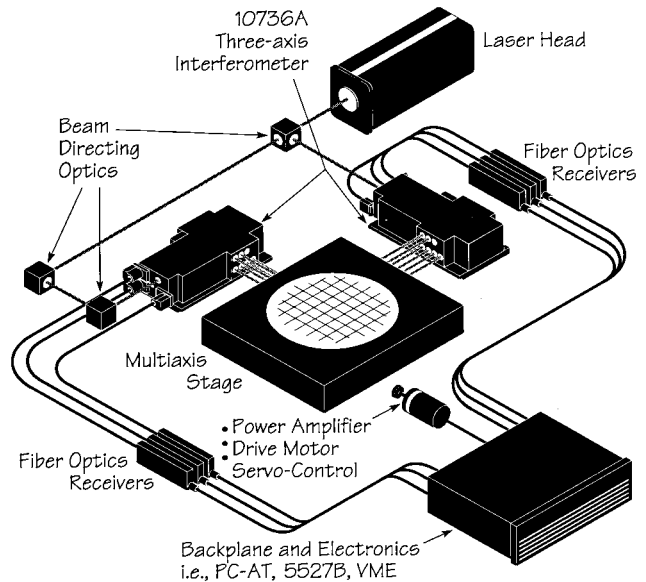
Laser Heads

Four laser heads are available for Agilent interferometer systems: the 5517A, 5517B (500 mm/second axis velocity for linear optics), 5517C (700 mm/second for linear optics), and 5517D (1000 mm/second for linear optics).

The total accuracy of an interferometer system is the sum of the errors from the laser head, the optics, and the effects of the environment. All Agilent laser heads have a vacuum wavelength accuracy of ± 0.1 ppm. Option UK6, an NIST-traceable wavelength calibration service, is available. With this calibration, a laser's wavelength accuracy becomes ± 0.02 ppm. Agilent laser heads over the last 25 years have a demonstrated mean time between failure of greater than 50,000 hours.

Improving Accuracy and Repeatability

Maximum accuracy and repeatability require compensation for environmental conditions. The wavelength of light in air varies with the air's refractive index, which is a function of air temperature, pressure, and composition. In addition to the wavelength-of-light effects, errors can result from thermal expansion of the workpiece. To take full advantage of Agilent's high-wavelength stability, the 10717A Wavelength Tracker compensates for changes in the air's refractive index. The 10896B, with wavelength-of-light compensation and material temperature measurement, increases accuracy and repeatability for VMEbus systems, and the 10886A provides these functions for PC-compatible systems. Product Note 5527A/B-2 (p/n 5952-7973) describes in detail how to achieve maximum accuracy and repeatability.



The 10735A and 10736A Three-Axis Interferometers offer greater accuracy for microlithography and other applications that require up to five degrees of freedom.

Reflectors and Interferometers: Supported Combinations

Interferometers	Reflectors/Mirrors			
	10703A, 10713B	10704A, 10713C, D	10724A	Custom Mirrors
10702A	•			
10705A		•		
10706A/B			•	•
10716A			•	•
10715A			•	•
10719A, 10721A				•
10735A, 10736A				•
10737L/R			•	•

Key Literature

To configure and order an Agilent laser interferometer positioning system, please request the appropriate data sheets and ordering information from the Agilent Technologies Call Center in your region:

Introduction to Laser Systems Brochure, p/n 5091-2507E
Laser Head and Optics Technical Data Sheet, p/n 5964-6190E
PC Compatible Technical Data Sheet, p/n 5091-8435E
VMEbus Technical Data Sheet, p/n 5965-1569E
Systems Ordering Information, p/n 5964-3700E

See the next page for information on laser system electronics.

Table 1: Key Characteristics of Agilent Laser Interferometer Electronics

System	Backplane	Electronics	Output Formats	Other Differentiators
PC Compatible	ISA (PC/AT)	10885A	32-bit digital (hardware output and backplane output)	Lowest-cost, most-popular, industry-standard backplane
		10889B	Motor drive (in ± 10 Vdc)	
		10887B	32-bit digital	Servo-axis board Fast system development Part of 5529A calibration system Programmable version of 10887B Complete environmental compensation 3 axes per card Fast data rate
	10887P	32-bit digital		
	10886A	PC compensation board		
PCI	N1231A	24-bit PMAC compatible	32-bit via PCI	
		32-bit via PCI		
VMEbus	VMEbus	10895A	32-bit digital (hardware output and backplane output)	High-performance, robust, industry-standard 32-bit backplane
		10897B	36-bit digital (hardware output and backplane output)	High resolution and data rate Fast system development
		10898A	36-bit digital (hardware output and backplane output)	
		10896B	VME compensation board	Complete environmental compensation

5507B
10885A
10886A
10887B
10887P
10889B
10895A
10896B
10897B

PC-Based Laser Interferometer Positioning System

The 10889B PC servo-axis board is a programmable, digital servo with built-in motion control algorithms for closed-loop positioning that is compatible with the most popular PC backplane. Output is a ± 10 V analog motor drive signal updated at 20 kHz. A trace function speeds and simplifies servo-loop characterization and tuning. The 10885A PC axis board provides a 32-bit digital, real-time position output via hardware, and position can also be read over the backplane. The N1231A PC axis board provides 24-bit PMAC compatible position data for 3 axes (per board) and 32-bit position and velocity data over PCI bus. Data collection time for 3 axes of position data = 4.5 μ s + PC processing time. The 10886A PC compensation board increases accuracy and repeatability of systems by compensating for environmental conditions using Agilent environmental sensors. Combining the high performance of Agilent laser interferometers with the most popular, lowest-priced, industry-standard backplane speeds system development and reduces system costs.

VMEbus Laser Interferometer Positioning System

The 10897B and 10898A high-resolution laser axis boards provide high position resolution (up to 0.3 nm) at a 10 MHz rate for the most demanding applications. Position data is output in 36-bit format for very high performance closed-loop positioning systems. The 10895A laser axis board provides output in 32-bit format for typical applications. Both boards provide a hardware position output and also output position over the VMEbus backplane. The 10896B compensation board increases the accuracy and repeatability of systems using either the 10897B or 10895A by compensating for environmental conditions using Agilent or custom environmental sensors. All Agilent laser electronics for VMEbus are compatible with VME Rev. C.1 providing easy, cost-effective integration into VMEbus.

System Specifications

	PC Compatible	VMEbus
Accuracy		
Vacuum	0.1 ppm	0.1 ppm
Vacuum with MIL-STD-45662A	0.02 ppm	0.02 ppm
Maximum Resolution		
Linear optics	0.6 nm	1.2 nm
Plane mirror optics	0.3 nm	0.6 nm
High-res. optics	0.15 nm	0.3 nm
Maximum Axis Velocity		
Linear optics	1000 mm/s	1000 mm/s
Plane mirror optics	500 mm/s	500 mm/s
High-res. optics	250 mm/s	250 mm/s
Maximum Optical Range	40 m	40 m
Maximum Hardware Data Output Rates		
Position/position error	3.0 MHz	10.0 MHz
A-Quad-B (transition rate)	N/A	N/A
Up-down pulse	N/A	N/A
Motor-drive	20 kHz	N/A
Environmental Compensation	Yes	Yes



5529A
55292A

- Calibration of machine tools, CMMs, pick and place machines, robots, and machines with precision movement
- Comprehensive calibration
- Flexible triggering and parameter setting
- Minimum machine downtime with easy control through MS-Windows
- Graphical output provides conformance to seven international standards
- Complete localization in eight languages
- Customized compensation table enables improved performance



5529A Dynamic Calibrator for Flexible, Comprehensive Calibration

The 5529A dynamic calibrator is a high-performance calibration tool for most equipment with precision movement. This calibrator minimizes downtime and enables conformance to international standards with its powerful measurement capability. The 5529A is a laser-based machine tool calibration system consisting of a laser head, optics, PC-based electronics, and Microsoft Windows-based software that operates in an IBM-PC-style (ISA bus) computer.

Comprehensive Measurements

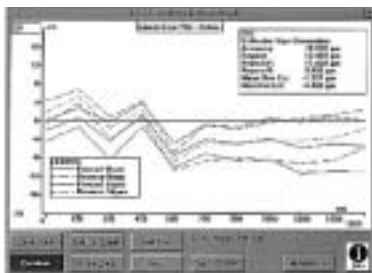
- Linear
- Angular
- Straightness
- Squareness
- Way straightness
- Parallelism
- Flatness
- Timebase
- Ballbar
- Diagonal
- Thermal drift
- 2-axis
- Rotary table

Flexible Triggering

- Manual
- Automatic
- A-Quad-B

Flexible Parameters

- Environmental compensation
- English/metric units
- 0 to 10 seconds averaging
- Measurement target lists
- Upload/Download CNC compensation tables



Linear Plot Using ISO 230-2

Conform to Seven International Standards

Today's world market requires many manufacturers to conform with a specific international standard. The 5529A provides graphical output that shows your machines' conformance with seven international standards:

- ISO 230-2
- NMTBA
- ANSI B5.54
- BSI
- VDI
- JIS
- GB 10931-89

English URL www.agilent.com/find/products

Available in Eight Languages

Complete documentation, control, and on-line help is available in eight languages:

- English
- French
- Spanish
- German
- Italian
- Japanese
- Chinese (PRC)
- Chinese (ROC)

Brief Specifications

Data Rate: Up to 33 kHz

Linear

- Accuracy (range): ± 0.02 ppm to ± 3.0 ppm
- Resolution: Down to 1 nm
- Range: Up to 80 meters

Angular

- Resolution: Down to 0.005 arc seconds
- Range: $\pm 20^\circ$

Key Literature

- 5529A Brochure, p/n 5968-0111E
- 5529A Price List, p/n 5966-3285EUS
- 5529A Spec Sheet, p/n 5964-9307E

Ordering Information

5529A Dynamic Calibrator



55292A

55292A USB Expansion Module

- Designed especially for the 5529A dynamic calibrator
- Universal serial bus for use with 5529A laser measuring system
- Host for one 10887B calibration board and one 10886A compensation board in each module
- 5 modules can be used simultaneously with addition of a USB hub
- Allows use of small, lightweight laptop computers using Windows 98 or Windows 2000
- Extreme portability
- Includes new metrology software meeting the latest known revisions of 7 international machine-tool standards

Universal Serial Bus Offers

Faster speed, Windows 2000 compatibility and ease of use, no more IRQ conflicts.

Minimum Requirements:

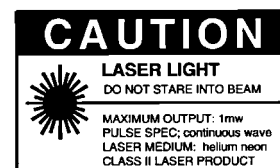
- IBM compatible computer with Windows 98 or Windows 2000 installed
- 64 MB ram, CD-ROM drive
- 1 internal USB port

Note: Add-on adapters are not supported.

All 10887A and 10886A boards must be reset to factory defaults: 10887A to addr 512, IRQ5 and 10886A to addr 288

Shipping Weight: 2.1 kg (4.62 lb)

Envelope: 387 mm H x 184 mm W x 127 mm D (15.42 in x 7.36 in x 5.08 in)



Korean URL www.agilent.co.kr/find/products

Printed Circuit Board Test and Inspection Systems	472
Automated Semiconductor Test Systems	473
Semiconductor Parameter Analyzer	474

Automated Test Equipment

472

Printed Circuit Board Test and Inspection Systems

SJ Series
5DX Series
3070 Family

- A family of flexible automated optical inspection (AOI) systems that enable lower repair and warranty costs, faster time-to-market, broad coverage and scalable tests
- Automated x-ray inspection (AXI) systems that provide the highest fault coverage of any tester, accelerating repairs and shipping schedules and reducing warranty costs
- A full range of in-circuit test (ICT) systems built around a common architecture that has become the industry standard

Cut Costs. Build Profits. Compete to Win. Agilent Helps you Do It

Cut costs. Build profits. Compete to win. It's what we help the world's electronics manufacturers do every day. With high-quality, versatile, innovative technologies, we partner with you to provide high-value, low-risk solutions preferred worldwide.

Agilent offers a complete range of test systems for printed-circuit-board test and inspection, including: automated optical inspection (AOI) of solder paste and flux (pre-reflow), solder joints (post-reflow), and parts placement defects; automated x-ray inspection (AXI) for solder defects; and in-circuit test (ICT) for electrical faults. Our intelligent test solutions provide additional capabilities spanning these test technologies.



Selection Guide for Printed Circuit Board Test and Inspection Systems

	SJ, SP and FX Families	5DX	3070 Family	AwareTest xi Software	Other Intelligent Test Solutions
Test Technology	AOI	AXI	ICT	AXI + ICT	Decrease costs
Application	Component placement, solder paste, bare board, post reflow; flux inspection	Solder defects	Electrical defects: wrong, defective parts	Minimize testing; reduce fixturing costs	Repair, SQC, connection to CAD/CAM
Automated Board Handling Capability	Yes	Yes	Yes	N/A	N/A
Full Board in Single Pass	No	Yes	Yes	Yes	N/A
Inspect Totally Hidden Solder Joints	No	Yes	Yes	Yes	N/A

14

- The Agilent 93000 SOC series single platform covers today's testing needs and can be upgraded in the future
- Specialized testing systems for high-volume Flash memory (Versatest series) and RF modules (84000)
- Fast, accurate electrical parametric measurements of wafers for semiconductor process control



Broadest Production-Test-Application Coverage on a Single, Scalable Architecture

Agilent's 93000 SOC-series systems give you the ability to test your most complex SOC devices with the highest throughput for the most economical price. Systems can be configured with standard system components to test a wide variety of devices such as: the highest-speed computation chipsets and graphics chips; mixed-signal devices for mass storage, digital entertainment or broadband access; wired communications devices comprising high-speed buses, like SerDes, HyperTransport and 10 Gb Ethernet; wireless communications like *Bluetooth*, cellular or WLAN.

Agilent's Versatest series of memory test systems enables you to test a wide range of memory and logic devices at wafer sort and final test. With several compatible models to choose from, you can find the cost-effective solution for your memory test needs.

Agilent also provides solutions for IV and CV electrical parametric testing for semiconductor wafers. The 4070 family of parametric test systems is rapidly becoming the standard in 300 mm fabs.

93000 SOC
Versatest
Series
84000RF
4070 Family

Selection Guide for Semiconductor Test Systems

	93000 SOC	Versatest Series	84000 RF	4070 Family
Applications	SOC: computation, digital consumer, wired and wireless communications	Flash memory, NOR or NAND; SRAM; embedded memory; and pure logic	RF power amplifiers, mixers, modulators, transceivers, etc.	Semiconductor parametric process characterization and control; I-V and C-V
Digital Pattern Application Rate	200-3300 Mbps; up to 10 GBps BERT	40, 70, 100 MHz	200 MHz	DC measurements
Analog BW	8 GHz	N/A	2.996 GHz stimulus, 7.996 GHz receive	RF measurements (20 GHz)
Pins	Up to 1024	Up to 2304	2 RF ports	Up to 48
Process Step	Wafer sort	Wafer sort and final test	Final test	Wafer fab processes
Simultaneous Sites	Multi-site (unlimited number of parallel devices); also, multiple simultaneous IP block testing	Up to 36 (NOR) or 144 (NAND)		N/A

4155C
4156C
4157A
E5270A
E5272A/
73A

- Make fast C-V and I-V measurements of semiconductor, LCD/TFT characterization or optical process technologies
- All-inclusive systems or modular components for accurate measurement and analysis
- Fully automated software for interactive control of instruments and statistical data analysis



Fast, Precise Parametric Measurements to Ensure Semiconductor Process Characterization and Control

The Agilent 4155C, 4156C and 4157A semiconductor parametric analyzers provide fast and accurate measurements on laboratory bench tops. They feature intuitive front-panel controls and an MS Windows-based graphical user interface. Included I/CV Lite software gives you full instrument control and adds wafer-probe control, test-sequencing capability and powerful data-analysis tools. In addition, these versatile analyzers support a variety of programming commands (including SCPI and Agilent FLEX/FLEX plus) for flexible configuration.

The modular Agilent E5270 series, based on Agilent 4070 series system technology, makes it an ideal choice for high-speed production test as well as interactive benchtop use. The E5270 series ensures you will be able to test the technologically advanced devices of today and tomorrow.

The Agilent E5250A low-leakage switch combines with the above analyzers to form a total bench-top solution. The E5252A crosspoint matrix card performs conventional switching matrix functions, such as performing I/CV measurements at the wafer level using a probe card. The Agilent E5255A multiplexer card is useful for performing long-term reliability testing such as hot carrier injection (HCI) and time-dependent dielectric breakdown (TDDB).

Selection Guide for Semiconductor Parametric Benchtop Measurements

	4155C	4156C	4157A	E5270A	E5272A/73A
Application	Semiconductor Test Wafer Level Reliability (WLR) Test LCD/TFT test	Semiconductor Test Wafer Level Reliability (WLR) Test LCD/TFT test High Precision	Semiconductor Test Flexible Configuration and Cost Effective	Semiconductor Test MMIC Test Optical Component Test Reliability Test Modular DC source/monitor	Semiconductor Test Optical Component Test 2 channel DC source/monitor
SMU Number	4 – 6	4 – 6	2 – 8	2 – 8	2
QSCV Function	Yes	Yes	No	No	No
Max Current	100 mA (1 A with expander)	100 mA (1 A with expander)	4.0 A (by multiple SMU)	4.0 A (by multiple SMU)	10 mA: E5272A 1 A: E5273A
Current Measurement Resolution	10 fA	0.01 fA (on display)	10 fA	10 fA	10 fA
Voltage Measurement Resolution	0.2 uV	0.2 uV	2 uV	2 uV	2 uV

Refurbished Equipment,
Trade Up, Leasing & Finance 476

Stretch your Budget with Creative Financing Options

Agilent Technologies offers a variety of ways to help you get the equipment you need, even if your budget isn't what it used to be.

Rent, Lease or Finance to Conserve Capital

Take advantage of Agilent's newest technology without large, up-front payments – and cut the risk of technical obsolescence at the same time. Leasing or financing frees up capital for other investments, and the return on those can offset the cost of your lease. Fixed monthly payments simplify budgeting, too.

We offer three options to fit your needs:

- **EasyRent** offers the convenience and flexibility of a rental with the low payments of a lease
- The **Operating Lease Plan** gives you all the advantages of using new technology without the risk or expense of ownership
- The **Finance Lease or Installment Plan** provides the rewards of owning the latest technology without the up-front investment



Option	Key Advantage	Length (months)	Ownership	End of Term
EasyRent	<ul style="list-style-type: none"> • Low cost • Convenience and flexibility • Off-balance-sheet financing 	36 months with exit options at month 12 or 24	Agilent Financial Services	Purchase the used equipment at fair market value; renew month-to-month at current rate or for a longer term at a reduced rate; return with no obligation
Operating Lease Plan	<ul style="list-style-type: none"> • Pay only for the term you need • Shift obsolescence risk to Agilent • Option to purchase • Off-balance-sheet financing 	12 – 48	Agilent Financial Services	Purchase the used equipment at fair market value; renew month-to-month at current rate or for a longer term at a reduced rate; return with no obligation
Finance Lease or Installment Plan	<ul style="list-style-type: none"> • No large up-front cash outlay • No down payment • Tax benefits of depreciation 	12 – 48	You	Title passes at the end of the lease term with the payment of a US\$1 nominal fee

For more information on all of our Lease and Finance plans, see our Web site at below. Then choose the option that best fits your needs.

Singapore: www.agilent.com.sg/find/leasing
 China: www.agilent.com.cn/find/leasing
 Korea: www.agilent.co.kr/find/leasing

Hong Kong: www.agilent.com.hk/find/leasing
 Taiwan: www.agilent.com.tw/find/leasing
 Japan: www.agilent.co.jp/find/leasing

Note: Leasing and financing solutions are now available in the following countries in Asia: China, Taiwan, Hong Kong, Korea, Singapore, Japan, Australia, New Zealand and Malaysia, through our appointed financing partners.



Trade Up to the Latest Technology

Agilent Trade Up helps you make the most of your investment in previous technology. You acquire Agilent's latest test-and-measurement solutions while stretching your budget and disposing of instruments you no longer need.

Simply trade in an idle or outdated instrument from Agilent or another manufacturer; then receive a credit toward hundreds of qualifying products. The amount will depend upon the manufacturer, model, options, and age of the trade-in product, plus your choice of a new product. Your Agilent representative will use our proprietary, web-based tools to calculate your trade-up offer quickly and automatically.

You can use your credit toward new equipment in the same product category (for example, you could trade in your old oscilloscope for a new Infiniium) or in a different product category, or toward Agilent test-and-measurement software and solutions. Check the sidebar for the extensive list of products from Agilent and other manufacturers that qualify for trade-up credits all the time.

And watch for special limited-time promotions, too! To sign up for customized e-mail updates to get early notice of trade-up promotions that match your equipment needs, or for more information on Agilent Trade Up, visit our Web site at www.agilent.com/find/trade-up

NOTE: Agilent Trade Up is not available in all countries.

Product Categories

- Calibration and Verification Kits, Network Analyzers
- Distributed Datacom Network Analyzers
- Impedance Analyzers
- LCR Meters
- Logic Analyzer Cards
- Logic Analyzers
- Mobile Communications Test Sets
- Network Analyzers
- Noise Figure Analyzers
- Oscilloscopes
- Power Meters
- Protocol Analyzers
- Semiconductor Parameter Analyzers
- Signal Analyzers
- Signal Generators
- Spectrum Analyzers
- System Power Supplies
- Telecom Signaling Test Sets
- Telecom Transmission Test Sets
- VCO/PLL Signal Analyzers
- Voice Quality Analyzers
- Wireless Appliance Test Sets
- Wireless Communications Test Sets

Purchase Premium Refurbished Equipment, Guaranteed to Perform

Save up to half the new product cost when you buy Refurbished Equipment, but still get products guaranteed to perform the jobs for which they were manufactured.

Eliminate the uncertainty of buying a previously owned product by purchasing from the original equipment manufacturer. Agilent often selects Refurbished Equipment from our prior year's demo inventory, and then puts these instruments through a rigorous refurbishment process, including recalibration (if applicable) verified by an Agilent Certificate of Calibration.

Our refurbished equipment comes with the same industry-leading warranty you receive with new equipment, which means three years for most products**. We also give you the same return policy, service, and support as products sold new.



Compare Agilent Refurbished Equipment with your Other Options

You'll see why our refurbished equipment is an even better value the second time around.

	Agilent New Equipment	Agilent Refurbished Equipment	Other Used Equipment
Quality	Exceptional	Guaranteed to perform the functions for which it is designed	Not refurbished, or refurbished to varying standards
Source	New	Only the best equipment; typically recent off-lease or off-demo inventory	Various sources with unpredictable quality
Support	Full support	Full support	Typically limited*
Warranty	Full warranty	Brand-new, full** warranty with option to buy an additional warranty	Wide range – check with the vendor
Price	New	Competitive; Exceptional "Special Deals" also available	Competitive
Inventory	Made to order	Largest stock of Agilent refurbished equipment; online searchable database	Limited inventory of Agilent used equipment

* Agilent support is included only for products purchased directly from Agilent, unless the product you buy has some of the original warranty remaining.

** Except the discontinued products, which have a one-year warranty only.

Search online to see our extensive inventory of premium Refurbished Equipment. Our list changes daily, so visit frequently – and check our Special Deals for even better discounts on popular models.

For more information on Agilent Refurbished Equipment, check our Web site at www.agilent.com/find/refurbished

Learn more about all of our creative financing options at www.agilent.com/find/financial_solutions

Ordering Information & Local Assistance 16

Test & Measurement Products 479

Ordering Information and
Local Assistance 481





Prices and Payment

Please contact your Agilent Technologies sales office or authorized distributor for the latest prices and information on payment terms specific to your country.

Catalog Errors

Agilent reserves the right to correct printing errors.

Agilent Technologies' Test and Measurement Support, Services and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By Internet, phone or fax, get assistance with all your test and measurement needs.

On-line Assistance

www.agilent.com/find/assist

Warranty

As an expression of confidence that Agilent's products will continue to meet the high standards of reliability and performance that Agilent's customers expect, Agilent products carry the following limited warranty:

Agilent Technologies products are warranted against defects in materials and workmanship. If Agilent Technologies receives notice of such defects during the warranty period, Agilent Technologies shall, at its option, either repair or replace hardware products that prove to be defective.

Contact Agilent

For more information on Agilent Technologies products, applications or services, please contact your local Agilent office. The complete listing is available at: www.agilent.com/find/contactus



Asia Pacific

Australia

Tel: 1-800-629-485
 Fax: 1-800-142-134
 E-mail: tm_ap@agilent.com

China

Tel: 800-810-0189
 Fax: 800-820-2816
 E-mail: tm_asia@agilent.com

Hong Kong

Tel: 800-930-871
 Fax: (852) 2506-9233
 E-mail: tm_ap@agilent.com

India

Tel: 1-600-112-929
 Fax: 000-800-650-1101
 or 1-600-113-035
 E-mail: tm_ap@agilent.com

Japan

Tel: (81) 426 7832
 Fax: (81) 426 7840
 E-mail: contact_japan@agilent.com

Korea

Tel: (82-2) 2004-5004
 or 080-769-0800
 Fax: (82-2) 2004-5115
 E-mail: korea_call@agilent.com

Malaysia

Tel: 1-800-888-848
 Fax: 1-800-801-664
 E-mail: tm_ap@agilent.com

Singapore

Tel: 1-800-375-8100
 Fax: (65) 6836-0252
 E-mail: tm_ap@agilent.com

Taiwan

Tel: 0800-047-866
 Fax: 0800-286-331
 E-mail: tm_asia@agilent.com

Thailand

Tel: (66-2) 268-1345
 or 1-800-226-008
 Fax: (66-2) 268-1346
 E-mail: tm_ap@agilent.com

Other Asia-Pacific Countries

Tel: (65) 6375-8100
 Fax: (65) 6836-0252
 E-mail: tm_ap@agilent.com

Americas

United States

Tel: (800) 452-4844
 Fax: (888) 900-8921

Canada

General Inquiries
 Tel: (877) 424-4536
 Product Information
 Tel: (877) 894-4414
 Fax: (888) 900-8921

Latin America

Headquarters

Tel: (305) 269-7500
 or Toll Free: (877) 4AGILENT
 Fax: (305) 269-7599
 Fax: (305) 269-7558

Argentina

Tel: (54 11) 5811 7115
 Fax: (54 11) 5811 7287

Brazil

Tel: (55 11) 4197 3600
 Fax: (55 11) 4197 3800
 E-mail: tmobrasil@agilent.com

Mexico

Tel: (01800) 506 4800
 Fax: (52 55) 5081 9467
 E-mail: linea_directa@agilent.com

Europe and Middle East

Austria

Tel: 0820 87 44 11
Fax: 0820 87 44 22
E-mail: contactcenter_austria@agilent.com

Belgium

Tel: +32 (0)2 404-9340
Fax: +32 (0)2 404-9395
E-mail: contactcenter_benelux@agilent.com

Denmark

Tel: +45 70 13 15 15
Fax: +45 45 58 23 30
E-mail: kundeservice_danmark@agilent.com

Finland

Tel: +358 (0)10 855 2100
Fax: +358 (0)10 855 2923
E-mail: asiakaspalvelu@agilent.com

France

Tel: 0825 010 700
Fax: 0825 010 701
E-mail: contactcenter_france@agilent.com

Germany

Tel: 01805 24 63 33
Fax: 01805 24 63 36
E-mail: contactcenter_germany@agilent.com

Ireland

Tel: +353 1890 924 204
Fax: +353 1890 924 024
E-mail: contactcenter_ireland@agilent.com

Italy

Tel: +39 02 92 60 8484
Fax: +39 02 92 10 4069
E-mail: contactcenter_italy@agilent.com

Luxembourg

Tel: +32 (0)2 404-9340
Fax: +32 (0)2 404-9395
E-mail: contactcenter_benelux@agilent.com

Netherlands

Tel: +31 (0)20 547 2111
Fax: +31 (0)20 547 2190
E-mail: contactcenter_benelux@agilent.com

Spain

Tel: +34 91 631 3300
Fax: +34 91 631 3301
E-mail: contactcenter_spain@agilent.com

Sweden

Tel: 0200 88 22 55
Fax: +46 (0)8 506 48616
E-mail: kundcenter_sverige@agilent.com

Switzerland

Tel: 0800 80 53 53
Fax: (0)1 272 7373 (German)
Fax: 022 567 5314 (Italian)
Fax: 022 567 5313 (French)
E-mail: contactcenter_switzerland@agilent.com

United Kingdom

Tel: +44 (0)7004 666666
Fax: +44 (0)7004 444555
E-mail: contactcenter_uk@agilent.com

Israel

Tel: +972 3 9288 555
Fax: +972 3 9288 501
E-mail: contactcenter_israel@agilent.com

Russia

Tel: +7 095 797 3900
Fax: +7 095 797 3901
E-mail: contactcenter_russia@agilent.com