Microwave Products

Handbook

September 1992

GEC PLESSEY
SEMICONDUCTORS

MICROWAVE PRODUCTS

Handbook

GEC PLESSEY
SEMICONDUCTORS

Foreword

GEC Plessey Semiconductors has an established broad portfolio of RF products within its Microwave activity covering frequencies from 10MHz to above 110GHz. This is built on an investment in microwave enabling technologies that includes Semiconductor diodes, Surface Acoustic Wave devices, Ferrite and Dielectric materials and Planar microstrip hybrid circuit integration. Coupled to this are extensive in-house design groups experienced in, not only RF design, but also mechanical stress analysis, thermal dissipation modeling and design for reliability. Combined with the in-house design and production of Silicon RF and ASIC integrated circuits, GPS offers customers a "total solution" to their RF requirements.

The Microwave group continues to support its involvement in the Space and Defence markets, in particular through the supply of customised integrated receiver modules and high power passive components to the Electronic Warfare, Guided Weapons, Radar, Communications, Navigation and IFF markets, as well as Hi-Rel thin and thick film circuits for Space applications.

GPS has expanded its capabilities in the design and manufacture of SAW filters and resonators with a range of surface mount packaged devices for the Personal Communications, Wireless LAN and Global Positioning markets.

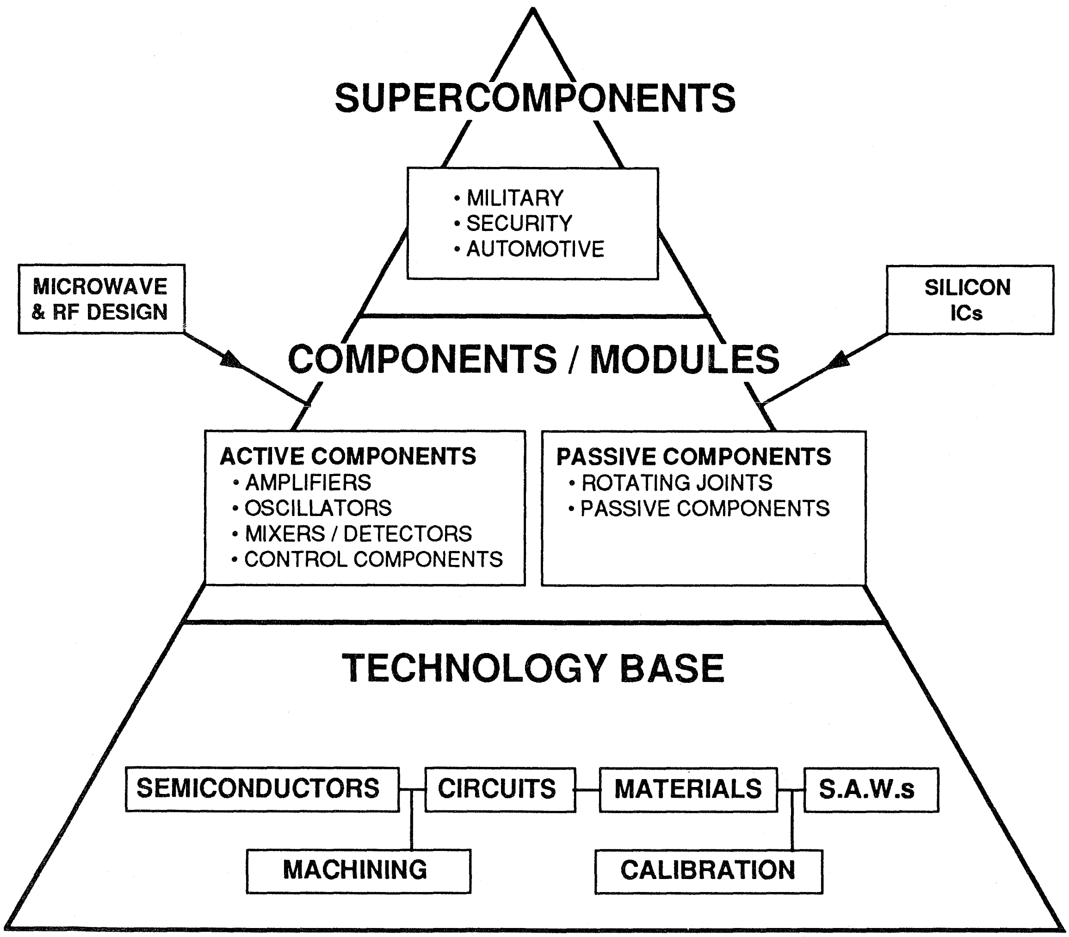
GPS is also active in the Automotive sector through the release of a range of Doppler module sensors, Auto-tolling transponders, Autonomous Intelligent Cruise Control radars and car fob key components.

All these product developments underline GPS' commitment to Innovative design, Quality manufacture and a Personalised customer service.

Contents

		Page
Foreword		2
Microwave & RF Vertically Integrated Product		4
Product List		5 to 21
Section 1:	**Microwave & R.F. Semiconductors**	23 to 205
Section 2:	**Microwave Materials**	207 to 221
Section 3:	**Microwave Hybrid Circuits**	223 to 234
Section 4:	**Surface Acoustic Wave Devices**	235 to 303
Section 5:	**Microwave Passive Components**	305 to 352
Section 6:	**Rotating Joints**	353 to 364
Section 7:	**Amplifiers**	365 to 366
Section 8:	**Mixers & Detectors**	367 to 368
Section 9:	**Control Components**	369 to 370
Section 10:	**Oscillators**	371 to 373
Section 11:	**Automotive Products**	375 to 398
Section 12:	**Supercomponents**	399 to 400
Section 13:	**GPS Locations**	401 to 407

Microwave & RF Vertically Integrated Product



Product List

TYPE No.	DESCRIPTION	PAGE
DA5800	MICROWAVE DOPPLER VEHICLE ALARM SENSOR	377
DA5800/02	MICROWAVE CAR ALARM SENSORS - APPLICATION NOTE	383
DA5802	MICROWAVE DOPPLER VEHICLE ALARM SENSOR	380
DA8009	8-12GHz ANTENNA	316
DA8030	9.4-10.7GHz DETECTOR MODULE	386
DA8031	9.4-10.7GHz DETECTOR MODULE	386
DA8032	24.0-24.5GHz DETECTOR MODULE	388
DA8042	8-12GHz ANTENNA	316
DA8043	8-12GHz ANTENNA	316
DA8044	18-26GHz ANTENNA	320
DA8045	18-26GHz ANTENNA	320
DA8046	18-26GHz ANTENNA	320
DA8504	10.5-10.7GHz DOPPLER MOTION DETECTION MODULE	389
DA8505	24.0-24.5GHz DOPPLER MOTION DETECTION MODULE	391
DA8505-1	24.0-24.5GHz DOPPLER MOTION DETECTION MODULE	391
DA8506	10.5-10.7GHz DIRECTION SENSING DOPPLER MODULE	393
DA8507	24.0-24.5GHz DIRECTION SENSING DOPPLER MODULE	395
DA8507-1	24.0-24.5GHz DIRECTION SENSING DOPPLER MODULE	395
DA9200	200MHz BANDPASS SAW FILTER - NARROW BANDWIDTH	250
DA9201	200MHz BANDPASS SAW FILTER - WIDE BANDWIDTH	252
DA9202	10.7MHz BANDPASS SAW FILTER	254
DA9203	63.5MHz BANDPASS SAW FILTER	256
DC1016	MINIATURE EPOXY PIN DIODE	129
DC1028A	MINIATURE EPOXY PIN DIODE	129
DC1101	CW IMPATT DIODE	199
DC1152	PULSED IMPATT DIODE	198
DC1191	CW IMPATT DIODE	199
DC1220 Series	MILLIMETRE WAVE GUNN DIODES	188
DC1251F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1251G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1251H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1251J	HIGH POWER MICROWAVE GUNN DIODE	192
DC1251K	HIGH POWER MICROWAVE GUNN DIODE	192
DC1251L	HIGH POWER MICROWAVE GUNN DIODE	192
DC1252F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1252G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1252H	HIGH POWER MICROWAVE GUNN DIODE	192

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC1252J	HIGH POWER MICROWAVE GUNN DIODE	192
DC1253F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1253G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1253H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1270 Series	MILLIMETRE WAVE GUNN DIODES	188
DC1275F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1275G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1275H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1281F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1281G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1281H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1281J	HIGH POWER MICROWAVE GUNN DIODE	192
DC1282F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1282G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1282H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1283G	HIGH POWER MICROWAVE GUNN DIODE	192
DC1283H	HIGH POWER MICROWAVE GUNN DIODE	192
DC1288F	HIGH POWER MICROWAVE GUNN DIODE	192
DC1301	GaAs SCHOTTKY X-BAND MICROSTRIP MIXER DIODE	49
DC1301C	GaAs SCHOTTKY X-BAND MICROSTRIP MIXER DIODE	49
DC1302	GaAs SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	55
DC1303	GaAs SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	53
DC1304	GaAs SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	55
DC1306	GaAs SCHOTTKY J-BAND MICROSTRIP BEAM LEAD MIXER DIODE	52
DC1312	GaAs SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	53
DC1314	GaAs SCHOTTKY J-BAND MICROSTRIP LID DETECTOR DIODE	54
DC1316	GaAs SCHOTTKY J-BAND MICROSTRIP LID DETECTOR DIODE	54
DC1321	GaAs SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	53
DC1322	GaAs SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODE	57
DC1323	GaAs SCHOTTKY J-BAND MICROSTRIP LID MIXER DIODE	50
DC1324	GaAs SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODE	57
DC1325	GaAs SCHOTTKY J-BAND WAVEGUIDE MIXER DIODE	56
DC1330	GaAs SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	55
DC1331	GaAs SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODE	59
DC1332	GaAs SCHOTTKY X-BAND MICROSTRIP MIXER DIODE	49
DC1333	GaAs SCHOTTKY X-BAND MICROSTRIP MIXER DIODE	49
DC1334	GaAs SCHOTTKY J-BAND MICROSTRIP LID MIXER DIODE	50

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC1335	GaAs SCHOTTKY J-BAND WAVEGUIDE DETECTOR DIODE	58
DC1338	GaAs SCHOTTKY Q-BAND MICROSTRIP MIXER DIODE	51
DC1339	GaAs SCHOTTKY Q-BAND MICROSTRIP MIXER DIODE	51
DC1340	GaAs SCHOTTKY J-BAND MICROSTRIP BEAM LEAD MIXER DIODE	52
DC1343	GaAs SCHOTTKY Q-BAND MICROSTRIP MIXER DIODE	51
DC1501	SILICON SCHOTTKY X-BAND DETECTOR DIODE FOR INTRUDER ALARM	83
DC1501	SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	76
DC1502	SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	76
DC1503	SILICON SCHOTTKY L-BAND MICROSTRIP LID MIXER DIODE	64
DC1504	SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	76
DC1505	SILICON SCHOTTKY S-BAND WAVEGUIDE MIXER DIODE	74
DC1507	SILICON SCHOTTKY S-BAND WAVEGUIDE MIXER DIODE	74
DC1508	SILICON SCHOTTKY S-BAND MICROSTRIP LID MIXER DIODE	65
DC1509	SILICON SCHOTTKY S-BAND MICROSTRIP LID DETECTOR DIODE	70
DC1510	SILICON SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	71
DC1511	SILICON SCHOTTKY S-BAND MICROSTRIP LID MIXER DIODE	65
DC1512	SILICON SCHOTTKY X-BAND DETECTOR DIODE FOR INTRUDER ALARM	83
DC1512	SILICON SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	71
DC1513	SILICON SCHOTTKY S-BAND MICROSTRIP LID DETECTOR DIODE	70
DC1514	SILICON SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODE	81
DC1515	SILICON SCHOTTKY S-BAND WAVEGUIDE DETECTOR DIODE	79
DC1516	SILICON SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODE	71
DC1517	SILICON SCHOTTKY S-BAND MICROSTRIP LID DETECTOR DIODE	70
DC1518	SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	76
DC1519	SILICON SCHOTTKY S-BAND MICROSTRIP LID MIXER DIODE	65
DC1520	SILICON SCHOTTKY J-BAND MICROSTRIP LID DETECTOR DIODE	72
DC1521	SILICON SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODE	81
DC1523	SILICON SCHOTTKY C-BAND MICROSTRIP LID MIXER DIODE	67
DC1524	SILICON SCHOTTKY J-BAND MICROSTRIP LID MIXER DIODE	69
DC1526	SILICON SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODE	81
DC1527	SILICON SCHOTTKY S-BAND WAVEGUIDE DETECTOR DIODE	79
DC1528	SILICON SCHOTTKY C-BAND MICROSTRIP LID MIXER DIODE	67
DC1529	SILICON SCHOTTKY C-BAND MICROSTRIP LID MIXER DIODE	67
DC1535	SILICON SCHOTTKY J-BAND WAVEGUIDE DETECTOR DIODE	82
DC1536F	SILICON SCHOTTKY X-BAND MICROSTRIP BEAM LEAD MIXER DIODE	68
DC1536G	SILICON SCHOTTKY X-BAND MICROSTRIP BEAM LEAD MIXER DIODE	68
DC1539	SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODE	76

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC1542	SILICON SCHOTTKY J-BAND WAVEGUIDE MIXER DIODE	78
DC1544	SILICON SCHOTTKY X-BAND DETECTOR DIODE FOR INTRUDER ALARM	83
DC1546	SILICON SCHOTTKY J-BAND WAVEGUIDE MIXER DIODE	78
DC1547	SILICON SCHOTTKY J-BAND WAVEGUIDE DETECTOR DIODE	82
DC1551	SILICON SCHOTTKY X-BAND ZERO BIAS WAVEGUIDE DETECTOR DIODE	80
DC1553	SILICON SCHOTTKY X-BAND ZERO BIAS MICROSTRIP LID DETECTOR DIODE	73
DC1554	SILICON SCHOTTKY X-BAND ZERO BIAS WAVEGUIDE DETECTOR DIODE	80
DC1557	SILICON SCHOTTKY X-BAND ZERO BIAS MICROSTRIP LID DETECTOR DIODE	73
DC1558	SILICON SCHOTTKY X-BAND ZERO BIAS WAVEGUIDE DETECTOR DIODE	80
DC1570	SILICON SCHOTTKY S-BAND WAVEGUIDE LOW DRIVE MIXER DIODE	90
DC1571	SILICON SCHOTTKY S-BAND MICROSTRIP LOW DRIVE MIXER DIODE	88
DC1572	SILICON SCHOTTKY S-BAND WAVEGUIDE LOW DRIVE MIXER DIODE	90
DC1573	SILICON SCHOTTKY S-BAND MICROSTRIP LOW DRIVE MIXER DIODE	88
DC1574	SILICON SCHOTTKY X-BAND WAVEGUIDE LOW DRIVE MIXER DIODE	91
DC1575	SILICON SCHOTTKY X-BAND MICROSTRIP LOW DRIVE MIXER DIODE	89
DC1576	SILICON SCHOTTKY X-BAND WAVEGUIDE LOW DRIVE MIXER DIODE	91
DC1577	SILICON SCHOTTKY X-BAND WAVEGUIDE LOW DRIVE MIXER DIODE	91
DC1578	SILICON SCHOTTKY X-BAND MICROSTRIP LOW DRIVE MIXER DIODE	89
DC1590	SILICON SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODE	86
DC1591	SILICON SCHOTTKY X & S-BAND MICROSTRIP INTEGRAL LIMITER MIXER DIODE	85
DC1593	SILICON SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODE	86
DC1595	SILICON SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODE	86
DC1596	SILICON SCHOTTKY X & S-BAND MICROSTRIP INTEGRAL LIMITER MIXER DIODE	85
DC1597	SILICON SCHOTTKY X & S-BAND MICROSTRIP INTEGRAL LIMITER MIXER DIODE	85
DC1801	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1802	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1803	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1804	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1805	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1806	PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODE	96
DC1820	PLANAR DOPED BARRIER MICROSTRIP BEAM LEAD MIXER DIODE	98
DC1821	PLANAR DOPED BARRIER MICROSTRIP BEAM LEAD MIXER DIODE	98
DC1822	PLANAR DOPED BARRIER MICROSTRIP BEAM LEAD MIXER DIODE	98
DC1823	PLANAR DOPED BARRIER Q-BAND MICROSTRIP BEAM LEAD DETECTOR DIODE	100
DC1824	PLANAR DOPED BARRIER MICROSTRIP BEAM LEAD MIXER DIODE	98
DC1840	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID MIXER DIODE	103
DC1841	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID DETECTOR DIODE	105

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC1842	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID MIXER DIODE	103
DC1843	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID MIXER DIODE	103
DC1844	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID MIXER DIODE	103
DC1845	PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID DETECTOR DIODE	105
DC1860	PLANAR DOPED BARRIER W-BAND MICROSTRIP COPLANAR MIXER DIODE	109
DC1870	PLANAR DOPED BARRIER WAVEGUIDE MIXER DIODE	111
DC1871	PLANAR DOPED BARRIER WAVEGUIDE MIXER DIODE	111
DC1872	PLANAR DOPED BARRIER X-BAND WAVEGUIDE DETECTOR DIODE	113
DC1873	PLANAR DOPED BARRIER X-BAND WAVEGUIDE DETECTOR DIODE	113
DC1874	PLANAR DOPED BARRIER WAVEGUIDE MIXER DIODE	111
DC2011	MIC PIN DIODE	130
DC2011A	MIC PIN DIODE	130
DC2011AR	MIC PIN DIODE	130
DC2012	MIC PIN DIODE	130
DC2013	MIC PIN DIODE	130
DC2013A	MIC PIN DIODE	130
DC2013AR	MIC PIN DIODE	130
DC2020	MICROSTRIP PIN DIODE	132
DC2023	MICROSTRIP PIN DIODE	132
DC2101A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2101B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2101C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2101G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2103A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2103B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2103C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2103G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2104A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2104B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2104C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2104F	CERAMIC WAVEGUIDE PIN DIODE	135
DC2104G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2110A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2110B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2110C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2110G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2118A	CERAMIC WAVEGUIDE PIN DIODE	135

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC2118B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2118C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2118G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2119A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2119B	CERAMIC WAVEGUIDE PIN DIODE	135
DC2119C	CERAMIC WAVEGUIDE PIN DIODE	135
DC2119G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2130A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2130G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2130G-1	CERAMIC WAVEGUIDE PIN DIODE	135
DC2140A	CERAMIC WAVEGUIDE PIN DIODE	135
DC2140G	CERAMIC WAVEGUIDE PIN DIODE	135
DC2171H	MICROSTRIP PIN DIODE	132
DC2172H	MICROSTRIP PIN DIODE	132
DC2210	DOUBLE DIFFUSED PIN DIODE	138
DC2211	DOUBLE DIFFUSED PIN DIODE	138
DC2262	DOUBLE DIFFUSED PIN DIODE	138
DC2310	DOUBLE DIFFUSED PIN DIODE	138
DC2316	DOUBLE DIFFUSED PIN DIODE	138
DC2363	DOUBLE DIFFUSED PIN DIODE	138
DC2367	DOUBLE DIFFUSED PIN DIODE	138
DC2403A	TRIPLATE STRIPLINE PIN DIODE	139
DC2410A	TRIPLATE STRIPLINE PIN DIODE	139
DC2412A	TRIPLATE STRIPLINE PIN DIODE	139
DC2418A	TRIPLATE STRIPLINE PIN DIODE	139
DC2418A-1	TRIPLATE STRIPLINE PIN DIODE	139
DC2419A	TRIPLATE STRIPLINE PIN DIODE	139
DC2419A-1	TRIPLATE STRIPLINE PIN DIODE	139
DC2443A	TRIPLATE STRIPLINE PIN DIODE	139
DC2510A	MIC PIN DIODE	130
DC2512A	MIC PIN DIODE	130
DC2518A	MIC PIN DIODE	130
DC2519A	MIC PIN DIODE	130
DC2552A	MIC PIN DIODE	130
DC2602	MIC PIN DIODE	130
DC2603	MIC PIN DIODE	130
DC2604	MIC PIN DIODE	130

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC2605	MIC PIN DIODE	130
DC2608	MIC PIN DIODE	130
DC2609	MIC PIN DIODE	130
DC2610A	MICROSTRIP PIN DIODE	132
DC2611	MICROSTRIP PIN DIODE	132
DC2612A	MICROSTRIP PIN DIODE	132
DC2613	MICROSTRIP PIN DIODE	132
DC2614	MICROSTRIP PIN DIODE	132
DC2615	MICROSTRIP PIN DIODE	132
DC2616	MICROSTRIP PIN DIODE	132
DC2618A	MICROSTRIP PIN DIODE	132
DC2619A	MICROSTRIP PIN DIODE	132
DC2620	MICROSTRIP PIN DIODE	132
DC2622	MICROSTRIP PIN DIODE	132
DC2623	MICROSTRIP PIN DIODE	132
DC2624D	MICROSTRIP PIN DIODE	132
DC2628	MICROSTRIP PIN DIODE	132
DC2652A	MICROSTRIP PIN DIODE	132
DC2817	GLASS PACKAGE PLANAR PIN DIODE	141
DC2825E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2839	GLASS PACKAGE PLANAR PIN DIODE	141
DC2840E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2841E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2842E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2843E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2844E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2845E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2846E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2847E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2848E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2848E-1	GLASS PACKAGE PLANAR PIN DIODE	141
DC2848E-2	GLASS PACKAGE PLANAR PIN DIODE	141
DC2848E-3	GLASS PACKAGE PLANAR PIN DIODE	141
DC2849E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2849E-1	GLASS PACKAGE PLANAR PIN DIODE	141
DC2849E-2	GLASS PACKAGE PLANAR PIN DIODE	141
DC2849E-3	GLASS PACKAGE PLANAR PIN DIODE	141

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC2850E	GLASS PACKAGE PLANAR PIN DIODE	141
DC2850E-1	GLASS PACKAGE PLANAR PIN DIODE	141
DC2916	UHF/VHF PIN DIODE	149
DC2917	UHF/VHF PIN DIODE	149
DC2918	UHF/VHF PIN DIODE	149
DC2919	UHF/VHF PIN DIODE	149
DC2926	UHF/VHF PIN DIODE	149
DC2927	UHF/VHF PIN DIODE	149
DC2928	UHF/VHF PIN DIODE	149
DC2929	UHF/VHF PIN DIODE	149
DC2929-2	UHF/VHF PIN DIODE	149
DC2936	UHF/VHF PIN DIODE	149
DC2936-1	UHF/VHF PIN DIODE	149
DC2936-2	UHF/VHF PIN DIODE	149
DC2937	UHF/VHF PIN DIODE	149
DC2938	UHF/VHF PIN DIODE	149
DC2939	UHF/VHF PIN DIODE	149
DC2941	UHF/VHF PIN DIODE	149
DC2943	UHF/VHF PIN DIODE	149
DC2956	UHF/VHF PIN DIODE	149
DC2956-1	UHF/VHF PIN DIODE	149
DC2957	UHF/VHF PIN DIODE	149
DC2958	UHF/VHF PIN DIODE	149
DC2958-2	UHF/VHF PIN DIODE	149
DC2962	UHF/VHF PIN DIODE	149
DC2972	UHF/VHF PIN DIODE	149
DC3031	BROADBAND BACK DIODE DETECTOR	121
DC3032	BROADBAND BACK DIODE DETECTOR	121
DC3033	BROADBAND BACK DIODE DETECTOR	121
DC3034	BROADBAND BACK DIODE DETECTOR	121
DC3037	BROADBAND BACK DIODE DETECTOR	121
DC3038	BROADBAND BACK DIODE DETECTOR	121
DC3039	BROADBAND BACK DIODE DETECTOR	121
DC3040	BROADBAND BACK DIODE DETECTOR	121
DC3041	BROADBAND BACK DIODE DETECTOR	121
DC3042	BROADBAND BACK DIODE DETECTOR	121
DC3043	BROADBAND BACK DIODE DETECTOR	121

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC3044	BROADBAND BACK DIODE DETECTOR	121
DC3047	BROADBAND BACK DIODE DETECTOR	121
DC3048	BROADBAND BACK DIODE DETECTOR	121
DC3049	BROADBAND BACK DIODE DETECTOR	121
DC3050	BROADBAND BACK DIODE DETECTOR	121
DC4210B	SILICON VHF/UHF TUNING VARACTOR	160
DC4211B	SILICON VHF/UHF TUNING VARACTOR	160
DC4212B	SILICON VHF/UHF TUNING VARACTOR	160
DC4213B	SILICON VHF/UHF TUNING VARACTOR	160
DC4214B	SILICON VHF/UHF TUNING VARACTOR	160
DC4215B	SILICON VHF/UHF TUNING VARACTOR	160
DC4216B	SILICON VHF/UHF TUNING VARACTOR	160
DC4217B	SILICON VHF/UHF TUNING VARACTOR	160
DC4218B	SILICON VHF/UHF TUNING VARACTOR	160
DC4224B	SILICON VHF/UHF TUNING VARACTOR	160
DC4225B	SILICON VHF/UHF TUNING VARACTOR	160
DC4226B	SILICON VHF/UHF TUNING VARACTOR	160
DC4227B	SILICON VHF/UHF TUNING VARACTOR	160
DC4228B	SILICON VHF/UHF TUNING VARACTOR	160
DC4229D	SILICON VHF/UHF TUNING VARACTOR	160
DC4229F	SILICON VHF/UHF TUNING VARACTOR	160
DC4232B	SILICON VHF/UHF TUNING VARACTOR	160
DC4233B	SILICON VHF/UHF TUNING VARACTOR	160
DC4234B	SILICON VHF/UHF TUNING VARACTOR	160
DC4244C	SILICON VHF/UHF TUNING VARACTOR	160
DC4255B	SILICON VHF/UHF TUNING VARACTOR	160
DC4256B	SILICON VHF/UHF TUNING VARACTOR	160
DC4257B	SILICON VHF/UHF TUNING VARACTOR	160
DC4265B	SILICON MICROWAVE TUNING VARACTOR	164
DC4266B	SILICON MICROWAVE TUNING VARACTOR	164
DC4267B	SILICON MICROWAVE TUNING VARACTOR	164
DC4285B	SILICON MICROWAVE TUNING VARACTOR	164
DC4286B	SILICON MICROWAVE TUNING VARACTOR	164
DC4287B	SILICON MICROWAVE TUNING VARACTOR	164
DC4298	SILICON VHF/UHF TUNING VARACTOR	160
DC4299	SILICON VHF/UHF TUNING VARACTOR	160
DC4301A	GaAs MICROWAVE TUNING VARACTOR	166

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC4301B	GaAs MICROWAVE TUNING VARACTOR	166
DC4302A	GaAs MICROWAVE TUNING VARACTOR	166
DC4302B	GaAs MICROWAVE TUNING VARACTOR	166
DC4303A	GaAs MICROWAVE TUNING VARACTOR	166
DC4303B	GaAs MICROWAVE TUNING VARACTOR	166
DC4304A	GaAs MICROWAVE TUNING VARACTOR	166
DC4304B	GaAs MICROWAVE TUNING VARACTOR	166
DC4305A	GaAs MICROWAVE TUNING VARACTOR	166
DC4305B	GaAs MICROWAVE TUNING VARACTOR	166
DC4371A	GaAs MICROWAVE TUNING VARACTOR	166
DC4371B	GaAs MICROWAVE TUNING VARACTOR	166
DC4372A	GaAs MICROWAVE TUNING VARACTOR	166
DC4372B	GaAs MICROWAVE TUNING VARACTOR	166
DC4373A	GaAs MICROWAVE TUNING VARACTOR	166
DC4373B	GaAs MICROWAVE TUNING VARACTOR	166
DC4374A	GaAs MICROWAVE TUNING VARACTOR	166
DC4374B	GaAs MICROWAVE TUNING VARACTOR	166
DC4375A	GaAs MICROWAVE TUNING VARACTOR	166
DC4375B	GaAs MICROWAVE TUNING VARACTOR	166
DC4402	SILICON NITRIDE CHIP CAPACITOR	202
DC4403	SILICON NITRIDE CHIP CAPACITOR	202
DC4404	SILICON NITRIDE CHIP CAPACITOR	202
DC4405	SILICON NITRIDE CHIP CAPACITOR	202
DC4406	SILICON NITRIDE CHIP CAPACITOR	202
DC4407	SILICON NITRIDE CHIP CAPACITOR	202
DC4408	SILICON NITRIDE CHIP CAPACITOR	202
DC4409	SILICON NITRIDE CHIP CAPACITOR	202
DC4410	SILICON NITRIDE CHIP CAPACITOR	202
DC4411	SILICON NITRIDE CHIP CAPACITOR	202
DC4412	SILICON NITRIDE CHIP CAPACITOR	202
DC4413	SILICON NITRIDE CHIP CAPACITOR	202
DC4414	SILICON NITRIDE CHIP CAPACITOR	202
DC4415	SILICON NITRIDE CHIP CAPACITOR	202
DC4416	SILICON NITRIDE CHIP CAPACITOR	202
DC4417	SILICON NITRIDE CHIP CAPACITOR	202
DC4418	SILICON NITRIDE CHIP CAPACITOR	202
DC4419	SILICON NITRIDE CHIP CAPACITOR	202

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DC4420	SILICON NITRIDE CHIP CAPACITOR	202
DC4421	SILICON NITRIDE CHIP CAPACITOR	202
DC4422	SILICON NITRIDE CHIP CAPACITOR	202
DC4423	SILICON NITRIDE CHIP CAPACITOR	202
DC4424	SILICON NITRIDE CHIP CAPACITOR	202
DC4425	SILICON NITRIDE CHIP CAPACITOR	202
DC4426	SILICON NITRIDE CHIP CAPACITOR	202
DC4439	SILICON NITRIDE CHIP CAPACITOR	202
DC4440	SILICON NITRIDE CHIP CAPACITOR	202
DC4451	SILICON NITRIDE CHIP CAPACITOR	202
DC4463	SILICON NITRIDE CHIP CAPACITOR	202
DC4464	SILICON NITRIDE CHIP CAPACITOR	202
DC4465	SILICON NITRIDE CHIP CAPACITOR	202
DC4466	SILICON NITRIDE CHIP CAPACITOR	202
DC4471	SILICON NITRIDE CHIP CAPACITOR	202
DC4475	SILICON NITRIDE CHIP CAPACITOR	202
DC4600 Series	GaAs HYPERABRUPT TUNING VARACTORS	168
DC4700 Series	GaAs HYPERABRUPT TUNING VARACTORS	168
DF9607	FERRITE POLARISER & FEED FOR Ku BAND APPLICATIONS	307
DF9608	FERRITE POLARISER & FEED FOR Ku BAND APPLICATIONS	307
DF9609	FERRITE POLARISER & FEED FOR Ku BAND APPLICATIONS	307
DF9610	FERRITE POLARISER & FEED FOR Ku BAND APPLICATIONS	307
DF9634	FEED HORN WITH INTEGRATED MAGNETIC POLARISER	309
DF9644	UNIVERSAL MAGNETIC POLARISER & OFFSET FEED HORN	310
DF9740	BLANK OFFSET FEED HORN	311
DF9741	SHORT FEED HORN FOR CIRCULAR POLARISED SIGNALS	312
DF9749	LONG FEED HORN FOR LINEARLY POLARISED SIGNALS	313
DF9750	LONG FEED HORN FOR LINEARLY POLARISED SIGNALS	314
DF9751	LONG FEED HORN FOR CIRCULAR POLARISED SIGNALS	315
DF9752	LONG FEED HORN FOR CIRCULAR POLARISED SIGNALS	315
DW1101	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1102	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1103	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1104	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1105	160MHz PROFESSIONAL BANDPASS SAW FILTER	262
DW1106	160MHz PROFESSIONAL BANDPASS SAW FILTER	262
DW1108	160MHz PROFESSIONAL BANDPASS SAW FILTER	262

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DW1121	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1147	21.4MHz PROFESSIONAL BANDPASS SAW FILTER	264
DW1152	70MHz PROFESSIONAL BANDPASS SAW FILTER	260
DW1155	21.4MHz PROFESSIONAL BANDPASS SAW FILTER	264
DW1401-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1404-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1406-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1408-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1409-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1411-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1502-I	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1503-I	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1505-I	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1603-M	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1605-M	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1701-K	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW1702-K	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW2501-G	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW9206	324.315MHz HIGH RELIABILITY SAW FILTER	258
DW9211	295.6MHz HIGH RELIABILITY SAW FILTER	259
DW9230	35.42MHz SAW FILTER FOR GLOBAL POSITIONING SYSTEMS	237
DW9231-I	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW9232-I	VESTIGIAL SIDEBAND FILTER FOR PROFESSIONAL APPLICATIONS	266
DW9237	433.92MHz SAW RESONATOR (APPLICATION NOTE)	244
DW9238	418.05MHz SAW RESONATOR (APPLICATION NOTE)	247
DW9240	65.8125MHz LOW LOSS SAW I.F. FILTER FOR PERSONAL COMMUNICATIONS	239
DW9241	78.8125MHz LOW LOSS SAW I.F. FILTER FOR PERSONAL COMMUNICATIONS	242
DW9503	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9504	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9508 Series	SAW RESONATOR OSCILLATORS	281
DW9509	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283
DW9510	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283
DW9511	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9512	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9513	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9514	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9515	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
DW9516	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283
DW9517	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9518	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9519	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9520	UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	273
DW9528	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283
DW9533	IFF TRANSMITTER DRIVE OSCILLATOR	285
DW9534	IFF TRANSMITTER DRIVE OSCILLATOR	285
DW9537	UHF FIXED FREQUENCY SAW RESONATOR OSCILLATOR	288
DW9538	TRIPLE OUTPUT FIXED FREQUENCY OSCILLATOR	290
DW9539	IFF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	276
DW9540	IFF FIXED FREQUENCY DELAY LINE SAW OSCILLATOR	276
DW9541	ECL COMPATIBLE SURFACE ACOUSTIC WAVE OSCILLATOR	292
DW9543	IFF RECEIVER TEST OSCILLATOR	278
DW9544	IFF RECEIVER TEST OSCILLATOR	278
DW9558	FIXED FREQUENCY SAW RESONATOR OSCILLATOR	283
DW9578	ECL COMPATIBLE SURFACE ACOUSTIC WAVE OSCILLATOR	292
DW9803	IFF DELAY LINE SAW VCO	297
DW9804	IFF DELAY LINE SAW VCO	297
DW9806	UHF DELAY LINE SAW VCO	295
DW9810	MULTIPLIED OUTPUT DELAY LINE OSCILLATOR	299
DW9822D	UHF DELAY LINE SAW VCO	295
DW9824	UHF DELAY LINE SAW VCO	295
DW9825D	UHF DELAY LINE SAW VCO	295
DW9827	UHF DELAY LINE SAW VCO	295
DW9846	UHF DELAY LINE SAW VCO	301
DW9847	UHF DELAY LINE SAW VCO	301
DW9852	UHF DELAY LINE SAW VCO	301
DW9853	UHF DELAY LINE SAW VCO	301
F1001	HIGH POWER WAVEGUIDE RESONATOR ISOLATOR	331
F1003	R26 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	335
F1003	R9 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	339
F1004	HIGH POWER WAVEGUIDE RESONATOR ISOLATOR	331
F1008	HIGH POWER WAVEGUIDE RESONATOR ISOLATOR	331
F1010	HIGH POWER WAVEGUIDE RESONATOR ISOLATOR	331
F1013	LOW POWER WAVEGUIDE CIRCULATOR	324
F1015	LOW POWER WAVEGUIDE CIRCULATOR	324

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
F1045	LOW POWER WAVEGUIDE CIRCULATOR	324
F1046	LOW POWER WAVEGUIDE CIRCULATOR	324
F1047	LOW POWER WAVEGUIDE CIRCULATOR	324
F1048	LOW POWER WAVEGUIDE CIRCULATOR	324
F1049	LOW POWER WAVEGUIDE CIRCULATOR	324
F1052	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1053	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1054	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1055	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1056	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1057	HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATOR	343
F1101-02	FERRITE TORRIDUCTOR CORE	220
F1101-06	FERRITE TORRIDUCTOR CORE	220
F1101-07	FERRITE TORRIDUCTOR CORE	220
F1101-08	FERRITE TORRIDUCTOR CORE	220
F1102-01	INDUCTIVE CORE	220
F1102-02	INDUCTIVE CORE	220
F1114	WAVEGUIDE SLIMLINE ISOLATOR	328
F1115	WAVEGUIDE SLIMLINE ISOLATOR	328
F1116	WAVEGUIDE SLIMLINE ISOLATOR	328
F1117	WAVEGUIDE SLIMLINE ISOLATOR	328
F1118	WAVEGUIDE SLIMLINE ISOLATOR	328
F1147	LOW POWER WAVEGUIDE CIRCULATOR	324
F1148	LOW POWER WAVEGUIDE CIRCULATOR	324
F1152	R26 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	335
F1152	R9 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	339
F1158	HIGH POWER AIR COOLED X-BAND WAVEGUIDE JUNCTION CIRCULATOR	351
F1241	R26 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	335
F1282	R9 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	339
F1284	R26 WAVEGUIDE COMPONENT FOR MICROWAVE HEATING SYSTEMS	335
F9100-01	ROTATING JOINT	355
F9100-04	ROTATING JOINT	355
F9100-05	ROTATING JOINT	355
F9100-06	ROTATING JOINT	355
F9100-07	ROTATING JOINT	355
F9100-08	ROTATING JOINT	355
F9100-09	ROTATING JOINT	355

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
F9100-10	ROTATING JOINT	355
F9100-11	ROTATING JOINT	355
F9100-12	ROTATING JOINT	355
F9100-13	ROTATING JOINT	355
F9100-16	ROTATING JOINT	355
F9100-23	ROTATING JOINT	355
F9100-24	ROTATING JOINT	355
F9100-25	ROTATING JOINT	355
F9101-01	ROTATING JOINT	355
F9101-02	ROTATING JOINT	355
F9101-03	ROTATING JOINT	355
F9101-04	ROTATING JOINT	355
F9101-05	ROTATING JOINT	355
F9101-06	ROTATING JOINT	355
F9101-07	ROTATING JOINT	355
F9101-08	ROTATING JOINT	355
F9101-09	ROTATING JOINT	355
F9101-10	ROTATING JOINT	355
F9101-11	ROTATING JOINT	355
F9101-12	ROTATING JOINT	355
F9101-13	ROTATING JOINT	355
F9101-14	ROTATING JOINT	355
F9101-15	ROTATING JOINT	355
F9101-16	ROTATING JOINT	355
F9101-17	ROTATING JOINT	355
F9101-19	ROTATING JOINT	355
F9101-20	ROTATING JOINT	355
G11A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213
G14A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213
G2A	YTTRIUM GADOLINIUM IRON GARNET	213
G3A	YTTRIUM GADOLINIUM IRON GARNET	213
G4A	YTTRIUM GADOLINIUM IRON GARNET	213
G5A	YTTRIUM GADOLINIUM IRON GARNET	213
G6A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213
G7A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213
G8A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213
G9A	YTTRIUM GADOLINIUM ALUMINIUM IRON GARNET	213

Product List (continued)

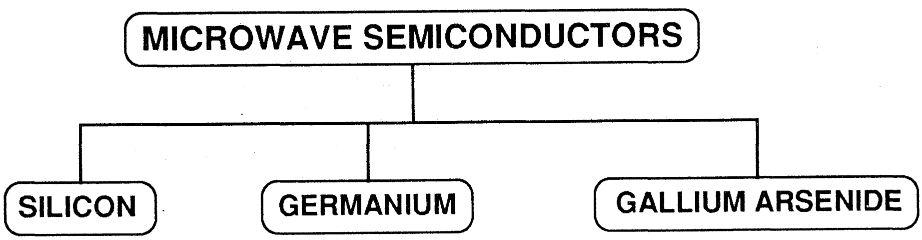
TYPE No.	DESCRIPTION	PAGE
L1A	LITHIUM TITANIUM ZINC IRON SPINEL	213
L2A	LITHIUM TITANIUM ZINC IRON SPINEL	213
L3A	LITHIUM TITANIUM ZINC IRON SPINEL	213
L4A	LITHIUM TITANIUM ZINC IRON SPINEL	213
L5A	LITHIUM TITANIUM ZINC IRON SPINEL	213
L6A	LITHIUM TITANIUM ZINC IRON SPINEL	213
M2A	MAGNESIUM MANGANESE ALUMINIUM IRON SPINEL	213
M3A	MAGNESIUM MANGANESE ALUMINIUM IRON SPINEL	213
M4A	MAGNESIUM MANGANESE ALUMINIUM IRON SPINEL	213
M5A	MAGNESIUM MANGANESE ALUMINIUM IRON SPINEL	213
M9A	MAGNESIUM MANGANESE ALUMINIUM IRON SPINEL	213
N10A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N11A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N2A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N3A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N4A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N5A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N7A	NICKEL CHRONIUM ZINC IRON SPINEL	213
N9A	NICKEL CHRONIUM ZINC IRON SPINEL	213
P2A	CERAMIC DIELECTRIC MATERIAL	212
PT-10.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-13.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-16.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-3.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-4.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-6.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
PT-8.0	SCHAEFER MICROWAVE DIELECTRIC MATERIAL	210
T3A	MICROWAVE CERAMIC DIELECTRIC MATERIAL	212
Y11A	YTTRIUM ALUMINIUM IRON GARNET	213
Y12A	YTTRIUM ALUMINIUM IRON GARNET	213
Y13A	YTTRIUM ALUMINIUM IRON GARNET	213
Y14A	YTTRIUM ALUMINIUM IRON GARNET	213
Y15A	YTTRIUM ALUMINIUM IRON GARNET	213
Y16A	YTTRIUM ALUMINIUM IRON GARNET	213
Y17A	YTTRIUM ALUMINIUM IRON GARNET	213
Y70A	NARROW LINEWIDTH GARNET	213
Y71A	NARROW LINEWIDTH GARNET	213

Product List (continued)

TYPE No.	DESCRIPTION	PAGE
Y72A	NARROW LINEWIDTH GARNET	213
Y73A	NARROW LINEWIDTH GARNET	213
Y74A	NARROW LINEWIDTH GARNET	213
Y75A	NARROW LINEWIDTH GARNET	213
Y76A	NARROW LINEWIDTH GARNET	213
Y77A	NARROW LINEWIDTH GARNET	213
Y78A	NARROW LINEWIDTH GARNET	213
Y9A	YTTRIUM ALUMINIUM IRON GARNET	213
	AUTOMOBILE CRUISE CONTROL SYSTEM	397

Section 1

Microwave & R.F. Semiconductors



GEC PLESSEY
SEMICONDUCTORS

Semiconductor Diodes

Silicon	• Epitaxial • Bulk • PIN / NIP • Schottky • Abrupt Varactors • Impatt • Noise • Capacitors
Germanium	• Tunnel
Galium Arsenide	• VPE / MOCVD / MBE • PIN / NIP • Schottky • Planar Doped Barrier • Abrupt Varactors • Hyperabrupt Varactors • Gunn • Impatt

CT3508-1.2 August 1992

MIXER & DETECTOR DIODES - INTRODUCTION

INTRODUCTION

A mixer is a sensitive receiver circuit which makes use of the nonlinear properties of a mixer diode to produce a difference frequency (I.F.) by mixing the received signal frequency with that of a local oscillator (L.O.) This can be done with a single diode or more commonly, with multiple diodes in balanced or double balanced mixer circuits. This reduces the effect of local oscillator noise and suppresses the generation of unwanted frequencies.

For applications with relaxed sensitivity the video detector is a good alternative receiver. This circuit uses a diode rectifier as a direct square law detector of a modulated signal. It can detect signals of about - 50dBm compared with about - 100 dBm for a mixer of comparable bandwidth. However, the circuitry is simplified and broad bandwidth can be attained without the problem of tracking the local oscillator frequency.

Semiconductor mixer and detector diodes for microwave applications are usually based on two main mechanisms. The phenomena of majority carrier injection across a potential barrier, such as the conventional Schottky barrier diode or the more recently introduced planar doped barrier (PDB), and quantum mechanical tunnelling of change carriers through a PN junction, such as the tunnel or backward diode.

METAL SEMICONDUCTOR (SCHOTTKY) BARRIER DIODES

The metal semiconductor junction of the Schottky barrier device is formed by vacuum deposition of a metal layer directly onto a freshly exposed semiconductor surface (Figure 1). The diode is more reproducible and rugged than a point contact diode and exhibits better long duty cycle burnout and flicker noise performance resulting from the larger area junction. Unlike the PN junction diode, the rectifying contact is based on majority carrier conduction and in normal operation exhibits virtually no storage of minority carriers. This results in more efficient rectification at high frequencies.

Silicon Schottky barrier diodes are available in either N type or P type polarity and with high, medium or low barrier height. They are general purpose diodes for applications requiring high performance mixers and detectors, low drive mixer diodes in systems where available local oscillator power is restricted and zero bias detectors. Gallium Arsenide diodes are available in N type only and are generally higher barrier height than silicon diodes. However, the higher carrier mobility results in a much lower series resistance and improved high frequency performance. These diodes are used in mixer applications requiring a better noise figure than can be achieved with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

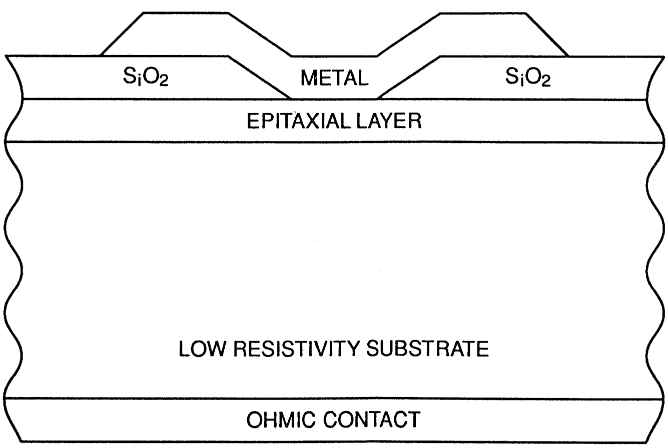


Figure 1

Both types of diode are available in a variety of packages suitable for coaxial, waveguide,tri-plate and microstrip feeders. Unpackaged die or beam lead diodes are available for higher frequency applications where the parasilic capacitance and inductance need to be minimised. For volume assembly, the gallium arsenide devices are available as a coplanar flip chip which is compatible with automated test & assembly equipment Integrated die such as ring quads, bridge quads, series pairs and common cathode or anode pairs can be supplied in either beam lead or coplanar outlines.

GERMANIUM BACKWARD DIODES

The backward diode is a low peak current tunnel diode which acts as a highly efficient rectifier over a limited voltage range but in the reverse direction, hence the term "backward diode". The junction structure (Figure 2) is similar to that of the tunnel diode, but the tunnelling is reduced from the high levels of a conventional diode to such levels that a negative resistance is almost non existent.

The microwave applications of the backward diode are primarily as a low level broadband detector, but also as a doppler mixer and mixer applications with low power local oscillators. As a mixer, the performance is not greatly degraded as the intermediate frequency is reduced to the KHz region. For low level detector applications, the backward diode exhibits improved tangential sensitivity (for a comparable video impedance) and temperature stability over Schottky barrier diodes, with the added advantage of zero bias operation. The cheif disadvantage of the backward diode is its inherent limited dynamic range.

The backward diode is available in a variety of package styles and also as a detector module consisting of a germanium backward diode chip with integrated thin film capacitor and broadband matching circuit on a microstrip tile. The modules can be supplied as fully RF tested tiles or in various package configurations and with either resistive or reactive input matching. Typical applications for the modules included power monitors, detector log video amplifiers, automatic levelling circuits and built in test equipment.

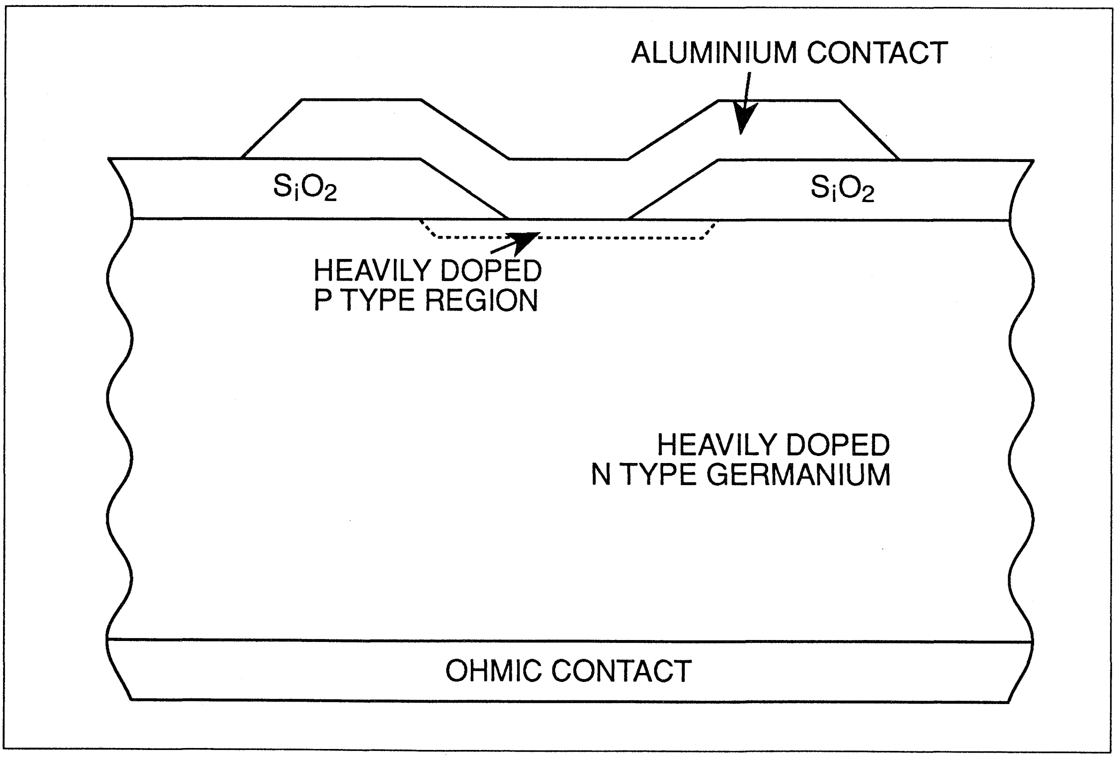


Figure 2

PLANAR DOPED BARRIER DIODES

Advances in epitaxial growth techniques have enabled gallium arsenide planar doped barrier (PDB) diode structures to be grown (Figure 3). These consist of a thin heavily doped P type acceptor within an undoped semiconductor layer, bounded by heavily doped N type donor layers. By variation of the thickness and doping concentration of the various layers, the barrier height and degree of asymmetry of the structure can be independently varied. This has enabled the design of materials for low bias mixer, zero bias detector and symmetrical subharmonic mixer applications.

PDB diodes offer several advantages over conventional Schottky barrier devices. Their design flexibility permits reduced drive levels to achieve a minimum conversion loss, improved detector sensitivity and extended dynamic range. They exhibit reduced low frequency (flicker) noise generation, resulting from the use of a larger area junction which is buried within the bulk of the semiconductor material. This combination also offers considerably improved pulsed burnout performance at low duty cycles and short pulse lengths and a marginal improvement at longer duty cycles and pulse lengths. Finally, the construction offers an inherently improved temperature stability.

As with the Schottky devices, PDB diodes are available in a variety of co-axial, waveguide, tri-plate and microstrip packages or in the low parasitic beam lead and coplanar flip chip outlines. Integrated die such as ring quads, bridge quads, series pairs and common cathode or anode pairs can also be supplied.

DEVICE THEORY
METAL SEMICONDUCTOR (SCHOTTKY) BARRIER DIODE

The operation of a metal semiconductor diode can best be understood by refering to its appropriate electron energy diagrams shown in figure 4 (overleaf). These show the energies of free electrons in the metal in for example an n-type semiconductor under various conditions of bias.

Both diffusion and diode theories predict an ideal I-V characteristic of the form:

$$I = I^{S}(e^{\alpha V}-1) \qquad \text{............(1)}$$

where $\alpha = \dfrac{e}{nkT}$

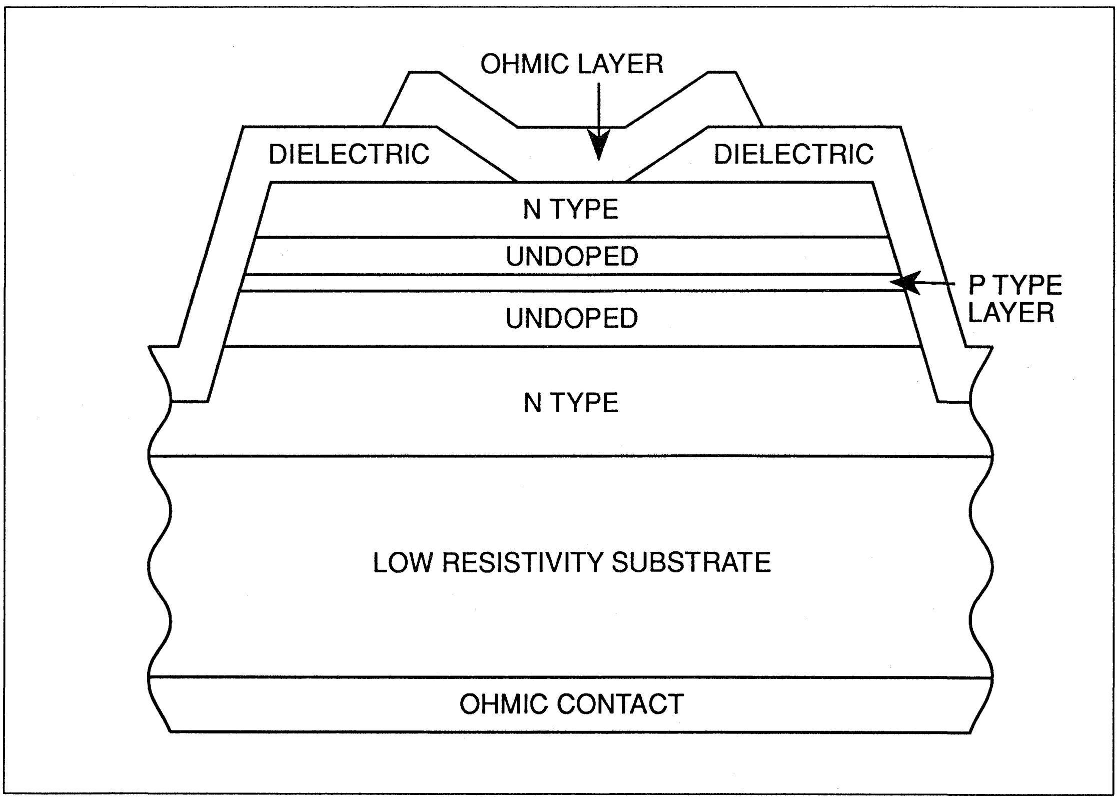


Figure 3

Thus $I = I_s [(\exp \frac{eV}{nkT}) - 1]$ ....(2)

where
I_s is the saturation current
e is electron charge = 1.6×10^{-18} (coulomb)
T is absolute temperature (°K)
k is Boltzmann's constant = 1.38×10^{-23} (Joule/°K)
V is voltage across the diode junction (volts)
n is termed the ideality factor and should equal 1.0 for an ideal characteristic.

That is $\frac{e}{kT} = 40\ (\text{volt})^{-1}$

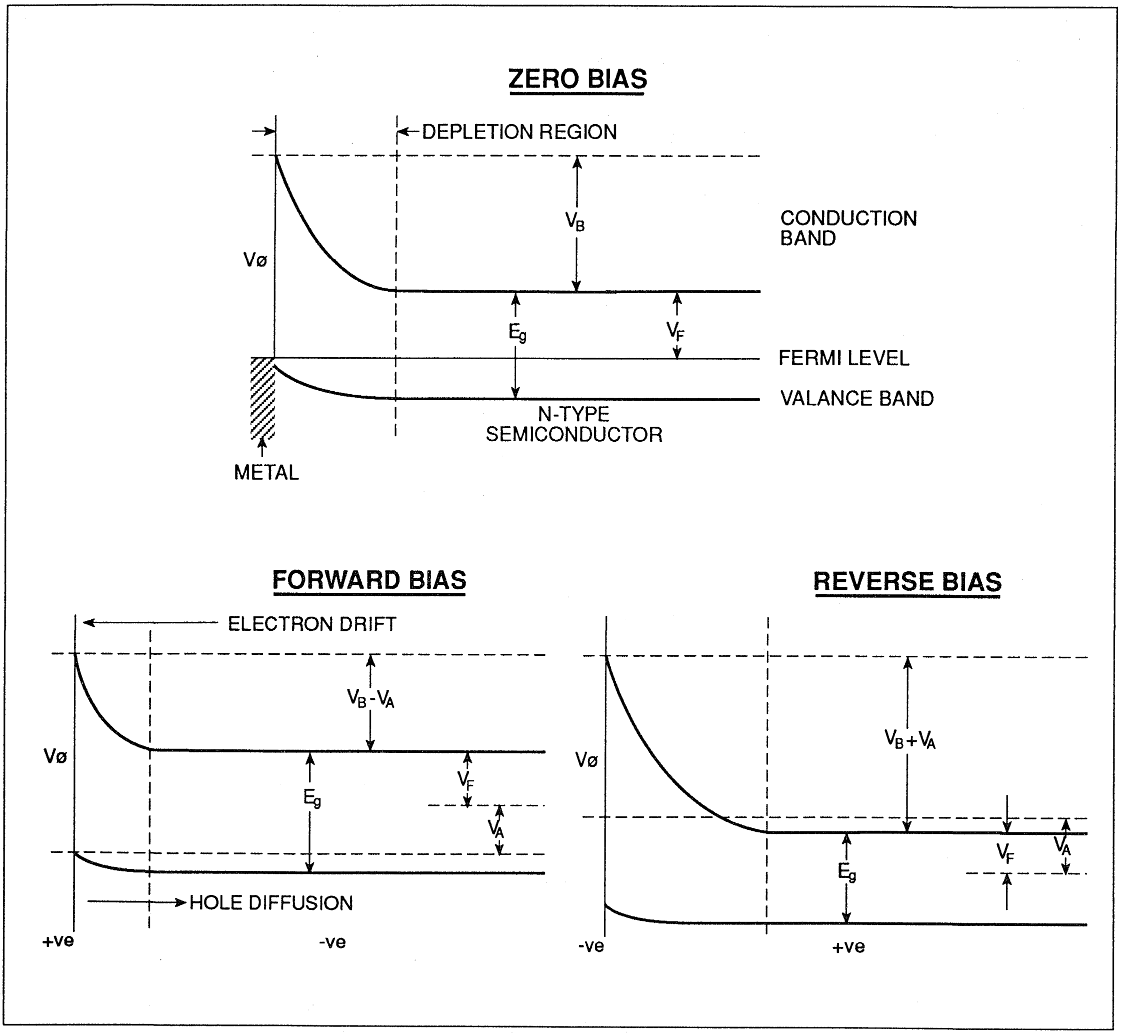


Figure 4. Metal semiconductor junction electron energy diagrams

GERMANIUM BACKWARD DIODE

Since electrons can be considered to have wave properties, they have the ability to penetrate potential barriers. This effect is known as quantum mechanical tunnelling. The most familiar example is the tunnel diode where impurity concentrations on both sides of a p-n junction are such that an increase in tunnelling current is followed by a decrease producing a negative resistance. The expression for the tunnelling current is

$$j \,\alpha\, \exp\left[-\frac{AM^{1/2}E_g^{3/2}}{F}\right] \qquad \text{...........(3)}$$

where
A = numerical constant
m = reduced mass of holes or electrons
E_g = energy gap of semiconductor
F = average electric field across the space charge region

F is inversely proportional to the width of the space charge region of the p-n junction. A wide space charge region means low tunnelling current, a narrow one means high tunnelling current. For a backward diode, it is necessary to reduce the tunnelling current from the high levels of a tunnel diode to such levels that a negative resistance is almost non-existent. The expression for the width of the space charge region of an abrupt junction is:

$$W = \left[\frac{2\,\varepsilon\,(N_D + N_A)}{e\,N_D\,N_A}\;(V_D + V_A)\right]^{1/2} \qquad \text{...........(4)}$$

where
N_D = donor concentration
N_A = acceptor concentration
V_D = built-in 'diffusion' voltage
V_A = applied bias voltage
ε = dielectric constant of semiconductor
e = electron charge

Thus, if in fabrication one doping level is kept constant at some high level, the space charge can be adjusted by decreasing the other impurity level.

The consequences of forming a junction on a highly doped semiconductor may best be illustrated by simple energy band diagrams. These are shown in figure 5 (overleaf), for different conditions of bias.

The predicted I-V characteristic of a backward diode is of the form

$$I = C_1\,V(S - eV)^2 \exp[-C_2(\Delta E_g - eV)^{1/2}] \qquad \text{...........(5)}$$

where $C_1 = \frac{Ae}{kT}$ (A is a numerical constant)

S = penetration of Fermi level
C_2 = constant determined by semiconductor carrier properties
E_g = energy gap of semiconductor
e = electronic charge
V = voltage across diode junction

PLANAR DOPED BARRIER DIODE

The planar doped barrier diode is a majority carrier device in which it is possible to control the barrier height and degree of rectification from within a series of epitaxially grown layers. The n^+-i-p^+-i-n^+ PDB structure is shown in figure 6. The p^+ layer is contained between two undoped i regions which are bounded by two highly doped N^+ regions. The P^+ region is sufficiently thin (<100Å) to be fully depleted and gives rise to the potential profile shown in Figure 7a. The relative position of the P^+ region within the i region determines the degree of asymmetry in the barrier.

An applied bias modifies the profile, changing the current (which is controlled by thermionic emission over the barrier in both directions) and giving the desired rectifying characteristics.

CURRENT-VOLTAGE CHARACTERISTICS

The simplest expression for the current density of a planar doped barrier diode in the thermionic regime is given by:

$$J = A^{**}T^2 \exp\{\frac{-q\emptyset_o}{kT}\}\,[\exp\{\frac{q\alpha_2 V}{kT}\} - \exp\{\frac{-q\alpha_1 V}{kT}\}] \qquad \text{..........(6)}$$

where A^{**} is the effective Richardson constant,

$$\alpha_1 = \frac{l_1}{l_1 + l_2},\ \alpha 2 = \frac{l_2}{l_1 + l_2} \text{ and } \emptyset_0 = \frac{l_1\,l_2}{l_1 + l_2}\cdot\frac{N_a}{\varepsilon_o\,\varepsilon_r} \qquad \text{........(7)}$$

in which l_1 and l_2 are the thickness of the intrinsic regions of the material and N_a is the areal density of the P^+ region.

For a symmetrical diode $l_1 = l_2$ and therefore $a_1 = a_2$.

The value of the zero bias barrier height may be determined experimentally from the temperature dependence of J or from the plot of Log (J) versus voltage V.

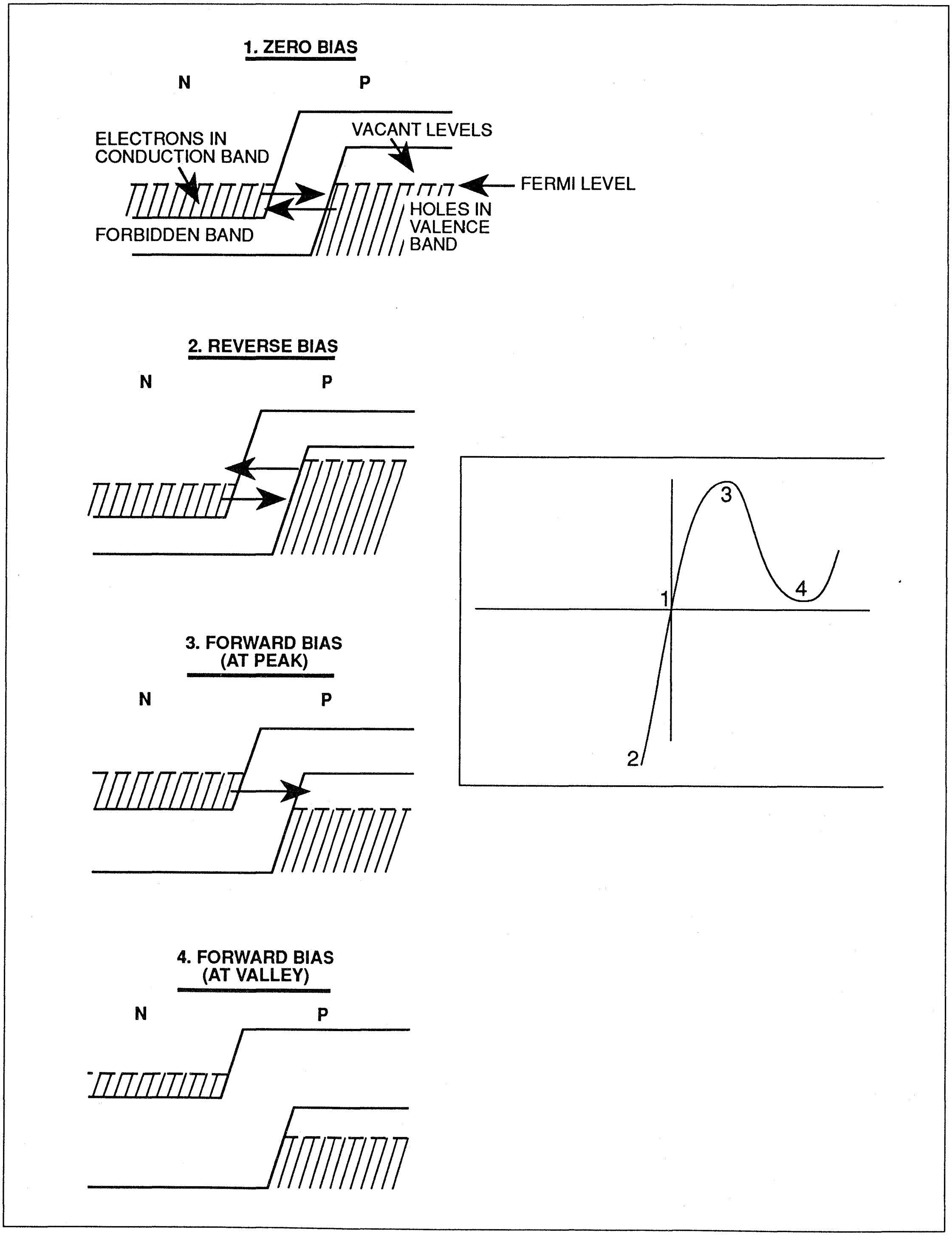
An extrapolation of the asymptote of the high bias regime to the current axis yields the value of J_0 where from the above formula:

$$J_0 = A^{**}T^2 \exp\frac{\{q\emptyset_o\}}{kT} \qquad \text{...........(8)}$$

Hence:

$$\emptyset_o = \frac{kT}{q}\,\mathrm{Ln}\,\frac{(A^{**}T^2)}{J_o} \qquad \text{...........(9)}$$

Under applied bias the barrier height is modified as shown in figure 7(b). $\emptyset_1$ (V) and $\emptyset_2$ (V) form the new values. The relationship between the current at a voltage +V and at a voltage -V in any one device can be shown to be:



1. ZERO BIAS
N
P
ELECTRONS IN
CONDUCTION BAND
VACANT LEVELS
FERMI LEVEL
HOLES IN
VALENCE
BAND
FORBIDDEN BAND
2. REVERSE BIAS
N
P
3. FORWARD BIAS
(AT PEAK)
N
P
4. FORWARD BIAS
(AT VALLEY)
N
P
1
2
3
4

Figure 5

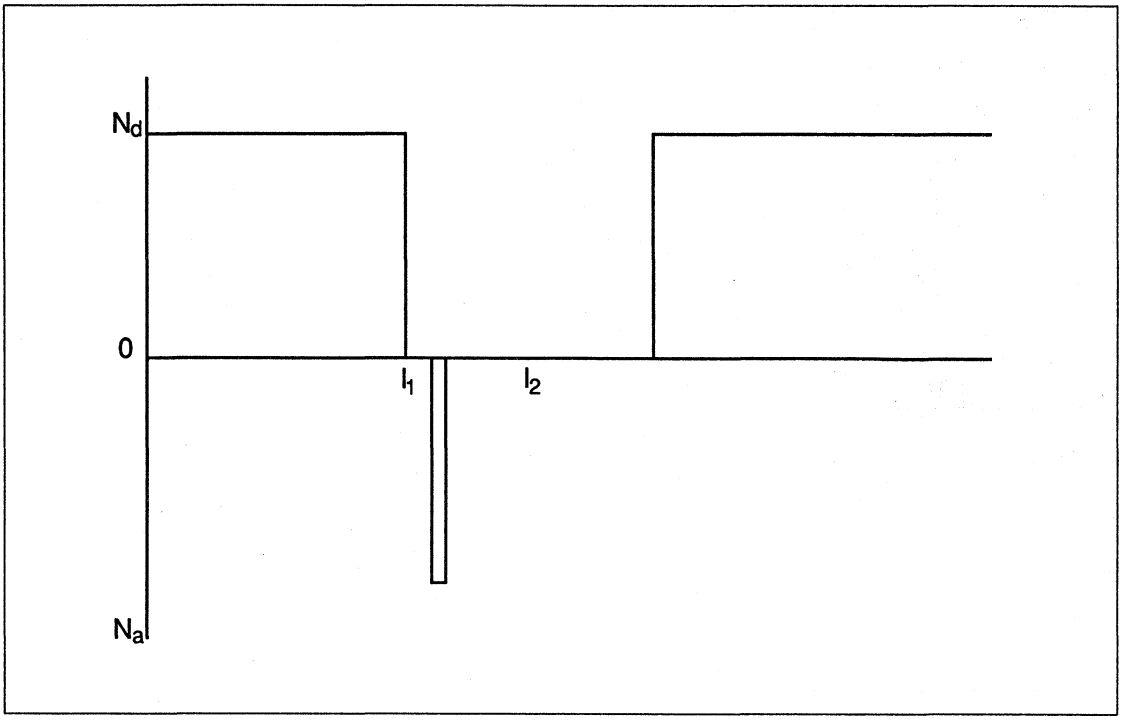


Figure 6. Planar doped barrier doping profile

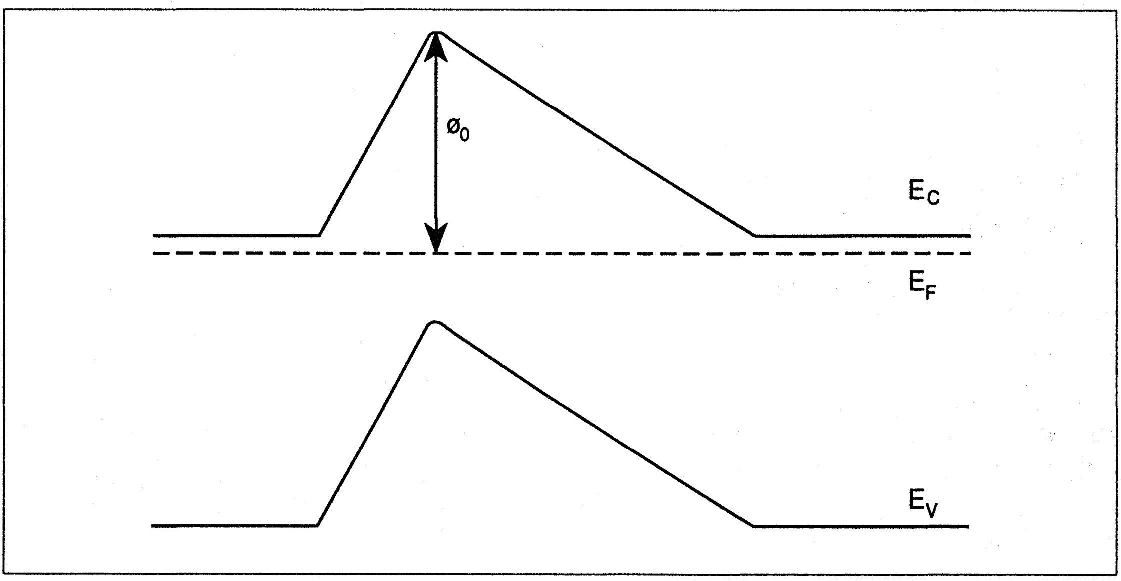


Figure 7a. Conduction band profile

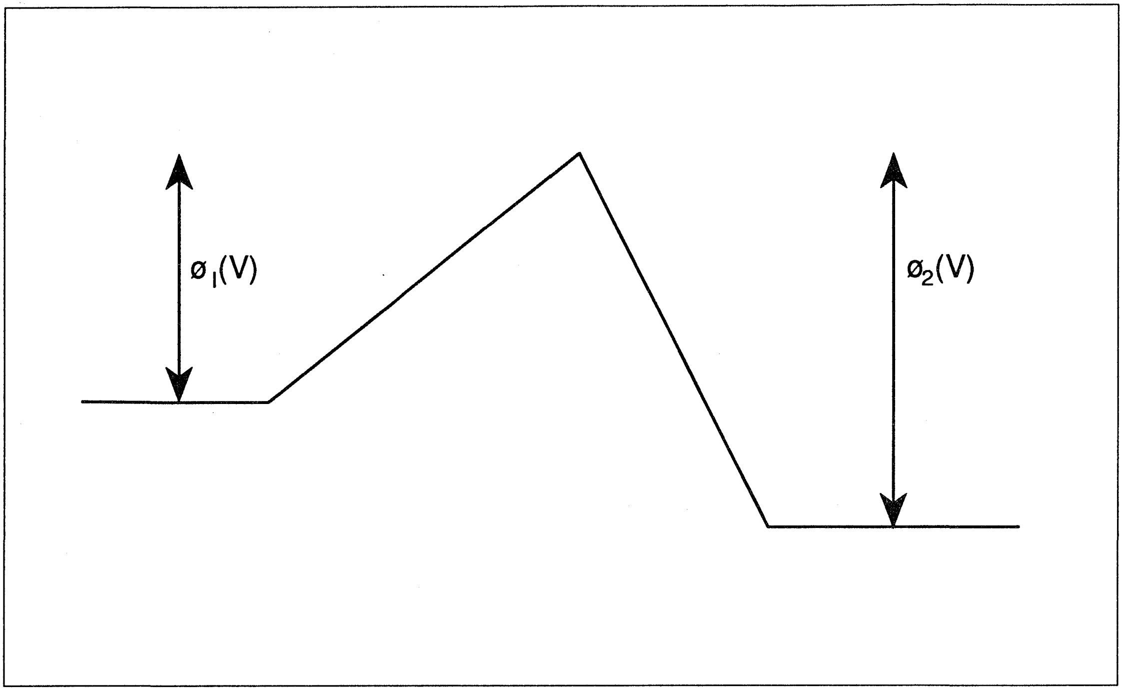


Figure 7b. Conduction band profile

$$\frac{|I(V)|}{|I(-V)|} = e^{\beta V} e^{\beta(\varnothing_2(V) - \varnothing_2(-V))} \quad ....(10)$$

where:

$$\beta = \frac{q}{kT}$$

As $\varnothing_2(V) - \varnothing_2(-V) = 0$ for a perfect diode, then for any diode:

$$|I(V)| \leq |I(-V)| e^{\beta V} \quad ....(11)$$

This effectively determines the limit of asymmetry achievable from a PDB diode.

CAPACITANCE

The junction capacitance (c) for a planar doped barrier diode (ignoring depletion and diffusion capacitance terms) is given simply by:

$$Cj = \frac{\varepsilon_r \varepsilon_o a}{(l_1 + l_2)} \quad ....(12)$$

where a is the device area.

Thus the capacitance is effectively constant and independent of applied voltage. In fact as the i layers are lightly doped this holds true even when forward bias voltages are applied.

SERIES RESISTANCE

For any processed PDB diode the Resistance (R_T) is given by:

$$R_T = \Sigma R_c + \Sigma R_{sp} + \Sigma R_{in} + R_b \quad ....(13)$$

where R_C is the contact resistance associated with the ohmic contacts to the two N^+ regions, R_{sp} is the sum of the spreading resistances through the N^+ regions, R_{in} is the contribution to the series resistance from the intrinsic regions and R_b is the barrier resistance.

All the terms have to be considered in the design of a PDB diode. In particular the contribution from the R_i term should not be ignored as under high bias conditions the high resistivity intrinsic regions can contribute significantly to the device series resistance.

CURVATURE COEFFICIENT

When considering PDB diodes for detector applications the figure of merit characterising the current sensitivity of a detector diode is the curvature coefficient γ.

where $$\gamma = \left[\left(\frac{d^2I}{dV^2}\right)/\left(\frac{dI}{dV}\right)\right] \qquad \text{...........(14)}$$

For a PDB diode, with a current-voltage relationship given by equation (6),γ is given by:

$$\gamma = \frac{\left[\left(\frac{e\alpha_2}{kT}\right)^2 .\exp\left(\frac{e\alpha_2 V}{kT}\right) - \left(\frac{e\alpha_1}{kT}\right)^2 .\exp\left(\frac{-e\alpha_1 V}{kT}\right)\right]}{\left[\left(\frac{e\alpha_2}{kT}\right)^2 .\exp\left(\frac{e\alpha_2 V}{kT}\right) + \left(\frac{e\alpha_1}{kT}\right)^2 .\exp\left(\frac{-e\alpha_1 V}{kT}\right)\right]} \qquad \text{......(15)}$$

The temperature dependence of γ for an asymmetric PDB diode has been shown to vary by approximately 35% over the temperature range 225-350K.

RECEIVER THEORY
MIXER DIODES

Noise Factor

The concept of the ability to detect a signal that is comparable in level to the noise may be expressed qualitatively by the use of 'noise factor', defined by the following expression.

$$F = \frac{\frac{S}{KTB}}{\frac{S_o}{N_o}} \qquad \text{...........(16)}$$

Where
F = Noise factor of the network
S = Available signal power from the signal source
S_0 = Available signal power from the network
N_0 = Available noise power from the network
K = Boltzmann's constant
T = Absolute temperature of the signal source
B = Noise bandwidth of the network

Thus $$F = \frac{S}{S_o}\,\frac{N_o}{KTB}$$

$$= \frac{1}{G}\,\frac{N_o}{KTB} \qquad \text{...........(17)}$$

Where G is the availabe noise power from the network.

The available noise power from the network can be conveniently regarded as arising from a resistor at an equivalent noise temperature T_0 where T_0 is defined by the expression.

$$N_o = K\,T_o\,B \qquad \text{...........(18)}$$

Thus equation 17 may be re-written as

$$F = \frac{1}{G}\,\frac{T_o}{T} \qquad \text{...........(19)}$$

Considering the more usual case of two networks in cascade, the noise factor of the combination may be shown to be,

$$F_{(1)(2)} = F_{(1)} + \frac{F_{(2)} - 1}{G_{(1)}} \qquad \text{...........(20)}$$

Where
$F_{(1)(2)}$ = the noise factor of network (1)
$F_{(2)}$ = the noise factor of network (2)
$G_{(1)}$ = the available power gain of network (1).

Bandwidth of network (2) assumed less than network (1).

If $T_{(1)}$ is the equivalent noise temperature of network (1) then

$$F_{(1)} = \frac{1}{G_{(1)}}\,\frac{T}{T_{(1)}}$$

OR $$F_{(1)} = \frac{t(1)}{G_{(1)}}$$

Where $$t_{(1)} = \frac{T_{(1)}}{T}$$

Hence expression (20) becomes

$$F_{(1)(2)} = \frac{t_{(1)} + F_{(2)} - 1}{G_{(1)}} \qquad \text{...........(22)}$$

SUPERHETERODYNE RECEIVER PERFORMANCE

The overall noise factor performance of a superheterodyne receiver may be given by

$$F_o = L_c(F_{if} + N_r - 1) \qquad \text{...........(23)}$$

assuming any local oscillator noise is adequately suppressed, where L_c is the conversion loss of the mixer diode, N_r is the noise temperature ratio of the mixer diode and F_{if} is the noise factor of the following i.f. amplifier. Hence L_C and N_r are the mixer diode parameters determining the value of overall noise factor and these should be minimised.

Diode Requirements

Conversion loss and noise temperature ratio.

A diode rectifier may be represented by the simple equivalent circuit of the barrier resistance R_B, shunted by the barrier capacitance C_B and this combination being in series with the spreading resistance R_S. The actual mixing is accomplished by the non-linear barrier resistance, the series resistance and barrier capacitance acting as parasitics which degrade the conversion loss.

The theory of mixing shows that the conversion loss of the mixer diode is

(1) Dependent on the low frequency rectification properties of the junction. That is, the minimum low frequency conversion loss that can be realised under various conditions of image termination is a function of the diode exponent X. The value of X is the slope of a log-log plot of the diode current voltage characteristic, or,

$$x = \frac{d \log I}{d \log V} \qquad \text{...........(24)}$$

(2) At an angular frequency ω, the conversion loss Lc is given by

$$L_c = L_o \frac{R_s + \dfrac{R_B}{1 + (\omega C_B R_B)^2}}{\dfrac{R_B}{1 + (\omega C_B R_B)^2}} \qquad \text{...........(25)}$$

Where	L_O	= Low frequency conversion loss determined by the I-V characteristic
	R_B	= Barrier resistance
	C_B	= Barrier capacitance
	R_S	= Series resistance

Thus at any frequency at which the barrier capacitance is significant, the product of the parasitics (series resistance and barrier capacitance) must be minimised for optimum conversion loss and thus satisfactory mixer performance.

Therefore $L_c \alpha C_B R_s$ ....(26)

The contributions to the noise temperature ratio Nr of the diode are the thermal noise of the series resistance, shot noise of the barrier and the flicker noise which is characteristic of the semiconductor. At intermediate frequencies in the MHz range, the major contribution is usually shot noise, but at lower frequencies flicker noise predominates. Noise temperature ratio is related to the semiconductor surface treatment, method of forming the junction, junction area, the ohmic contact and finally the reverse current leakage. In practise a large junction area and low reverse current leakage are both desirable properties for minimising noise temperature ratio.

DETECTOR DIODES

A noise figure cannot be defined (as for a superheterodyne receiver) for a crystal video receiver. Instead a signal level is found such that the output signal power is just equal to or a specified level above the output noise power.

Video Detector Receiver Performance

The quality of the video crystal detector can be expressed quantitively in terms of short circuit current sensitivity and video impedance, by the "figure of merit" which may be defined by:

$$M = ß Z_V^{1/2}$$

where ß is the microwave current sensitivity and Z_V is the video impedance.

However, the expression does not include the noise properties of the detector and does not present the true quality of devices under conditions of forward bias.

A widely used performance criterion for video detectors is tangential sensitivity which indicates the ability of the detector to detect a signal against a noise background, and includes the noise properties of the detector and video amplifier.

The tangential sensitivity performance in watts may be derived from the following equation

$$S_t = \frac{1}{ß\sqrt{Z_V}}\{4\, Y\, KTB(F_v + t - 1)\}^{1/2}$$

Where	K	= Boltzmann's constant
	T	= absolute temperature
	B	= video amplifier bandwidth in Hz
	F_v	= video amplifier noise figure
	t	= noise temperature ratio of detector diode
and	Y	= an experimentally determined factor, relating the edge to edge height of a band of Gaussian noise to its r.m.s. value when displayed on an oscilloscope, i.e. 6.3.

DIODE REQUIREMENTS

Sensitivity

Assuming that the forward bias current, I, and the voltage across the barrier, V, are related by the usual equation,

$$I = Is\,(e^{\alpha V} - 1)$$

Then the current sensitivity ß at an angular frequency ω, is given by:

$$\beta = \frac{\alpha}{2\left(1+\frac{R_s}{R_B}\right)^2} \quad \frac{1}{\left(1+\frac{\omega^2 C_B^2 R_s R_B}{R_B + R_s}\right)} \qquad \text{...........(29)}$$

Assuming $R_B >> R_S$. this reduces to

$$\beta \approx \frac{\alpha}{2} \quad \frac{1}{1+\omega^2 C_B^2 R_B R_S} \qquad \text{...........(30)}$$

$$\text{or}\quad \beta \approx \frac{\beta_o}{1+\omega^2 C_B^2 R_B R_S} \qquad \text{...........(31)}$$

where β_o is the low frequency current sensitivity determined by the curvature of the I-V characteristics at the operating point.

Thus, similar considerations apply to detector and mixer diodes, i.e. for high efficiency, missing section - see original Cb in contrast to linear dependency for the mixer.

For detector applications the best type of I-V charactics is one with maximum curvature at the operating point and it is desirable that this should occur at zero bias, as the use of the bias current say introduce some additional noise in to the systems.

Due to the greater curvature at the origin and steeper I-V characteristics associated with the backward diode, the backward diode may be expected to have a potentially higher current sensitivity than do Schottky diodes. Further, as the curvature occurs at the origin, optimum current sensitivity may be expected at zero bias.

TYPICAL D.C. CHARACTERISTICS

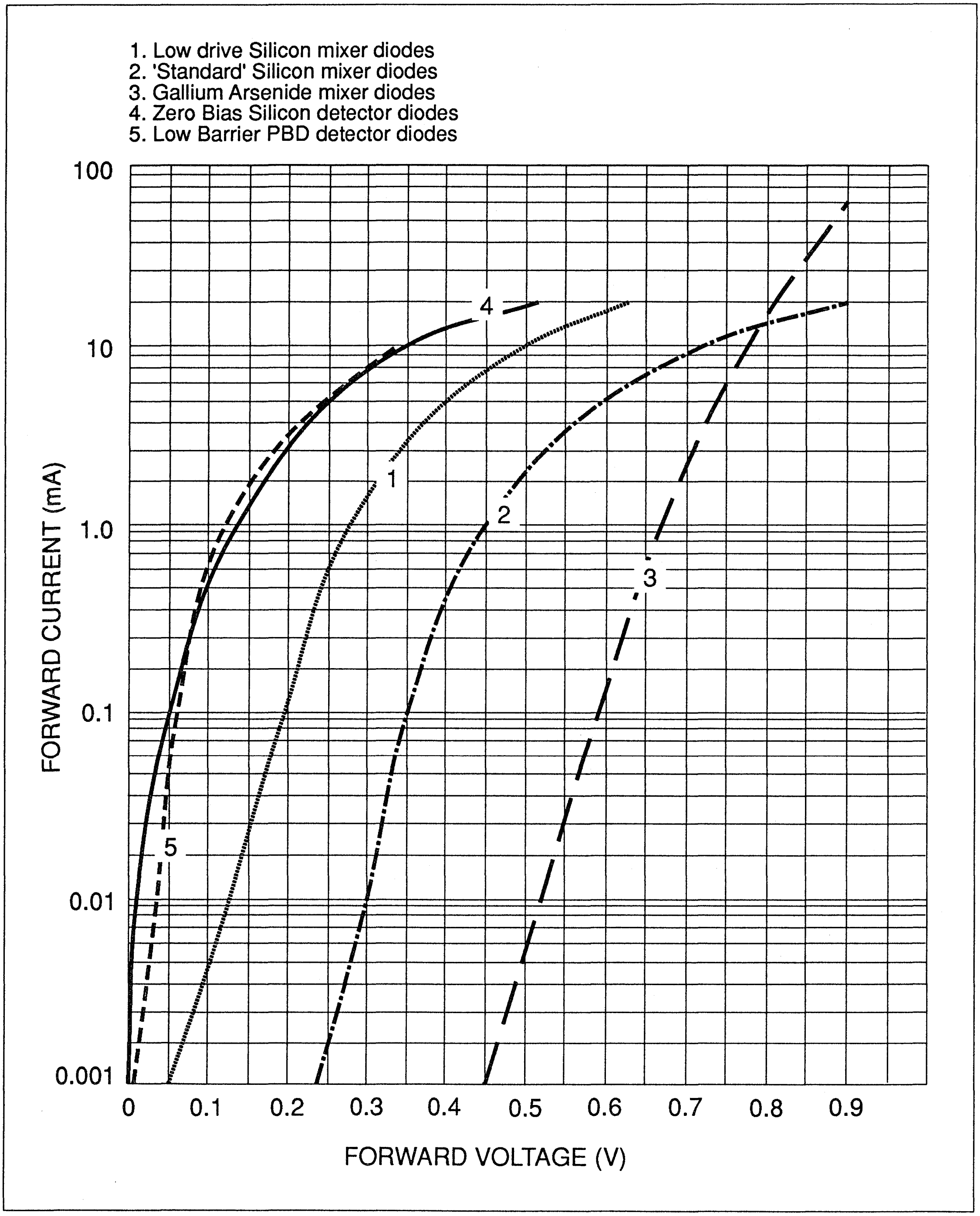


Figure 8. Comparison of Forward Characteristics of PDB and Schottky Diodes

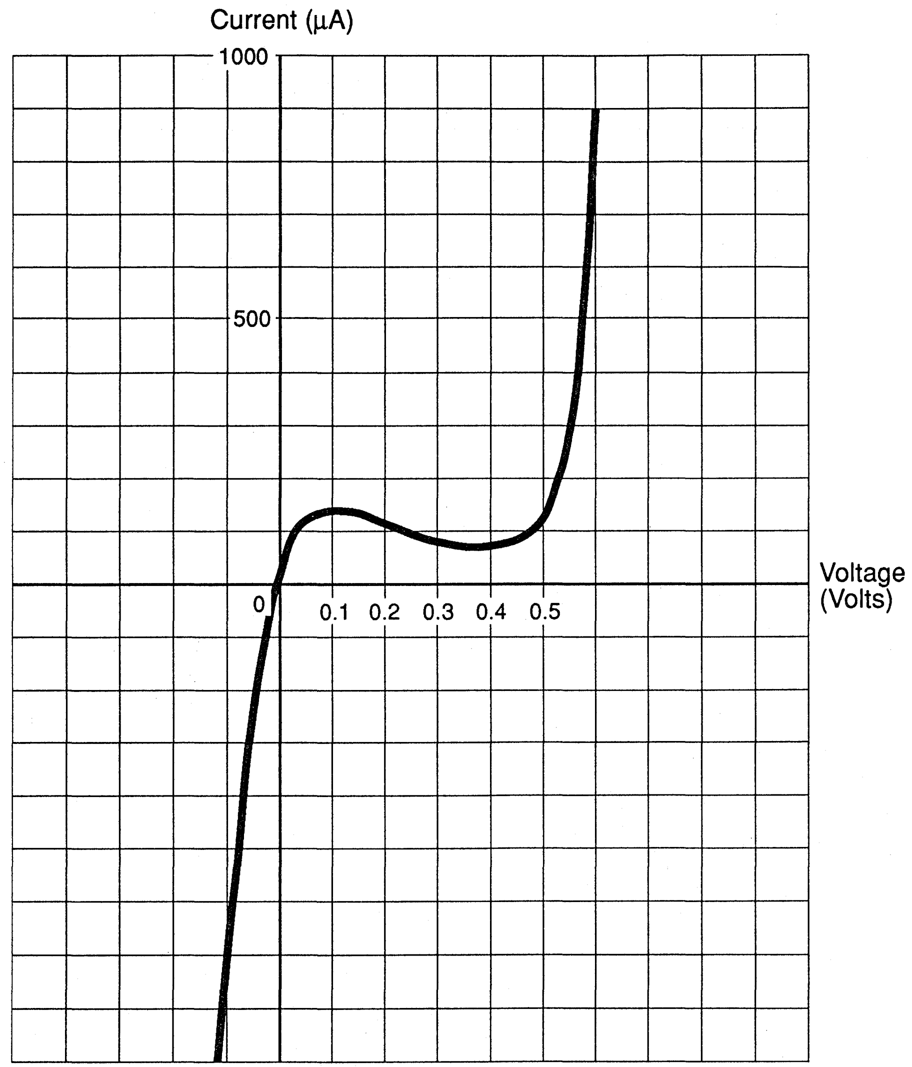


Figure 9. Typical Current-Voltage Characteristic for Germanium Backward Diodes

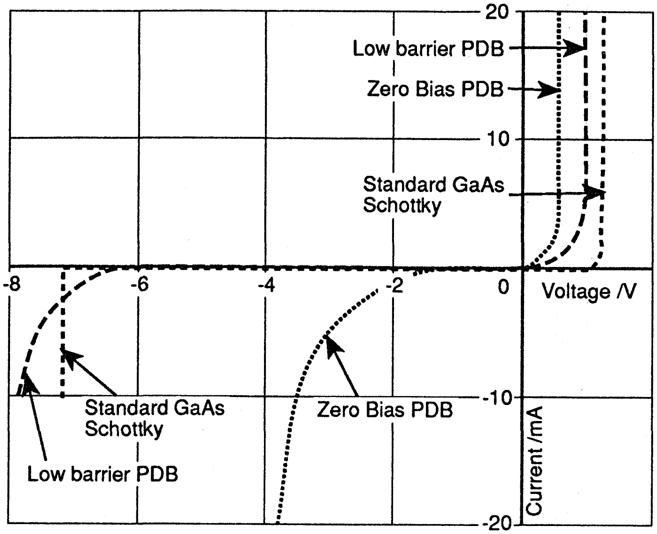
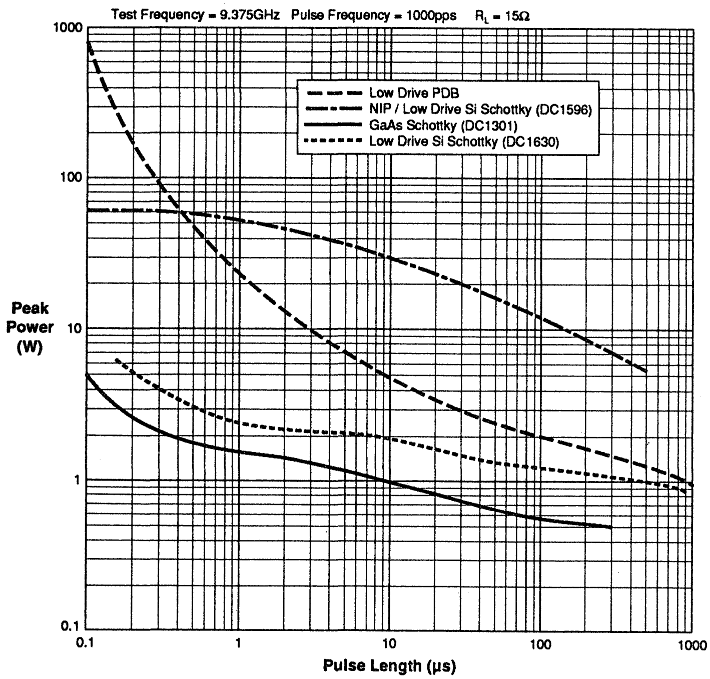


Figure 10. Comparison of the I-V characteristics of a 'zero bias' PDB diode, a low barrier PDB diode and a standard GaAs Schottky diode

TYPICAL BURNOUT CHARACTERISTICS



N.B. Burn-Out Rating

In a practical system, the properties of the circuit in which the diode is used becomes an important factor. Power will be reflected rather than dissipated at high levels since the diode is driven towards a low impedance. The starting point at low level on the admittance plot therefore becomes important as the matching arrangements on the circuit may place the diode at a net admittance point which causes it to move through a region of better match as the increasing incident power level drives the diode towards a short circuit thus raising the dissipated power at an intermediate point. The phase position of the diode is similarly important. Quite wide variations in burn-out performance can therefore result purely from circuit effects for a given diode.

Figure 11. Typical burnout performance

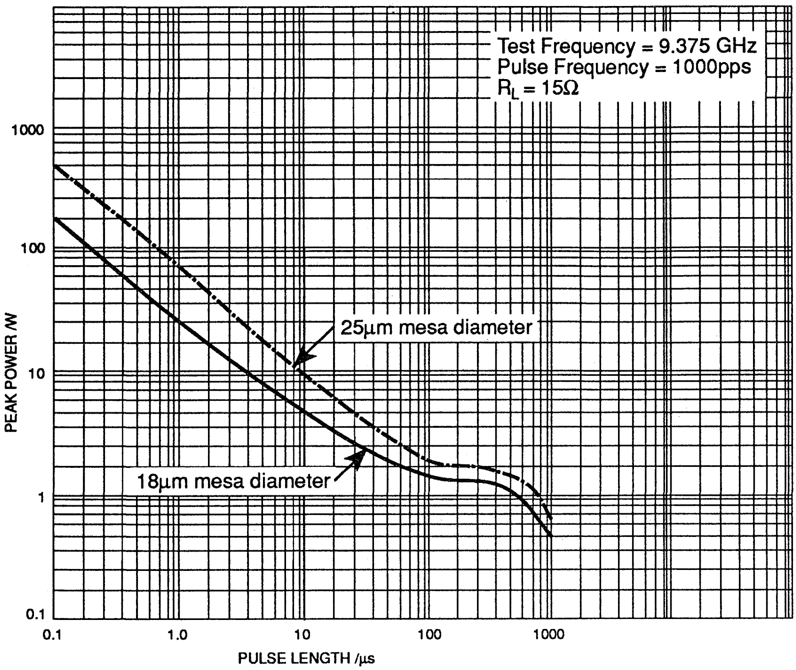


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Figure 12. Effect of device area upon the burnout performance of a zero bias PDB diode

MIXER DIODES Typical Comparative Characteristics

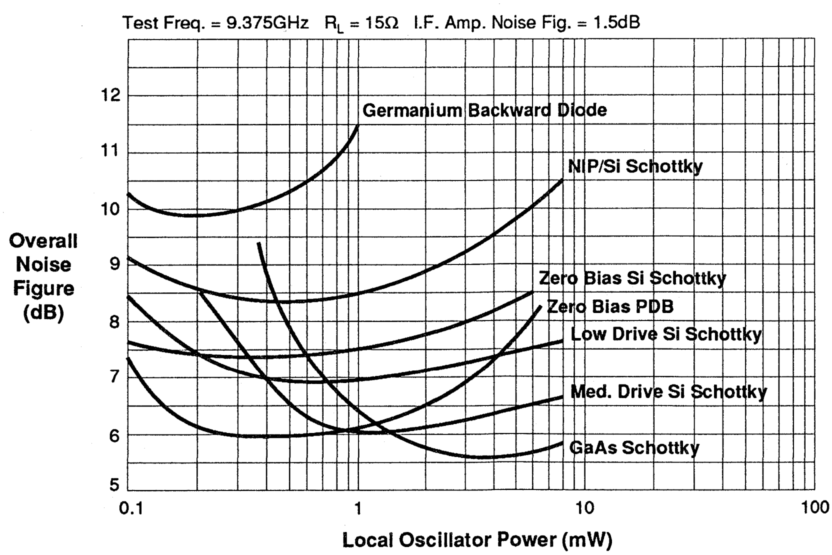


Figure 13. Comparison of Overall Noise Figure for X-Band Diodes

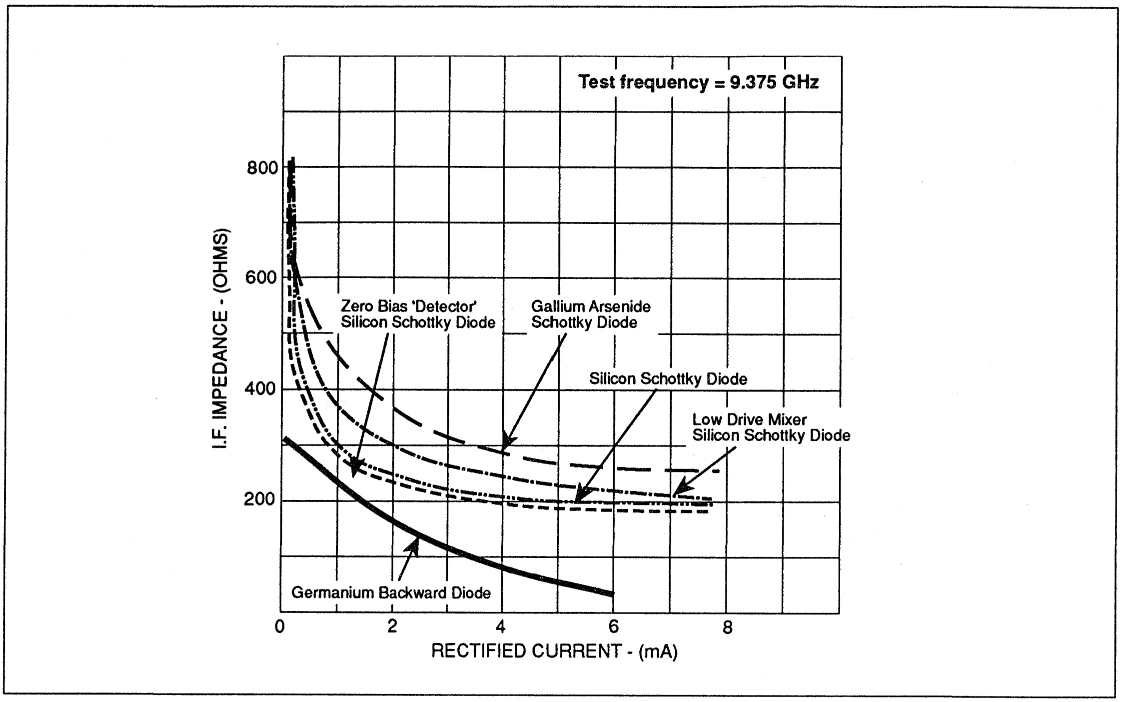


Figure 14. I.F. Impedance/Rectified Current for Typical Diodes

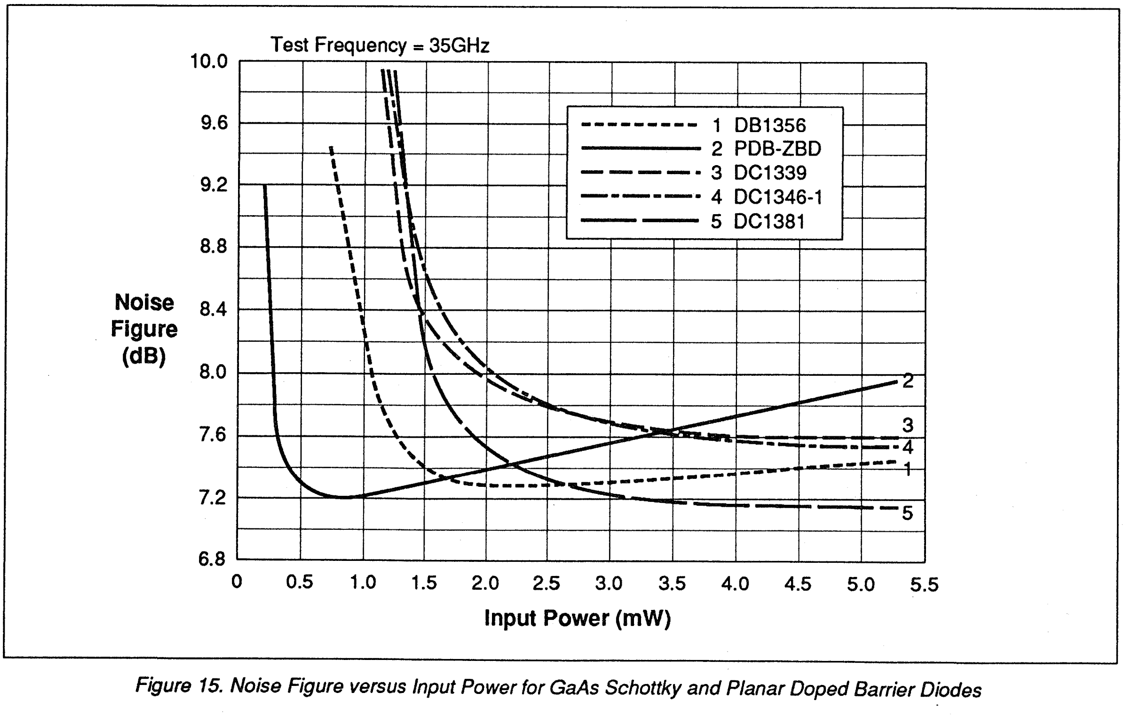


Figure 15. Noise Figure versus Input Power for GaAs Schottky and Planar Doped Barrier Diodes

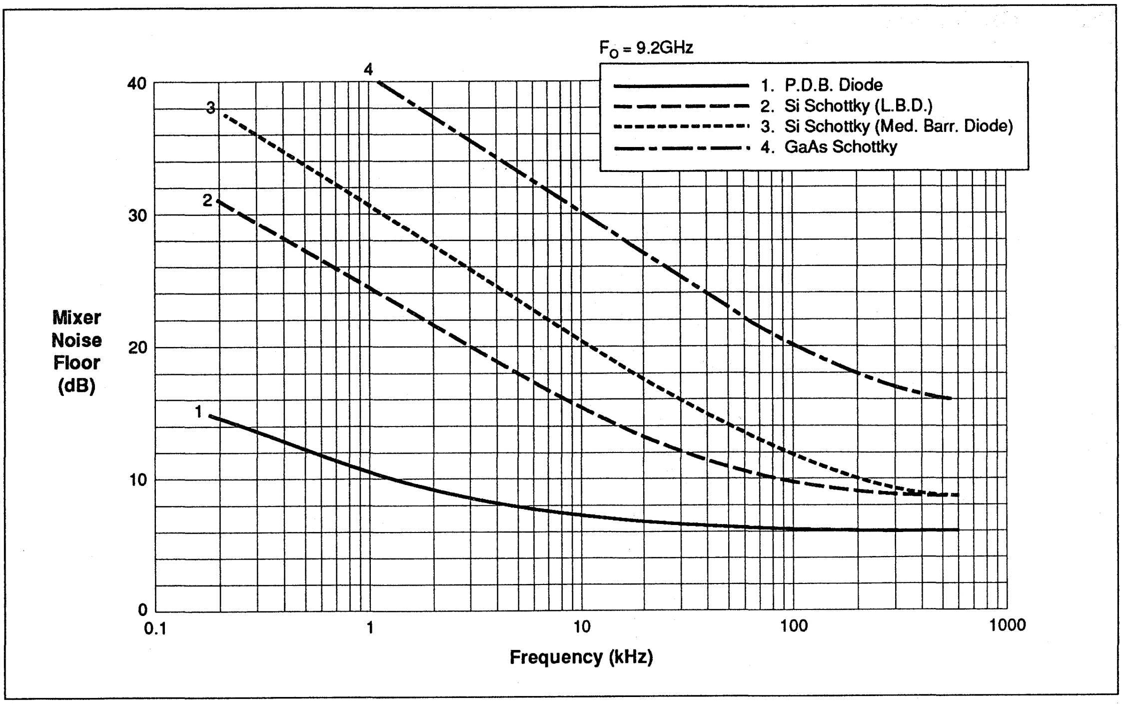


Figure 16. Comparison of Balanced Noise Floor Measurements

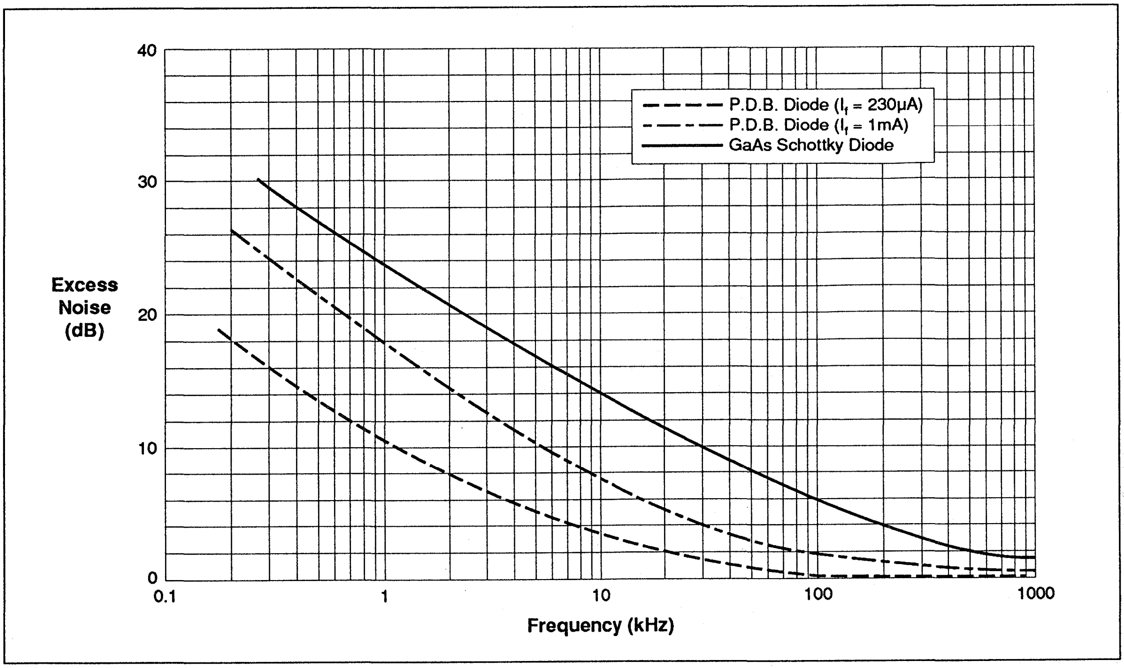


Figure 17. Comparison of l/f Noise performance for Coplanar Diodes

DETECTOR DIODES Typical Comparative Characteristics

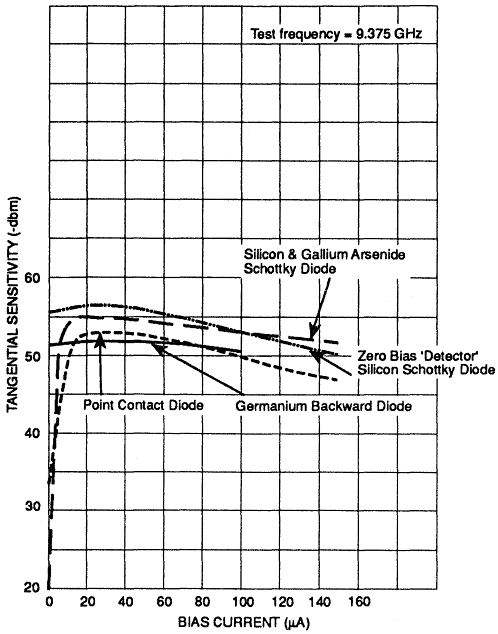


Figure 18. Tangential Sensitivity/Bias Current for Typical Diodes

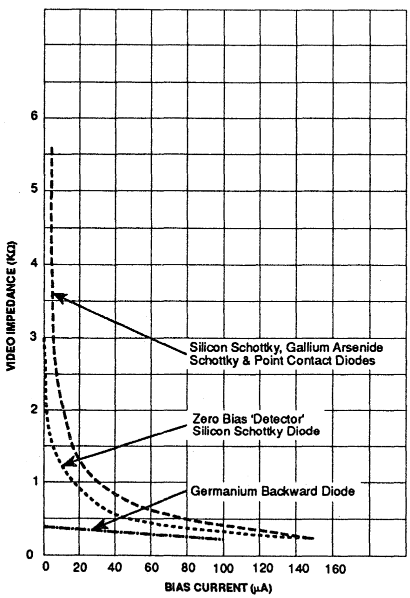


Figure 19. Video Impedance/Bias Current for Typical Diodes

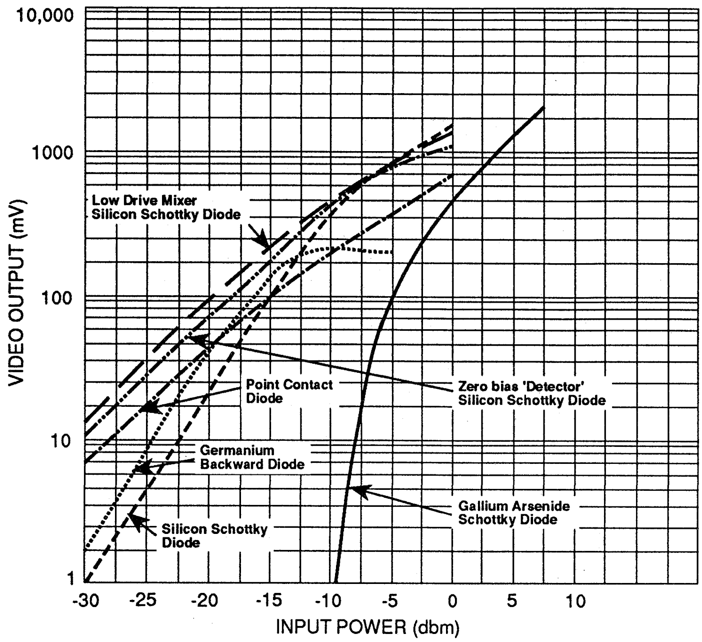


Figure 20. Variations of Output Voltage with Input Power for Typical Diodes. Diodes unbiased. Output O/C

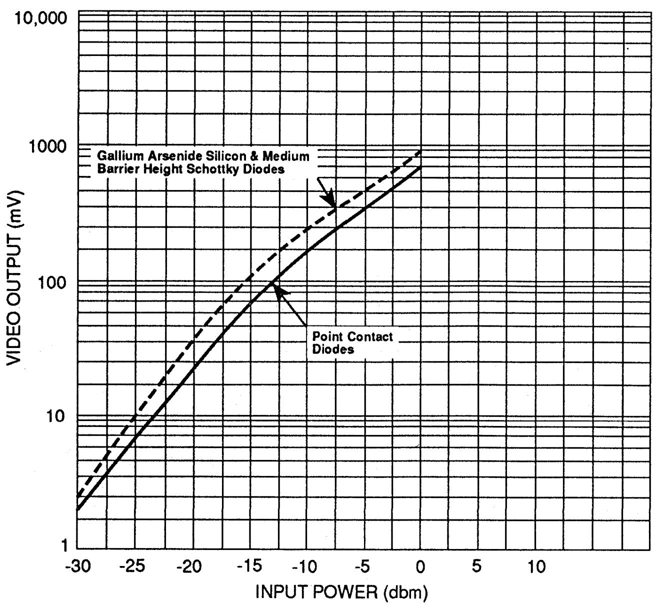


Figure 21. Variation of Output Voltage with Input Power for Typical Diodes. 150µA d.c. bias O/C output

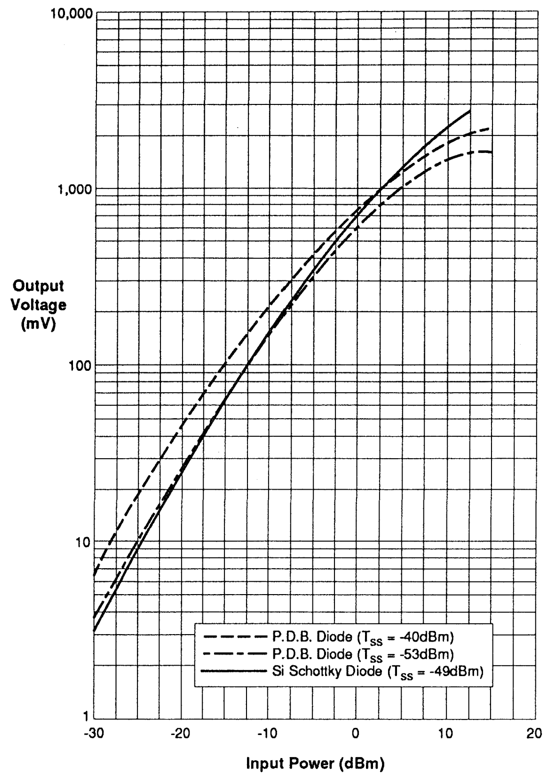


Figure 22. Transfer characteristics of PDB and Silicon Schottky Diodes (F_o = 35GHz)

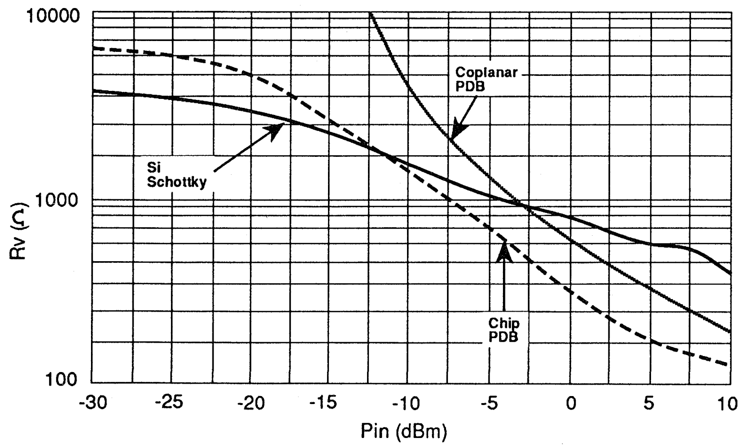


Figure 23. Video Resistance of Si Schottky Diodes (LBD) and Coplanar PDB Diode @ 35 GHz

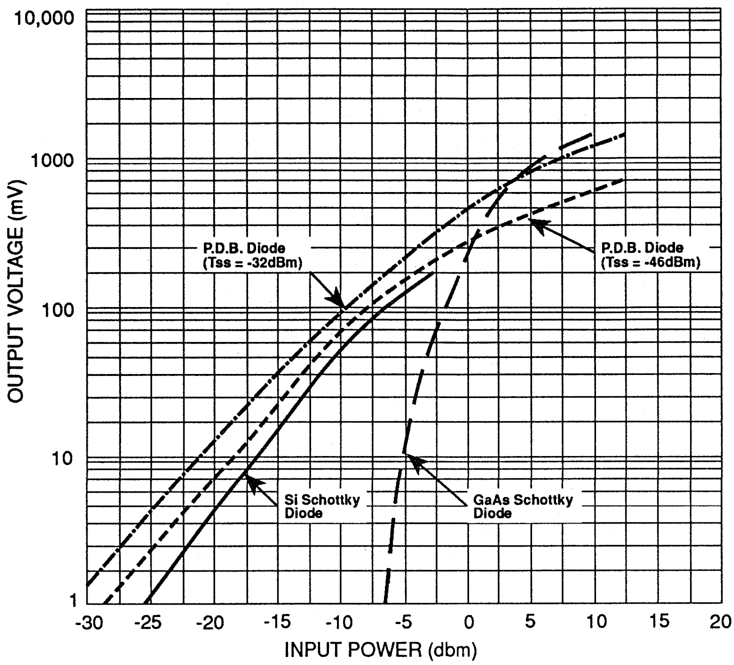


Figure 24. Transfer characteristics of PDB, Schottky Diodes (F_o = 94 GHz)

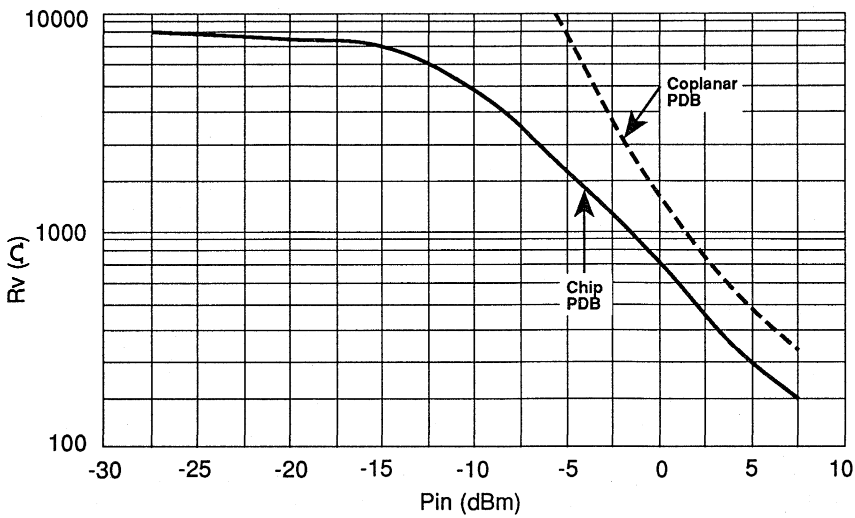


Figure 25. Video Resistance of Coplanar PDB Diode @ 94 GHz

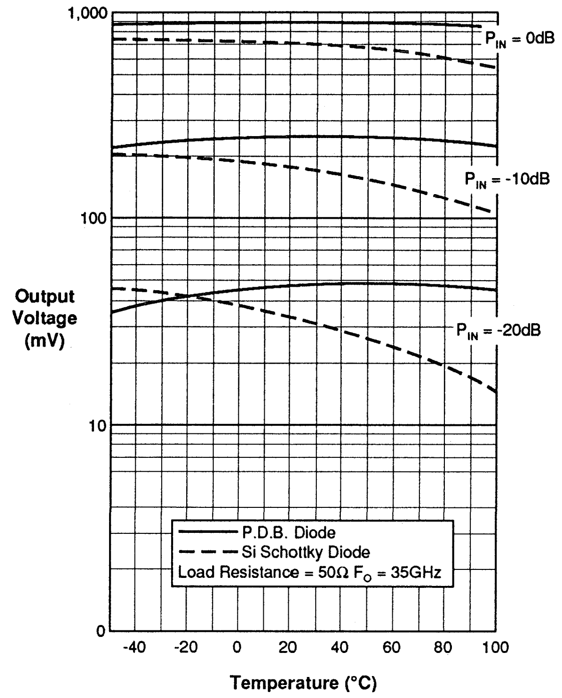


Figure 26. Output Voltage versus Temperature for PDB and Silicon Schottky Diodes

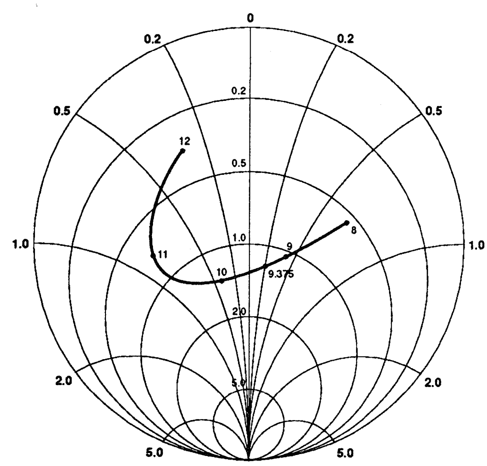


Figure 27. Silicon Schottky Barrier Diodes. Diode RF admittance with respect to 1/50 mho. Frequency in GHz. Input power @ 1mW. 50Ω test circuit A. Used as a mixer.

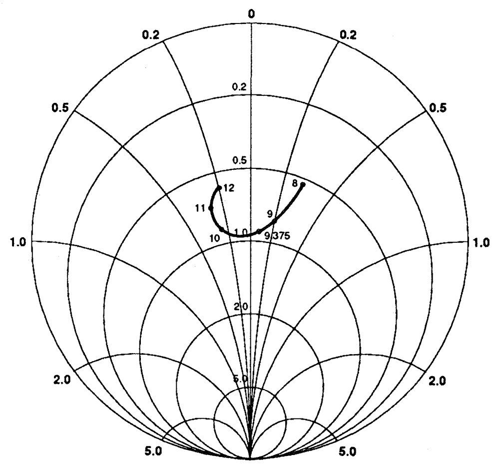


Figure 28. Silicon Schottky Barrier Diodes. Admittance relative to 1/50 mho measured in plane of short circuit as in circuit A. Power @ 2μW max. Bias current 150μA. Used as a detector

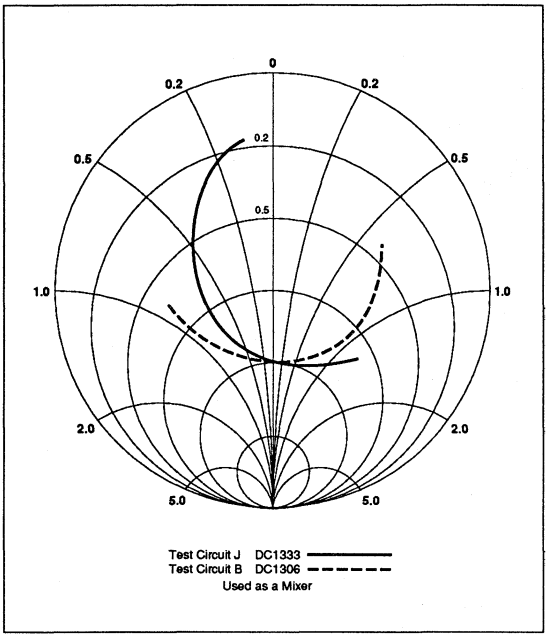


Figure 29. Gallium Arsenide Schottky Barrier Diodes.

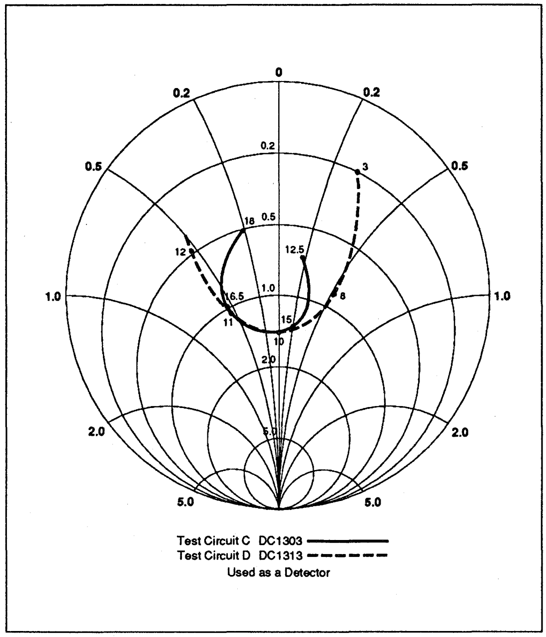


Figure 30. Gallium Arsenide Schottky Barrier Diodes

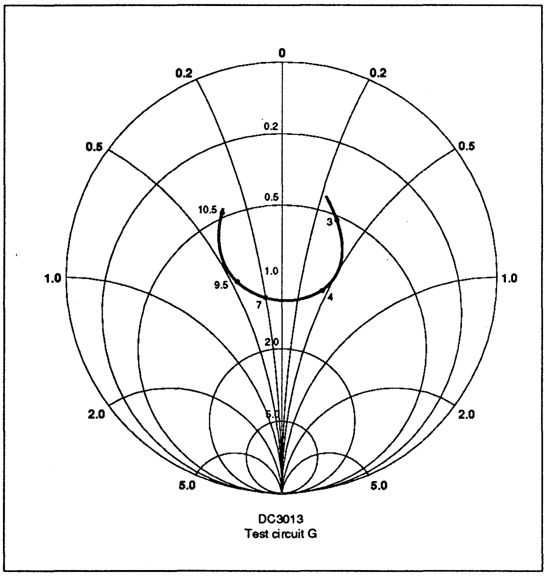


Figure 31. Germanium Backward Diodes. R.F. admittance w.r.t. 0.2mho. Frequency in GHz

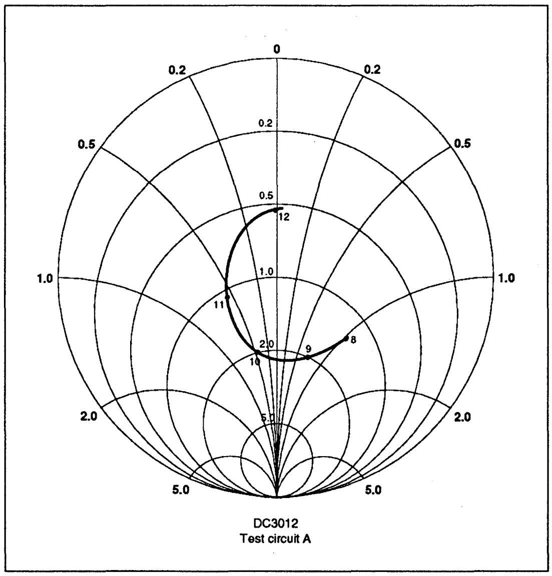


Figure 32. Germanium Backward Diodes. R.F. admittance w.r.t. 0.2mho. Frequency in GHz

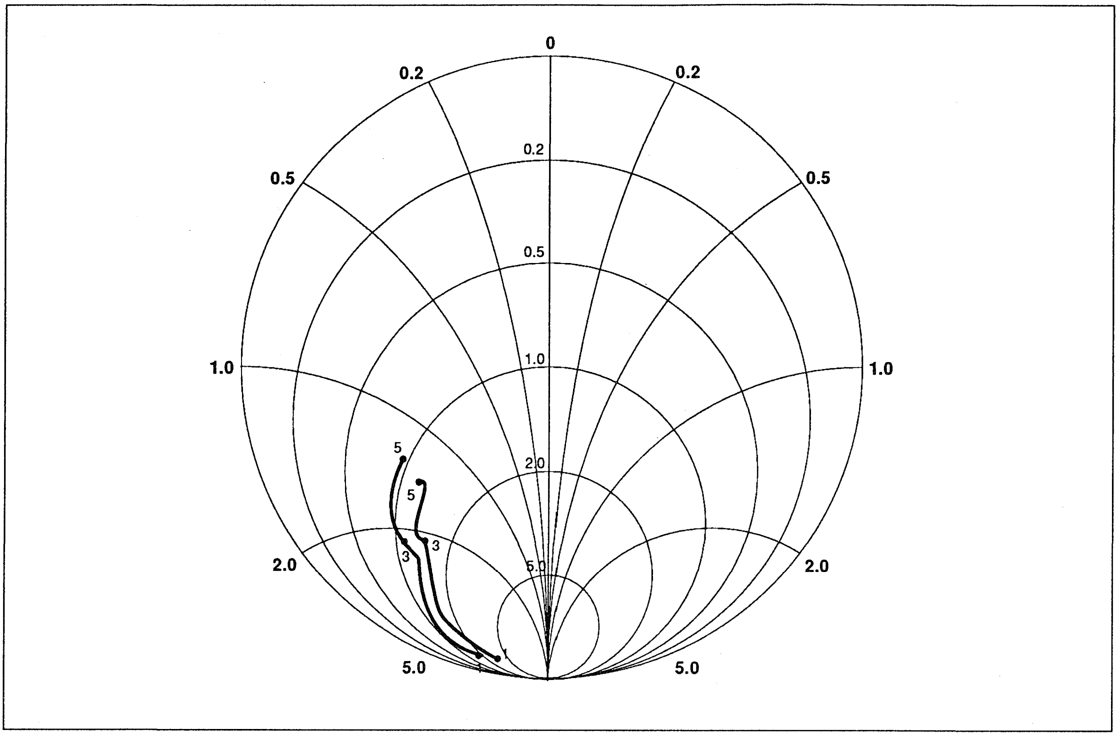


Figure 33. "S" Parameter Characteristics for Coplanar PDB Diodes

CT3510-1.2 August 1992

DC1301/01C & DC1332/33

GaAs SCHOTTKY X-BAND MICROSTRIP MIXER DIODES

These diodes are used in mixer applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- X Band Operation

APPLICATIONS

GaAs schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	200mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1301	DC1301C	DC1332	DC1333
Frequency	X Band	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	600mV	600mV	600mV	600mV
Reverse Voltage (Vr) min @ 10µA	2V	2V	2V	2V
R_S (10mA to 20mA)	5Ω	5Ω	5Ω	5Ω
C_j @ 0V	80fF	80fF	80fF	80fF
Outline	20	20	59	09

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1301	DC1301C	DC1332	DC1333
Test Frequency	9.375GHz	9.375GHz	9.375GHz	9.375GHz
LO Drive Level	1.5mW	1.5mW	1.5mW	1.5mW
IF Impedance at 150µA	400Ω	400Ω	400Ω	400Ω
Overall Noise Figure max. O.N.F.	6.0dB	5.7dB	6.0dB	6.0dB
Conversion Loss	4.5dB	4.2dB	4.5dB	4.5dB

DC1323/34

GaAs SCHOTTKY J-BAND MICROSTRIP LID MIXER DIODES

These diodes are used in mixer applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- J Band Operation

APPLICATIONS

GaAs schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	150mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1323	DC1334
Frequency	J Band	J Band
Forward Voltage (Vf) @ 100µA	600mV	600mV
Reverse Voltage (Vr) min. @ 10µA	2V	2V
R_S (10mA to 20mA)	6Ω	6Ω
C_j @ 0V	60fF	60fF
Outline	20	59

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1323	DC1334
Test Frequency	16.5GHz	16.5GHz
LO Drive Level	2.0mW	2.0mW
IF Impedance at 150µA	500Ω	500Ω
Overall Noise Figure max. O.N.F.	7.0dB	7.0dB
Conversion Loss	5.5dB	5.5dB

DC1338/39 & DC1343

GaAs SCHOTTKY Q-BAND MICROSTRIP MIXER DIODES

These diodes are used in mixer applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- Q Band Operation

APPLICATIONS

GaAs schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	100mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1338	DC1339	DC1343
Frequency	Q Band	Q Band	Q Band
Forward Voltage (Vf) @ 2.5mA	700mV	700mV	700mV
Reverse Voltage (Vr) min. @ 10μA	2V	2V	2V
R_S (10mA to 20mA)	4Ω	4Ω	4Ω
C_j @ 0V	75fF	55fF	80fF
Outline	107	107	111

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1338	DC1339	DC1343
Test Frequency	16.5GHz	16.5GHz	16.5GHz
LO Drive Level	4mW	4mW	4mW
IF Impedance at 150μA	300Ω	300Ω	300Ω
Overall Noise Figure max. O.N.F.	9.0dB	9.0dB	10.0dB
Conversion Loss	7.5dB	7.5dB	8.5dB

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1338	DC1339
L_P	0.1nH	0.1nH
R_S	2Ω	3Ω
C_j @ 0V	0.06pF	0.035pF
C_P @ 0V	0.02pF	0.02pF

DC1306 & DC1340

GaAs SCHOTTKY J-BAND MICROSTRIP BEAM LEAD MIXER DIODES

These diodes are used in mixer applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- J Band Operation

APPLICATIONS

GaAs schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	150mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1306	DC1340
Frequency	J Band	J Band
Forward Voltage (Vf) @ 2.5mA	700mV	700mV
Reverse Voltage (Vr) min. @ 10µA	2V	2V
R_S (10mA to 20mA)	4Ω	4Ω
C_j @ 0V	100fF	100fF
Outline	107	107

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1306	DC1340
Test Frequency	16.5GHz	16.5GHz
LO Drive Level	2.0mW	2.0mW
IF Impedance at 150µA	350Ω	350Ω
Overall Noise Figure max. O.N.F.	7.5dB	7.0dB
Conversion Loss	5.5dB	5.5dB

DC1303/12/21

GaAs SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODES

These diodes are used in detector applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High T_{SS}
- Very Good Temperature Stability
- Very High Pulse Burn Out
- X Band Operation

APPLICATIONS

GaAs schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	200mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1303	DC1312	DC1321
Frequency	X Band	X Band	X Band
Forward Voltage (Vf) @ 100μA	600μV	600μV	600μV
Reverse Voltage (Vr) min. @ 10μA	2V	2V	2V
R_S (10mA to 20mA)	5Ω	5Ω	5Ω
C_j @ 0V	80fF	80fF	80fF
Outline	09	59	20

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1303	DC1312	DC1321
Test Frequency	9.375GHz	9.375GHz	9.375GHz
Tangential Sensitivity (Ibias = 150μA)	-48dBm	-48dBm	-48dBm
Vout (-20dBm) Ibias = 150μA	35mV	35mV	35mV
Video Impedance	200Ω	200Ω	200Ω

DC1314/16

GaAs SCHOTTKY J-BAND MICROSTRIP LID DETECTOR DIODES

These diodes are used in detector applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High T_{SS}
- Very Good Temperature Stability
- Very High Pulse Burn Out
- J Band Operation

APPLICATIONS

GaAs schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	200mW
CW Burn Out	100mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1314	DC1316
Frequency	J Band	J Band
Forward Voltage (Vf) @ 100μA	600mV	600mV
Reverse Voltage (Vr) min. @ 10μA	2V	2V
R_S (10mA to 20mA)	6Ω	6Ω
C_j @ 0V	60fF	60fF
Outline	59	20

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1314	DC1316
Test Frequency	16.5GHz	16.5GHz
Tangential Sensitivity (Ibias = 150μA)	-47dBm	-47dBm
Vout (-20dBm) Ibias = 150μA	32mV	32mV
Video Impedance	200Ω	200Ω

DC1302/04 & DC1330

GaAs SCHOTTKY X-BAND WAVEGUIDE MIXER DIODES

These diodes are used in mixer applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- X Band Operation

APPLICATIONS

GaAs schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	200mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1302	DC1304	DC1304-3	DC1304C	DC1330
Frequency	X Band	X Band	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	600mV	600mV	600mV	600mV	600mV
Reverse Voltage (Vr) min. @ 10µA	2V	2V	2V	2V	2V
R_S (10mA to 20mA)	5Ω	5Ω	5Ω	5Ω	5Ω
C_j @ 0V	80fF	80fF	80fF	80fF	80fF
Outline	23A	51	51	51	17

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1302	DC1304	DC1304-3	DC1304C	DC1330
Test Frequency	9.375GHz	9.375GHz	9.375GHz	9.375GHz	9.375GHz
LO Drive Level	1.5mW	1.5mW	1.5mW	1.5mW	1.5mW
IF Impedance at 150µA	500Ω	500Ω	500Ω	500Ω	500Ω
Overall Noise Figure max. O.N.F.	6.0dB	6.0dB	5.8dB	5.7dB	6.0dB
Conversion Loss	4.5dB	4.5dB	4.3dB	4.2dB	4.5dB

DC1325

GaAs SCHOTTKY J-BAND WAVEGUIDE MIXER DIODE

This general purpose diode is available in the microstrip package and is suitable for applications requiring high performance mixers.

This diode can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Low Conversion Loss
- J Band Operation

APPLICATIONS

Silicon schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	150mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1325
Frequency	J Band
Forward Voltage (Vf) @ 100μA	600mV
Reverse Voltage (Vr) min. @ 10μA	2V
R_S (10mA to 20mA)	6Ω
C_j @ 0V	60fF
Outline	51

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1325
Test Frequency	16.5GHz
LO Drive Level	2.0mW
IF Impedance at 150μA	500Ω
Overall Noise Figure max. O.N.F.	7.0dB
Conversion Loss	5.5dB

DC1322/24

GaAs SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODES

These diodes are used in detector applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High T_{SS}
- Very Good Temperature Stability
- Very High Pulse Burn Out
- X Band Operation

APPLICATIONS

Silicon schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	250mW
CW Burn Out	200mW

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1322	DC1324
Frequency	X Band	X Band
Forward Voltage (Vf) @ 100µA	600mV	600mV
Reverse Voltage (Vr) min. @ 10µA	2V	2V
R_S (10mA to 20mA)	5Ω	5Ω
C_j @ 0V	80fF	80fF
Outline	23A	51

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1322	DC1324
Test Frequency	9.375GHz	9.375GHz
Tangential Sensitivity (Ibias = 150µA)	-48dBm	-48dBm
Vout (-20dBm) Ibias = 150µA	35mV	35mV
Video Impedance at 20µA	200Ω	200Ω

DC1335

GaAs SCHOTTKY J-BAND WAVEGUIDE DETECTOR DIODE

This diode is used in detector applications requiring a better noise figure than can be acheived with silicon diodes and as sensitive broadband detectors at high microwave frequencies.

This diode can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High T_{SS}
- Very Good Temperature Stability
- Very High Pulse Burn Out
- J Band Operation

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1335
Frequency	J Band
Forward Voltage (Vf) @ 100μA	600mV
Reverse Voltage (Vr) min. @ 10μA	2V
R_S (10mA to 20mA)	6Ω
C_j @ 0V	60fF
Outline	51

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1335
Test Frequency	16.5GHz
Tangential Sensitivity (Ibias = 150μA)	-47dBm
Vout (-20dBm) Ibias = 150μA	32mV
Video Impedance at 20μA	200Ω

APPLICATIONS

Silicon schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty Cycle 0.01%)	200mW
CW Burn Out	100mW

DC1331

GaAs SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODE

This diode is used in detector applications requiring a better noise figure than can be acheived with silicon diodes and as a sensitive broadband detector at high microwave frequencies.

This diode can be supplied in matched pairs by the addition of the letter M to the type number, or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low LO Drive level
- Excellent 1/f Noise
- Low Conversion Loss
- X Band Operation

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1331
Frequency	X Band
Forward Voltage of Schottky @ 100μA	600mV
Reverse Voltage of NIP @ 10μA	700mV
R_S (10mA to 20mA)	?Ω
C_j @ 0V	150fF
Outline	51

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1331
Test Frequency	9.375GHz
LO Drive Level	1.5mW
IF Impedance at 150μA	400Ω
Overall Noise Figure max. O.N.F.	8.0dB
Conversion Loss	6.5dB

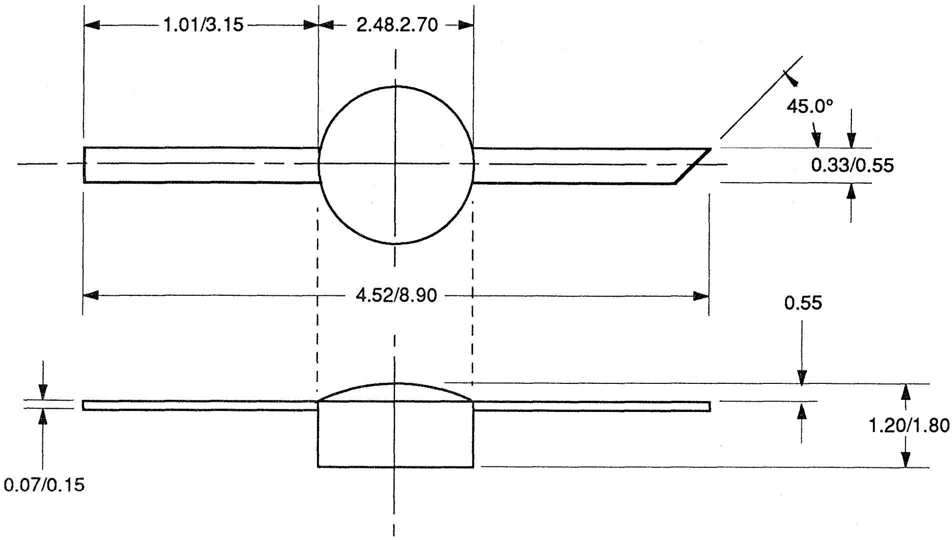
APPLICATIONS

Silicon schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

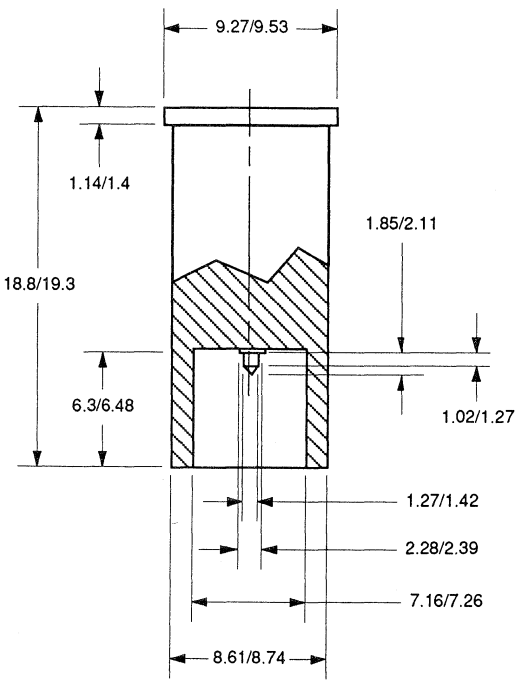
LIMITING CONDITIONS

Storage Temperature	-55°C to +100°C
Operating Temperature	-55°C to +100°C
Pulse Burn Out (Duty Cycle 0.01%)	?mW
CW Burn Out	?mW

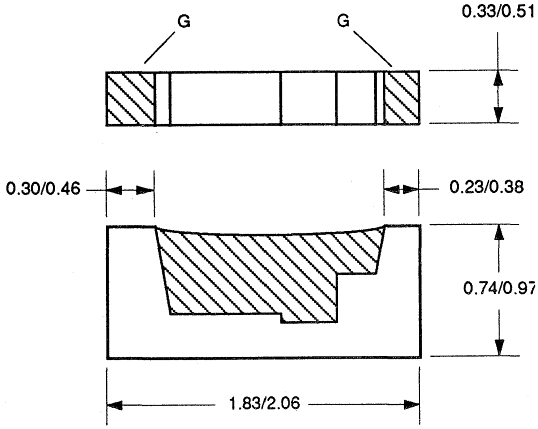
OUTLINES



09



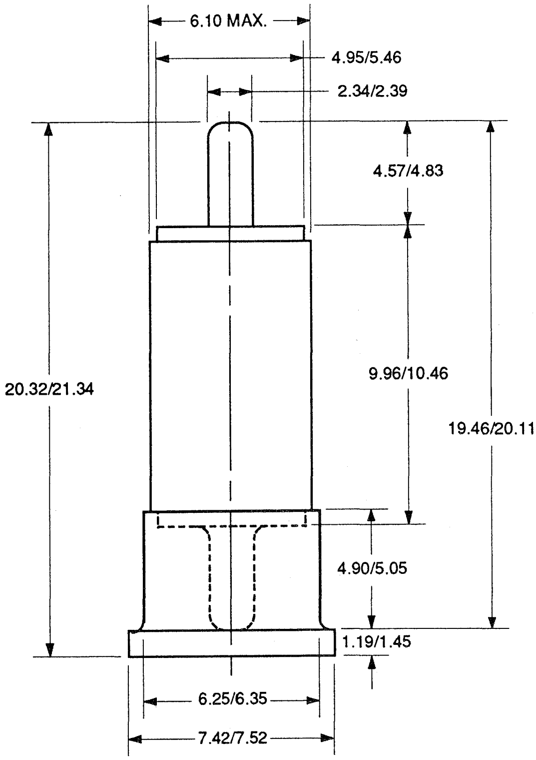
17



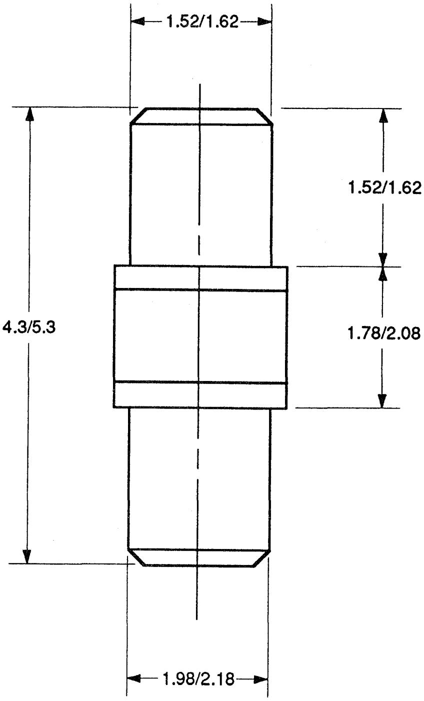
G - GOLD PLATE, 5 MICRONS MIN.
OVER 1.27 MICRONS OF NICKEL.

CATHODE - RED

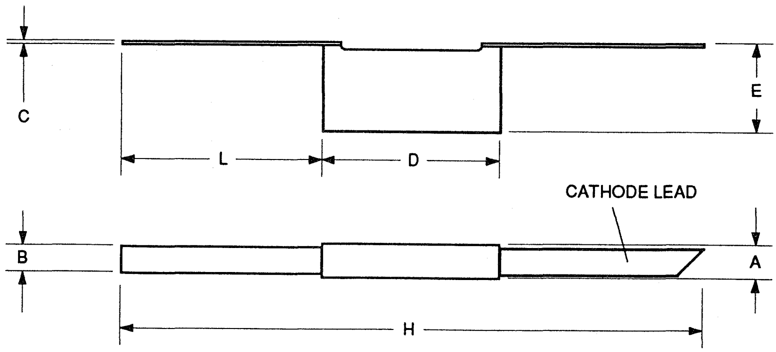
20



23A

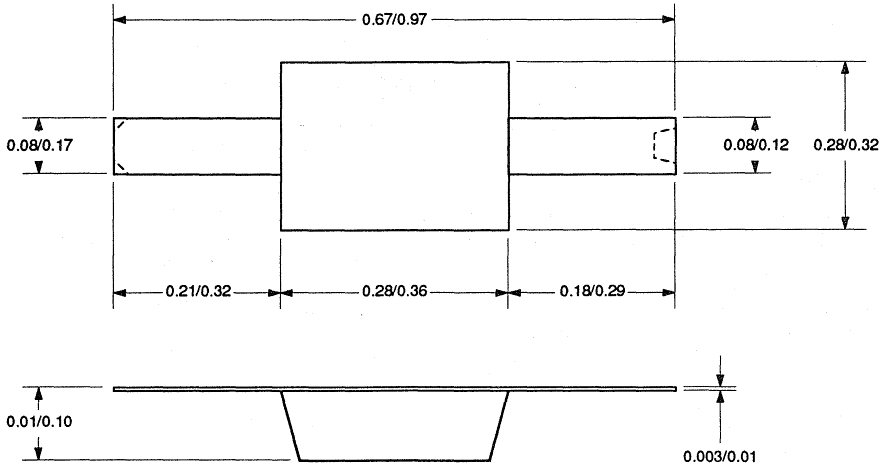


51

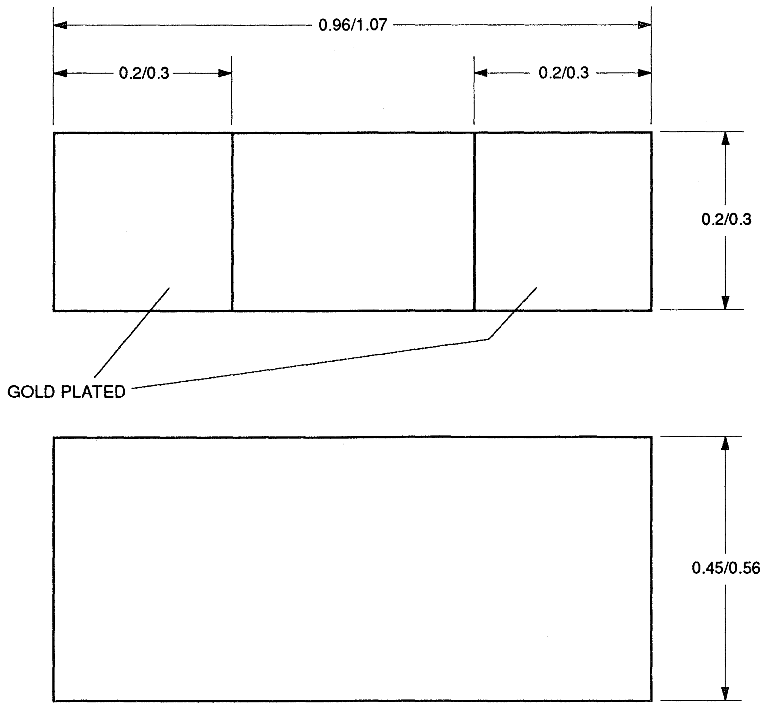


REF	MIN	MAX
A	0.33	0.75
B	0.33	0.55
C	0.07	0.17
D	1.83	2.10
E	0.74	1.25
H	4.52	8.90
L	1.05	3.15

59


0.67/0.97
0.08/0.17
0.08/0.12
0.28/0.32
0.21/0.32
0.28/0.36
0.18/0.29
0.01/0.10
0.003/0.01

107


0.96/1.07
0.2/0.3
0.2/0.3
0.2/0.3
GOLD PLATED
0.45/0.56

111

GEC PLESSEY
SEMICONDUCTORS

CT3509-1.2 August 1992

DC1503

SILICON SCHOTTKY L-BAND MICROSTRIP LID MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- L band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	600mW
CW burn out	250mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

Frequency	L Band
Forward Voltage (Vf) max. @ 500µA	500mV
Reverse voltage (Vr) min. @ 1µA	500mV
Rs (5mA to 15mA in ohms)	10
C_j @ 0V	68 - 83 fF
Outline	20

DC1508/11/19

SILICON SCHOTTKY S-BAND MICROSTRIP LID MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- S band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	500mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1508			DC1511			DC1519
	E	F	G	E	F	G	E
Frequency	S Band	S Band	S Band	S Band	S Band	S Band	S Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV	350mV	350mV	350mV	350mV
Reverse voltage (Vr) @ 10µA	2V	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	10	10	10	10	10	10	10
C_j @ 0V	180fF	180fF	180fF	180fF	180fF	180fF	180fF
Outline	20	20	20	59	59	59	09

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1508			DC1511			DC1519
	E	F	G	E	F	G	
Test Freq. (GHz)	3	3	3	3	3	3	3
LO Drive level (μW)	700	700	700	700	700	700	700
IF Impedance at 150μA (Ohms)	350	350	350	350	350	350	350
Max Overall noise figure O.N.F. (dB)	7.0	6.5	6.0	7.0	6.5	6.0	6.5
Conversion loss (dB)	5.5	5.0	4.5	5.0	4.5	4.5	5.0

GEC PLESSEY
SEMICONDUCTORS

DC1523/28/29

SILICON SCHOTTKY C-BAND MICROSTRIP LID MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- C band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	500mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1523	DC1528	DC1529
Frequency	C Band	C Band	C Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV
Reverse voltage (Vr) @ 10µA	2V	2V	2V
Rs (10mA to 20mA) in Ohms	10	10	10
C_j @ 0V	200fF	300fF	250fF
Outline	20	20	20

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1523	DC1528	DC1529
Test Freq. (GHz)	7.1	6.4	5.15
LO Drive level (mW)	2.4	2.4	0.7
IF Impedance at 150µA (Ohms)	350	350	175
Max. Overall noise figure O.N.F. (dB)	7.5	7.5	7.2
Conversion loss (dB)	6.0	6.0	5.8

GEC PLESSEY
SEMICONDUCTORS

DC1536F/36G

SILICON SCHOTTKY X-BAND MICROSTRIP BEAM LEAD MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent I/f noise
- Low conversion loss
- X band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1536F	DC1536G
Frequency	X Band	X Band
Forward Voltage (Vf) @ 2.5mA	400mV	400mV
Reverse voltage (Vr) @ 10μA	2.0V	2.0V
Rs max. (10mA to 20mA) in Ohms	18	18
C_j @ 0V (pF)	50 - 150	55 - 150
Outline	115	115

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1536F	DC1536G
Test Freq. (GHz)	9.375	9.375
LO Drive level (mW)	1.0	1.0
IF Impedance at 150μA (Ohms)	450	450
Max. Overall noise figure O.N.F. (dB)	7.0	6.5
Conversion loss (dB)	5.5	5.0

GEC PLESSEY
SEMICONDUCTORS

DC1524

SILICON SCHOTTKY J-BAND MICROSTRIP LID MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- J band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1524
Frequency	J Band
Forward Voltage (Vf) @ 100μA	350mV
Reverse voltage (Vr) min. @ 10μA	2V
Rs (10mA to 20mA) in Ohms	20
C_j @ 0V	60fF
Outline	20

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1524
Test Freq. (GHz)	16.5
LO Drive level (mW)	1.0
IF Impedance at 150μA (Ohms)	450
Max. Overall noise figure O.N.F. (dB)	8.0
Conversion loss (dB)	6.5

DC1509/13/17

SILICON SCHOTTKY S-BAND MICROSTRIP LID DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- S band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	250mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1509	DC1513	DC1517
Frequency	S Band	S Band	S Band
Forward Voltage (Vf) @ 100μA	350mV	350mV	350mV
Reverse voltage (Vr) min. @ 10μA	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20
C_j @ 0V (fF)	80	80	80
Outline	09	59	20

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1509	DC1513	DC1517
Test Freq. (GHz)	3.0	3.0	3.0
Tangential sensitivity Ibias = 150μA	-49	-49	-50
Vout (-20dBm) Ibias = 150μA	35mV	35mV	35mV
Video Impedance (Ohms)	200	200	200

DC1510/12/16

SILICON SCHOTTKY X-BAND MICROSTRIP LID DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- X band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1510	DC1512	DC1516
Frequency	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV
Reverse voltage (Vr) min. @ 10µA	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20
C_j @ 0V (fF)	80	80	80
Outline	09	59	20

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1510	DC1512	DC1516
Test Freq. (GHz)	9.375	9.375	9.375
Tangential sensitivity Ibias = 150µA	-50	-50	-50
Vout (-20dBm) Ibias = 150µA	35mV	35mV	35mV
Video Impedance (Ohms)	200	200	200

GEC PLESSEY
SEMICONDUCTORS

DC1520

SILICON SCHOTTKY J-BAND MICROSTRIP LID DETECTOR DIODE

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- J band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	200mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1520
Frequency	J Band
Forward Voltage (Vf) @ 100μA	350mV
Reverse voltage (Vr) min. @ 10μA	2V
Rs (10mA to 20mA) in Ohms	20
C_j @ 0V (fF)	60
Outline	20

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1520
Test Freq. (GHz)	16.5
Tangential sensitivity Ibias = 150μA	-50
Vout (-20dBm) Ibias = 150μA	32mV
Video Impedance (Ohms)	200

GEC PLESSEY
SEMICONDUCTORS

DC1553/57

SILICON SCHOTTKY X-BAND ZERO BIAS MICROSTRIP LID DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- X band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1553	DC1557
Frequency	X Band	X Band
Forward Voltage (Vf) @ 100µA	50mV	50mV
Rs (10mA to 20mA) in Ohms	40	40
Outline	20	59

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1553	DC1557
Test Freq. (GHz)	9.375	9.375
Tangential sensitivity Ibias = 150µA	-50	-50
Vout (-20dBm) Ibias = 150µA	70mV	70mV
Video Impedance (Ohms)	3000	3000

GEC PLESSEY
SEMICONDUCTORS

DC1505/07

SILICON SCHOTTKY S-BAND WAVEGUIDE MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- S band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	500mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1505		DC1507		
	F	G	F	G	H
Frequency	X Band	X Band	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV	350mV	350mV
Reverse voltage (Vr) min. @ 10µA	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	10	10	20	20	20
C_j @ 0V (fF)	200	200	100	100	100
Outline	23A	23A	17	17	17

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1505		DC1507		
	F	G	F	G	H
Test Freq. (GHz)	9.375	9.375	9.375	9.375	9.375
LO Drive level (μW)	500	500	500	500	500
IF Impedance at 150μA (Ohms)	400	400	350	350	350
Max. Overall noise figure O.N.F. (dB)	7.0	6.5	7.0	6.5	6.0
Conversion loss (dB)	5.5	5.0	5.5	5.0	4.5

GEC PLESSEY
SEMICONDUCTORS

DC1501/02/04/18/39

SILICON SCHOTTKY X-BAND WAVEGUIDE MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- X band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	500mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1501			DC1502		DC1504		DC1518	DC1539	
	E	F	G	E	F	E	F		F	G
Frequency	X Band	X Band	X Band	X Band	X Band	X Band	X Band	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV	350mV	350mV	350mV	350mV	350mV	350mV	350mV
Reverse voltage (Vr) min. @ 10µA	2V	2V	2V	2V	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20	20	20	20	20	20	20	20
C_j @ 0V (fF)	80	80	80	80	80	80	80	80	80	80
Outline	51	51	51	17	17	23A	23A	16	102	102

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1501			DC1502		DC1504		DC1518	DC1539	
	E	F	G	E	F	E	F		F	G
Test Freq. (GHz)	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375
LO Drive level (μW)	700	700	700	700	700	700	700	700	700	700
IF Impedance at 150μA (Ohms)	450	450	450	450	450	450	450	450	450	450
Max. Overall noise figure O.N.F. (dB)	7.5	7.0	6.5	7.5	7.0	7.5	7.0	7.5	7.0	6.5
Conversion loss (dB)	6.0	5.5	5.0	6.0	5.5	6.0	5.5	6.0	5.5	5.0

DC1542/46

SILICON SCHOTTKY J-BAND WAVEGUIDE MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- J band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	200mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1542	DC1546
Frequency	J Band	J Band
Forward Voltage (Vf) @ 100μA	350mV	350mV
Reverse voltage (Vr) min. @ 10μA	2V	2V
Rs (10mA to 20mA) in Ohms	25	25
C_j @ 0V (fF)	60	60
Outline	37	51

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1542	DC1546
Test Freq. (GHz)	16.5	16.5
Low Drive level (mW)	1.0	1.0
IF Impedance at 150μA (Ohms)	450	450
Max. overall noise figure O.N.F. (dB)	7.5	7.5
Conversion loss (dB)	6.0	6.0

DC1515/27

SILICON SCHOTTKY S-BAND WAVEGUIDE DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance detectors.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- S band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	250mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1515	DC1527
Frequency	S Band	S Band
Forward Voltage (Vf) @ 100μA	350mV	350mV
Reverse voltage (Vr) min. @ 10μA	2V	2V
Rs (10mA to 20mA) in Ohms	20	20
C_j @ 0V (fF)	70	70
Outline	23A	17

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1515	DC1527 at 20μA
Test Freq. (GHz)	3.0	3.0
Tangential sensitivity (dBm) at 20μA	-56	-56
Vout at -20dBm at 20μA	100mV	100mV
Video Impedance at 20μA (Ohms)	1000 - 2000	1000 - 2000

GEC PLESSEY
SEMICONDUCTORS

DC1551/54/58

SILICON SCHOTTKY X-BAND ZERO BIAS WAVEGUIDE DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance detectors.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- X band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	250mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1551	DC1554	DC1558
Frequency	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	50mV	50mV	50mV
Rs (10mA to 20mA) in Ohms	50 (max)	40	40
C_j @ 0V (fF)			
Outline	17	51	23B

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1551	DC1554	DC1558
Test Freq. (GHz)	9.375	9.375	9.375
Tangential sensitivity (dBm) at zero bias	-50	-50	-50
Vout (-20dBm) Ibias = 150µA	70mV	70mV	70mV
Video Impedance at 20µA (Ohms)	1000 - 5000	1000 - 5000	1000 - 5000

GEC PLESSEY
SEMICONDUCTORS

DC1514/21/26

SILICON SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance detectors.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- X band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1514	DC1521	DC1526
Frequency	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV
Reverse voltage (Vr) min. @ 10µA	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20
C_j @ 0V (fF)	80	80	80
Outline	23A	51	17

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1514	DC1521	DC1526
Test Freq. (GHz)	9.375	9.375	9.375
Tangential sensitivity (dBm) at 20µA	-56	-56	-53 at 50µA
Vout (at -20dBm) Ibias = 150µA	35mV	35mV	35mV
Video Impedance at 20µA (Ohms)	1000 - 2000	1000 - 2000	1000 - 2000

DC1535/47

SILICON SCHOTTKY J-BAND WAVEGUIDE DETECTOR DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance detectors.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- J band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in instrumentation, military, civil and marine communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	400mW
CW burn out	200mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1535	DC1547
Frequency	J Band	J Band
Forward Voltage (Vf) @ 100µA	350mV	350mV
Reverse voltage (Vr) min. @ 10µA	2V	2V
Rs (10mA to 20mA) in Ohms	25	25
C_j @ 0V (fF)	60	60
Outline	37	51

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1535	DC1547
Test Freq. (GHz)	15.0	16.5
Tangential sensitivity (dBm) at 20µA	-51	-40 @ 150µA
Vout (at -20dBm) at 20µA Ibias = 150µA	32mV	32mV
Video Impedance at 20µA (Ohms)	450 - 750	200 at 150µA

GEC PLESSEY
SEMICONDUCTORS

DC1501/12/44

SILICON SCHOTTKY X-BAND WAVEGUIDE DETECTOR DIODES FOR INTRUDER ALARM APPLICATIONS

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance detectors.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- High Tss
- Very good temperature stability
- Very high pulse burn out
- X band operation

APPLICATIONS

Silicon Schottky detector diodes are finding increasing applications in various dopplar alarm motion detection units.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	500mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1501	DC1512	DC1544				
Frequency	/1 X Band	/1 X Band	/1 X Band	/4 X Band	/5 X Band	/7 X Band	/8 X Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV	350mV	350mV	350mV	350mV
Reverse voltage (Vr) @ 10µA	2V	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20	20	20	20	20
C_j @ 0V (fF)	80	80	80	80	80	80	80
Outline	51	59	23B	23B	23B	23B	23B

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1501	DC1512	DC1544				
	/1		/1	/4	/5	/7	/8
Test Freq. (GHz)	9.375	9.375	10.6	9.375	9.375	9.375	9.375
Tangential sensitivity min. (dBm) at 20µA	-56	-50 at 150µA	-56	-56	-57	-53	-57
Vout (at -20Bm) Ibias = 150µA	90mV	90mV	90mV	90mV	90mV	90mV	90mV
Video Impedance at 20µA (Ohms)	1500	200 at 150µA	1500	1500	1500	1500	1500

DC1591/96/97

SILICON SCHOTTKY X & S BAND MICROSTRIP INTEGRAL LIMITER MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent I/f noise
- Low conversion loss
- X or S band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	300mW
CW burn out	300mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1591	DC1596	DC1597
Frequency	X Band	X Band	S Band
Forward Voltage of Schottky @ 100μA	200mV	200mV	200mV
Forward Voltage of NIP @ 100μA	700mV	700mV	700mV
Rs (10mA to 20mA) in Ohms	20	20	20
C_j @ 0V (fF)	150	150	150
Outline	59	20	17

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1591	DC1596	DC1597
Test Freq. (GHz)	9.375	9.375	3.0
Low Drive level (μW)	700	700	700
IF Impedance at 150μA (Ohms)	400	400	400
Overall noise figure O.N.F. (dB)	9.0	9.0	8.0
Conversion loss (dB)	7.5	7.5	6.5

GEC PLESSEY
SEMICONDUCTORS

DC1590/93/95

SILICON SCHOTTKY X-BAND WAVEGUIDE INTEGRAL LIMITER MIXER DIODES

DESCRIPTION

This general purpose diode available in the microstrip package is suitable for applications requiring high performance mixers.

These diodes can be supplied in matched pairs by the addition of the letter M to the type number or with reverse polarity by the addition of the letter R to the type number.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- X band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Pulse burn out (Duty cycle 0.01%)	? mW
CW burn out	? mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1590		DC1593	DC1595
	/1	/2		
Frequency	X Band	X Band	X Band	X Band
Forward Voltage of Schottky @ 100μA	200mV	200mV	200mV	200mV
Forward Voltage of NIP @ 100μA	700mV	700mV	700mV	700mV
Rs (10mA to 20mA) in Ohms	20	20	20	20
C_j @ 0V (fF)	150	150	150	150
Outline	23B	23B	51	17

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1590		DC1593	DC1595
	/1	/2		
Test Freq. (GHz)	9.375	9.375	9.375	9.375
LO Drive level (μW)	700	700	700	700
IF Impedance at 150μA (Ohms)	400	400	400	400
Max. Overall noise figure O.N.F. (dB)	9.0	9.0	9.0	9.0
Conversion loss (dB)	7.5	7.5	7.5	7.5

GEC PLESSEY
SEMICONDUCTORS

DC1571/73

SILICON SCHOTTKY S-BAND MICROSTRIP LOW DRIVE MIXER DIODES

DESCRIPTION

The DC1570 series are medium barrier height silicon mixer diodes intended primarily for operation as low drive mixer diodes in systems where available local oscillator power is restricted and can be used as replacement for point contact diodes in many applications.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- S band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +70°C
Operating temperature	-55°C to +70°C
Pulse burn out (Duty cycle 0.01%)	300mW
CW burn out	150mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1571			DC1573		
Frequency	E S Band	F S Band	G S Band	E S Band	F S Band	G S Band
Forward Voltage (Vf) @ 100μA	200mV	200mV	200mV	200mV	200mV	200mV
Reverse voltage (Vr) @ 10μA	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	10	10	10	10	10	10
C_j @ 0V (fF)	180	180	180	180	180	180
Outline	20	20	20	59	59	59

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1571			DC1573		
	E	F	G	E	F	G
Test Freq. (GHz)	3.0	3.0	3.0	3.0	3.0	3.0
LO Drive level (μW)	700	700	700	700	700	700
IF Impedance at 150μA (Ohms)	400	400	400	400	400	400
Max Overall noise figure O.N.F. (dB)	7.5	7.0	6.5	7.5	6.5	6.0
Conversion loss (dB)	6.0	5.5	5.0	6.0	5.0	4.5

GEC PLESSEY
SEMICONDUCTORS

DC1575/78

SILICON SCHOTTKY X-BAND MICROSTRIP LOW DRIVE MIXER DIODES

DESCRIPTION

The DC1570 series are medium barrier height silicon mixer diodes intended primarily for operation as low drive mixer diodes in systems where available local oscillator power is restricted and can be used as replacement for point contact diodes in many applications.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- X band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +70°C
Operating temperature	-55°C to +70°C
Pulse burn out (Duty cycle 0.01%)	300mW
CW burn out	150mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1575			DC1578		
	E	F	G	E	F	G
Frequency	X Band	X Band	X Band	X Band	X Band	X Band
Forward Voltage (Vf) @ 100µA	200mV	200mV	200mV	200mV	200mV	200mV
Reverse voltage (Vr) @ 10µA	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20	20	20	20
C_j @ 0V (fF)	80	80	80	80	80	80
Outline	20	20	20	59	59	59

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1575			DC1578		
	E	F	G	E	F	G
Test Freq. (GHz)	9.375	9.375	9.375	9.375	9.375	9.375
LO Drive level (µW)	700	700	700	700	700	700
IF Impedance at 150µA (Ohms)	400	400	400	400	400	400
Max Overall noise figure O.N.F. (dB)	7.5	7.0	6.5	7.5	6.5	6.0
Conversion loss (dB0	6.0	5.5	5.0	6.0	5.5	5.0

GEC PLESSEY
SEMICONDUCTORS

DC1570/72

SILICON SCHOTTKY S-BAND WAVEGUIDE LOW DRIVE MIXER DIODES

DESCRIPTION

The DC1570 series are medium barrier height silicon mixer diodes intended primarily for operation as low drive mixer diodes in systems where available local oscillator power is restricted and can be used as replacement for point contact diodes in many applications.

FEATURES

- Low drive LO level
- Excellent l/f noise
- Low conversion loss
- S band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +70°C
Operating temperature	-55°C to +70°C
Pulse burn out (Duty cycle 0.01%)	300mW
CW burn out	150mW

TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1570			DC1572		
	E	F	G	E	F	G
Frequency	S Band	S Band	S Band	S Band	S Band	S Band
Forward Voltage (Vf) @ 100μA	200mV	200mV	200mV	200mV	200mV	200mV
Reverse voltage (Vr) @ 10μA	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	10	10	10	10	10	10
C_j @ 0V (fF)	180	180	180	180	180	180
Outline	17	17	17	23A	23A	23A

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1570			DC1572		
	E	F	G	E	F	G
Test Freq. (GHz)	3.0	3.0	3.0	3.0	3.0	3.0
LO Drive level (μW)	700	700	700	700	700	700
IF Impedance at 150μA (Ohms)	400	400	400	400	400	400
Max Overall noise figure O.N.F. (dB)	7.5	7.0	6.5	7.5	6.5	6.0
Conversion loss (dB)	6.0	5.5	5.0	6.0	5.5	5.0

DC1574/76/77

SILICON SCHOTTKY X-BAND WAVEGUIDE LOW DRIVE MIXER DIODES

DESCRIPTION

The DC1570 series are medium barrier height silicon mixer diodes intended primarily for operation as low drive mixer diodes in systems where available local oscillator power is restricted and can be used as replacement for point contact diodes in many applications.

FEATURES

- Low drive LO level
- Excellent I/f noise
- Low conversion loss
- X band operation

APPLICATIONS

Silicon Schottky mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communications systems.

LIMITING CONDITIONS

Storage conditions	-55°C to +70°C
Operating temperature	-55°C to +70°C
Pulse burn out (Duty cycle 0.01%)	300mW
CW burn out	150mW

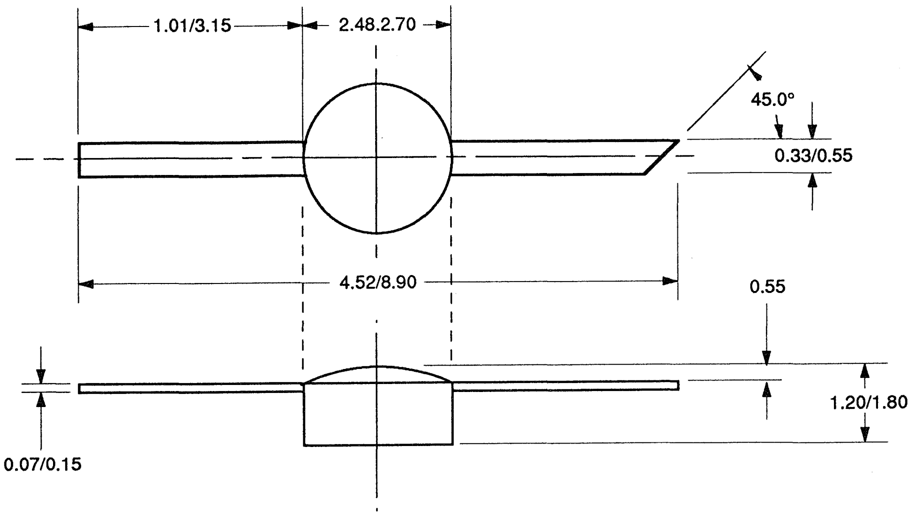
TYPICAL DC CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1574		DC1576		DC1577		
Frequency	E X Band	F X Band	E X Band	F X Band	E X Band	F X Band	G X Band
Forward Voltage (Vf) @ 100μA	200mV	200mV	200mV	200mV	200mV	200mV	200mV
Reverse voltage (Vr) @ 10μA	2V	2V	2V	2V	2V	2V	2V
Rs (10mA to 20mA) in Ohms	20	20	20	20	20	20	20
C_j @ 0V (fF)	80	80	80	80	80	80	80
Outline	17	17	23A	23A	51	51	51

TYPICAL RF CHARACTERSITICS Tamb 25°C

TYPE NUMBER	DC1574		DC1576		DC1577		
	E	F	E	F	E	F	G
Test Freq. (GHz)	9.375	9.375	9.375	9.375	9.375	9.375	9.375
LO Drive level (μW)	700	700	700	700	700	700	700
IF Impedance at 150μA (Ohms)	400	400	400	400	400	400	400
Max Overall noise figure O.N.F. (dB)	7.5	7.0	7.5	7.0	7.5	6.5	6.0
Conversion loss (dB)	6.0	5.5	6.0	5.5	6.0	5.5	5.0

PACKAGE DETAILS



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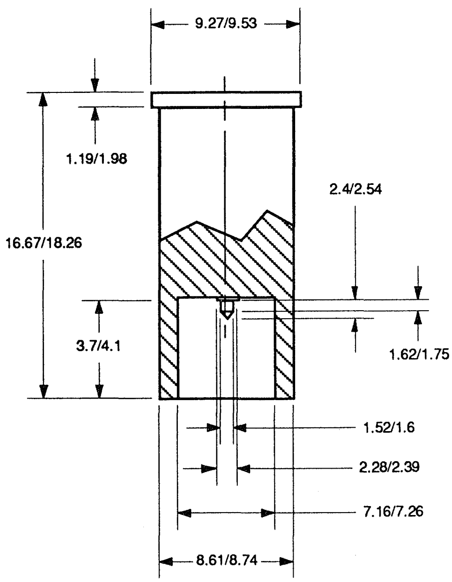

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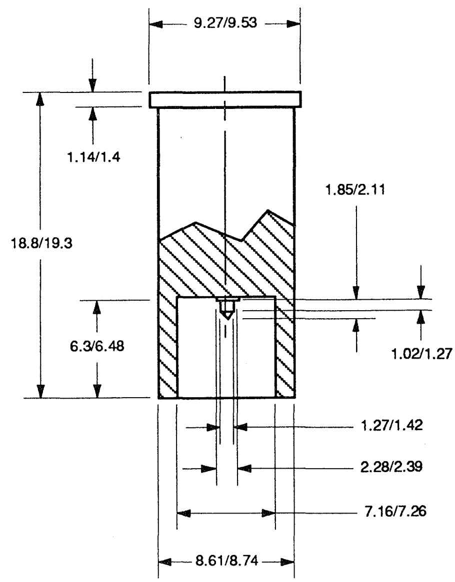

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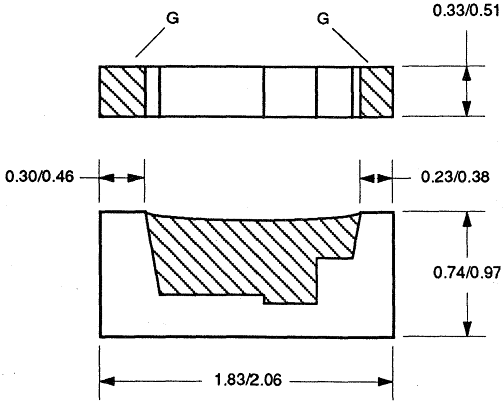
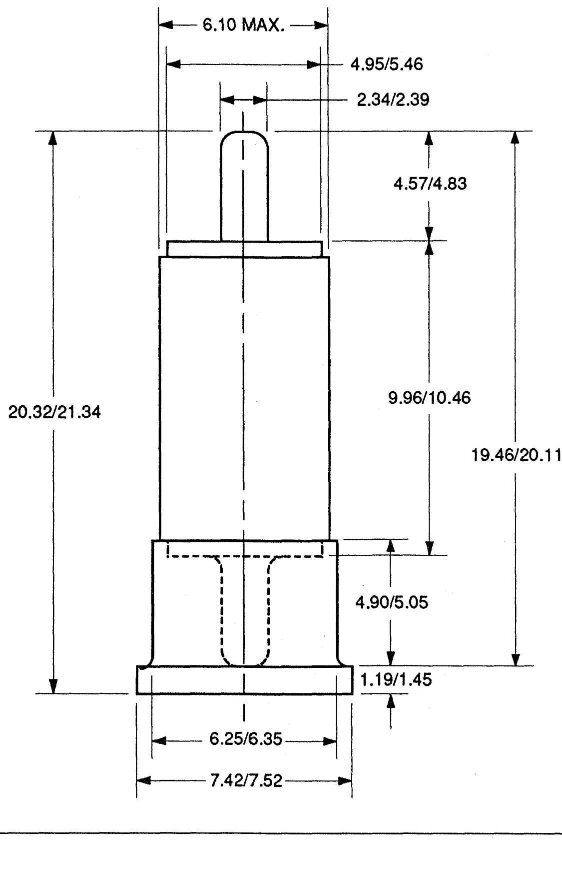


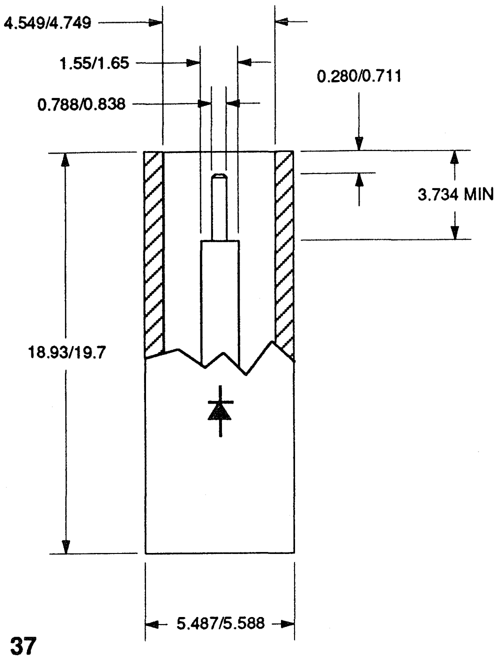
G - GOLD PLATE, 5 MICRONS MIN.
OVER 1.27 MICRONS OF NICKEL.

CATHODE - RED

20



23A & 23B



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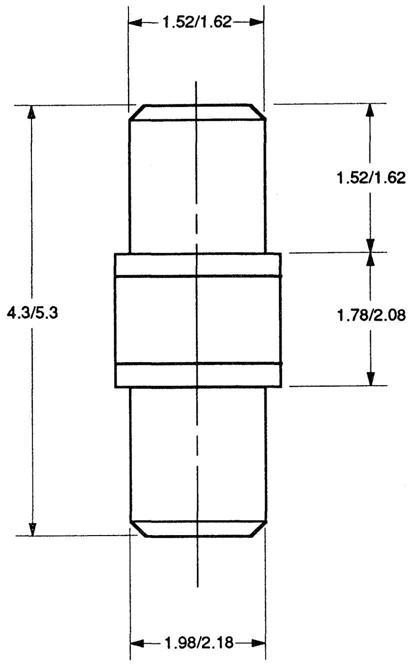

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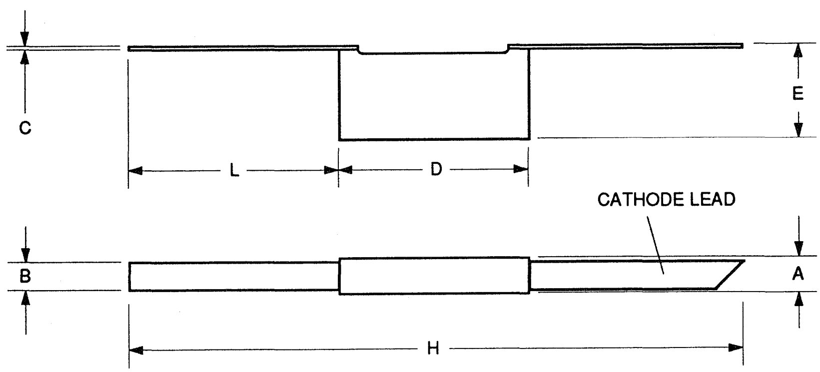
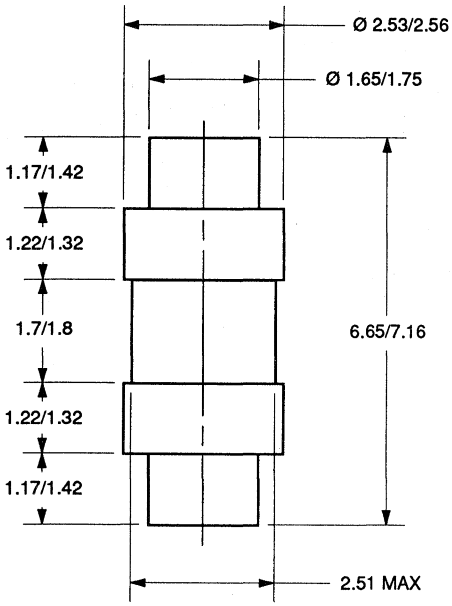
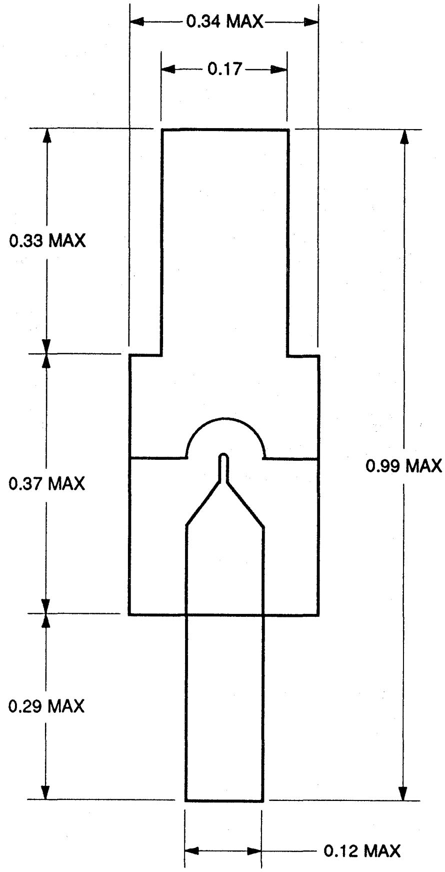


REF	MIN	MAX
A	0.33	0.75
B	0.33	0.55
C	0.07	0.17
D	1.83	2.10
E	0.74	1.25
H	4.52	8.90
L	1.05	3.15

59


Ø 2.53/2.56
Ø 1.65/1.75
1.17/1.42
1.22/1.32
1.7/1.8
1.22/1.32
1.17/1.42
6.65/7.16
2.51 MAX

102


0.34 MAX
0.17
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0.37 MAX
0.29 MAX
0.99 MAX
0.12 MAX

104

CT3417-1.3 August 1992

DC1800 Series

PLANAR DOPED BARRIER MULTIJUNCTION BEAM LEAD MIXER DIODES

Multijunction planar doped barrier beam lead mixer diodes are used in high frequency applications where parasitic capacitance and inductance need to be kept to a minimum, and are available in either mounted or unmounted configurations. The integrated die include ring quad,bridge quad, series pair and common anode/cathode pair outlines.

As mixers, these diodes offer good conversion loss at low local oscillator drive levels, without the need to bias the mixer, and have very high pulse burnout limits, thereby reducing, and in some applications negating, the need for limiter protection. These diodes also exhibit a close to carrier 1/f noise performance and temperature stability that is significantly better than that of gallium arsenide or silicon Schottky diodes.

FEATURES

- Low LO Drive Level (< 500µW)
- Excellent 1/f Noise
- Low Conversion Loss (< 6.0dB)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Frequencies up to 26GHz

APPLICATIONS

Multijunction planar doped barrier beam lead mixer diodes are finding increasing applications in instrumentation, military, civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon applications.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1801	DC1802	DC1803	DC1804	DC1805	DC1806
Frequency	J Band	J Band	J Band	J Band	J Band	J Band
Forward Voltage (Vf) @ 100µA	350mV	350mV	350mV	350mV	350mV	350mV
Reverse Voltage (Vr) @ 100µA	2.5V	2.5V	2.5V	2.5V	2.5V	2.5V
R_T (10mA to 20mA)	13Ω	13Ω	13Ω	13Ω	13Ω	13Ω
C_j @ 0V	50fF	50fF	50fF	50fF	50fF	50fF
Outline	231	231	232	232	233	233

TYPICAL RF CHARACTERISTICS Tamb 25°C

Information not available at time of going to print. Please contact GPS for latest information.

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1801	DC1802	DC1803	DC1804	DC1805	DC1806
L_P	0.1 nH	0.1 nH	0.1 nH	0.1 nH	0.1 nH	0.1 nH
R_S	11Ω	11Ω	11Ω	11Ω	11Ω	11Ω
C_j	50 fF	50 fF	50 fF	50 fF	50 fF	50 fF
C_P	20 fF	20 fF	20 fF	20 fF	20 fF	20 fF

DC1820 Series

PLANAR DOPED BARRIER MICROSTRIP BEAM LEAD MIXER DIODES

Planar doped barrier (PDB) beam lead mixer diodes represent a major advancement in mixer/detector technology. These diodes offer good conversion loss at low local oscillator drive level, without the need to bias. In addition, the diodes have very high pulse burn-out limits, thereby reducing, and in some applications, negating the need for limiter protection. Finally, these diodes exhibit a close-to-carrier 1/f noise performance and temperature stability that is significantly better than that of gallium arsenide or silicon Schottky diodes. These diodes are offered in a beam lead construction, minimising package parasitics, enabling the device to operate up to 110GHz.

FEATURES

- Low LO Drive Level (< 500µW)
- Excellent 1/f Noise
- Low Conversion Loss (< 6.0dB)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Frequencies up to 110GHz

APPLICATIONS

PDB beam lead mixer diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL DC CHARACTERISTICS Tamb 25°C

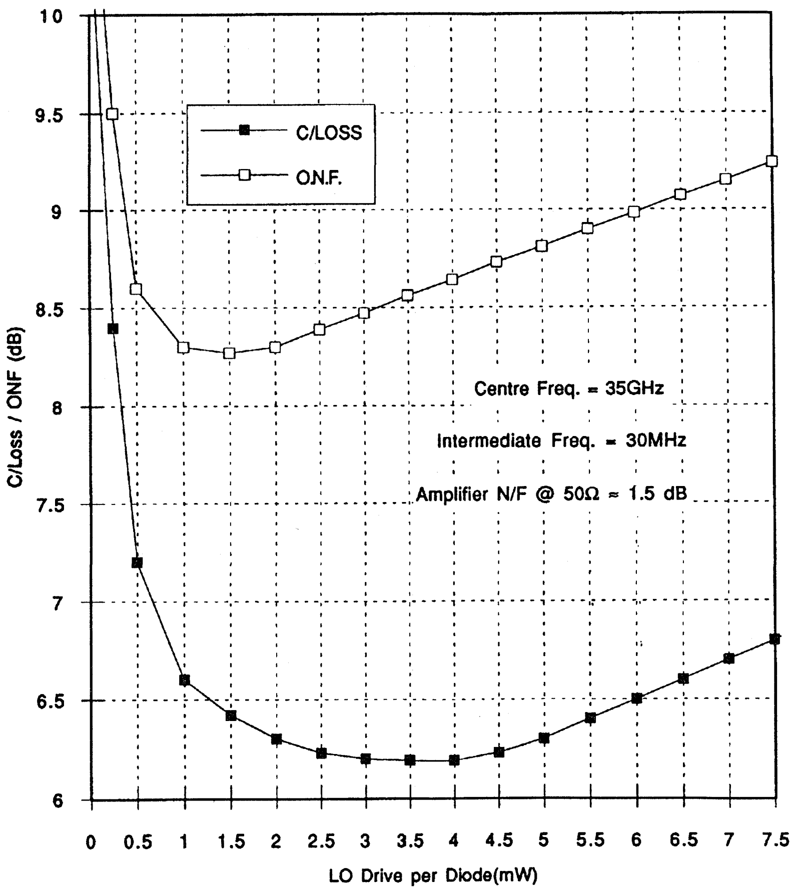
TYPE NUMBER	DC1820	DC1821	DC1822	DC1824
Frequency	X Band	J Band	Q Band	W Band
Forward Voltage (Vf) @ 100µA	180mV	180mV	180mV	275mV
Reverse Voltage (Vr) @ 100µA	1.5V	1.0V	1.0V	2.25V
R_T (10mA to 20mA)	12Ω	8Ω	10Ω	25Ω
C_j @ 0V	80fF	50fF	30fF	30fF
Outline	107	115	115	115

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1820	DC1821	DC1822	DCI824
Test Frequency	9.375GHz	16.5GHz	35GHz	TBA
LO Drive Level	0.75mW	1mW	2mW	TBA
IF Impedance at 150µA	200Ω	200Ω	200Ω	TBA
Overall Noise Figure O.N.F.	6.3dB	7.3dB	9dB	TBA
Conversion Loss (Irec = 2mA)	4.8dB	5.8dB	7.5dB	TBA

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1820	DC1821	DC1822	DCl824
L_P	0.1 nH	0.1 nH	0.1 nH	0.1 nH
R_S	10Ω	6Ω	8Ω	23Ω
C_j	50 fF	50 fF	50 fF	50 fF
C_P	20 fF	15 fF	15 fF	15 fF



Conversion Loss and Overall Noise Figure of the Q Band PDB Microstrip Mixer Diode

GEC PLESSEY
SEMICONDUCTORS

DC1823

PLANAR DOPED BARRIER Q BAND MICROSTRIP BEAM LEAD DETECTOR DIODE

Planar Doped Barrier (PDB) diodes represent a major advancement in detector technology. These diodes offer very high tangential sensitivity, high compression point and very good temperature stability. The high pulse burnout of these diodes also increases overall reliability of detection systems.

FEATURES

- High Tss (<-57dBm)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Usable up to 40GHz

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1823
Frequency	Q Band
Forward Voltage (Vf) @ 100µA	110mV
Reverse Voltage (Vr) @ 100µA	1.5V
R_T (10mA to 20mA)	15Ω
C_j @ 0V	35fF
Outline	234

APPLICATIONS

PDB beam lead detector diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or Silicon Schottky diode equivalents.

LIMITING CONDITIONS

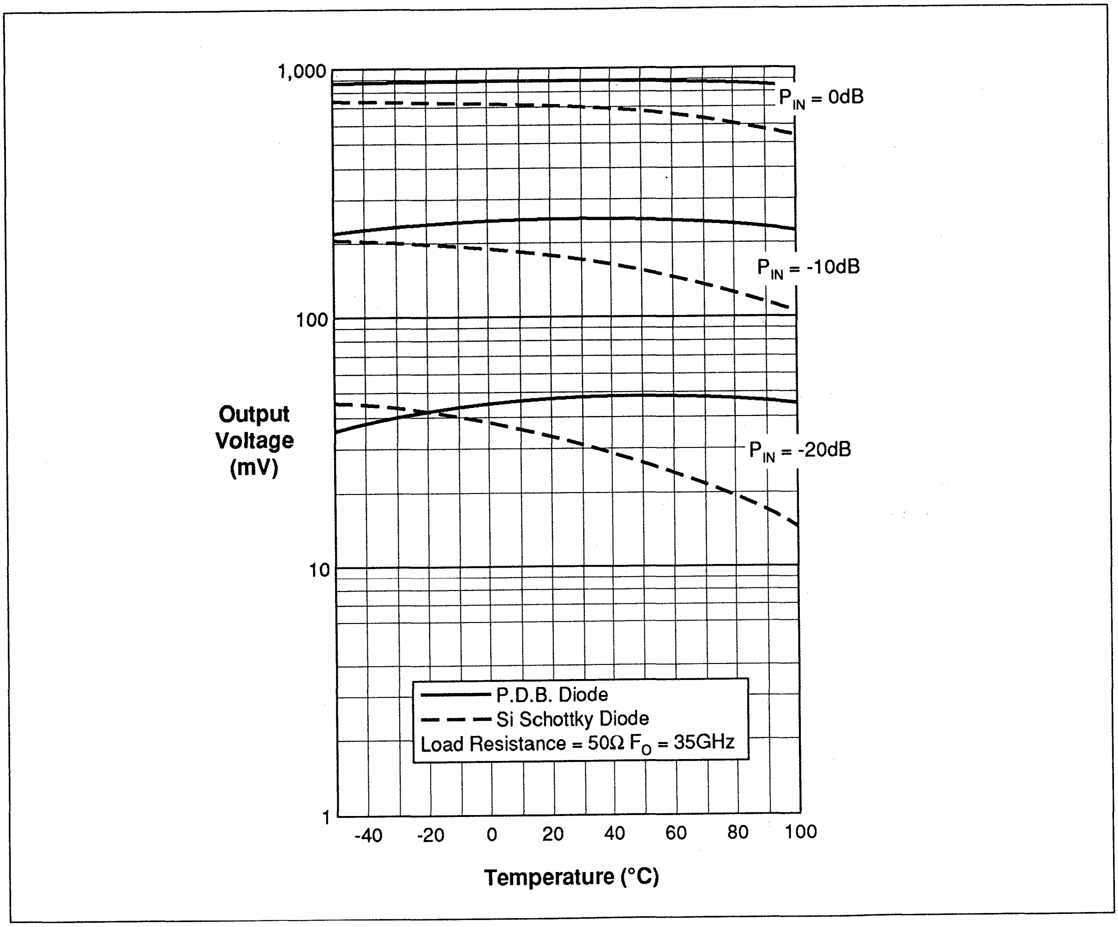
Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL RF CHARACTERISTICS Tamb 25°C

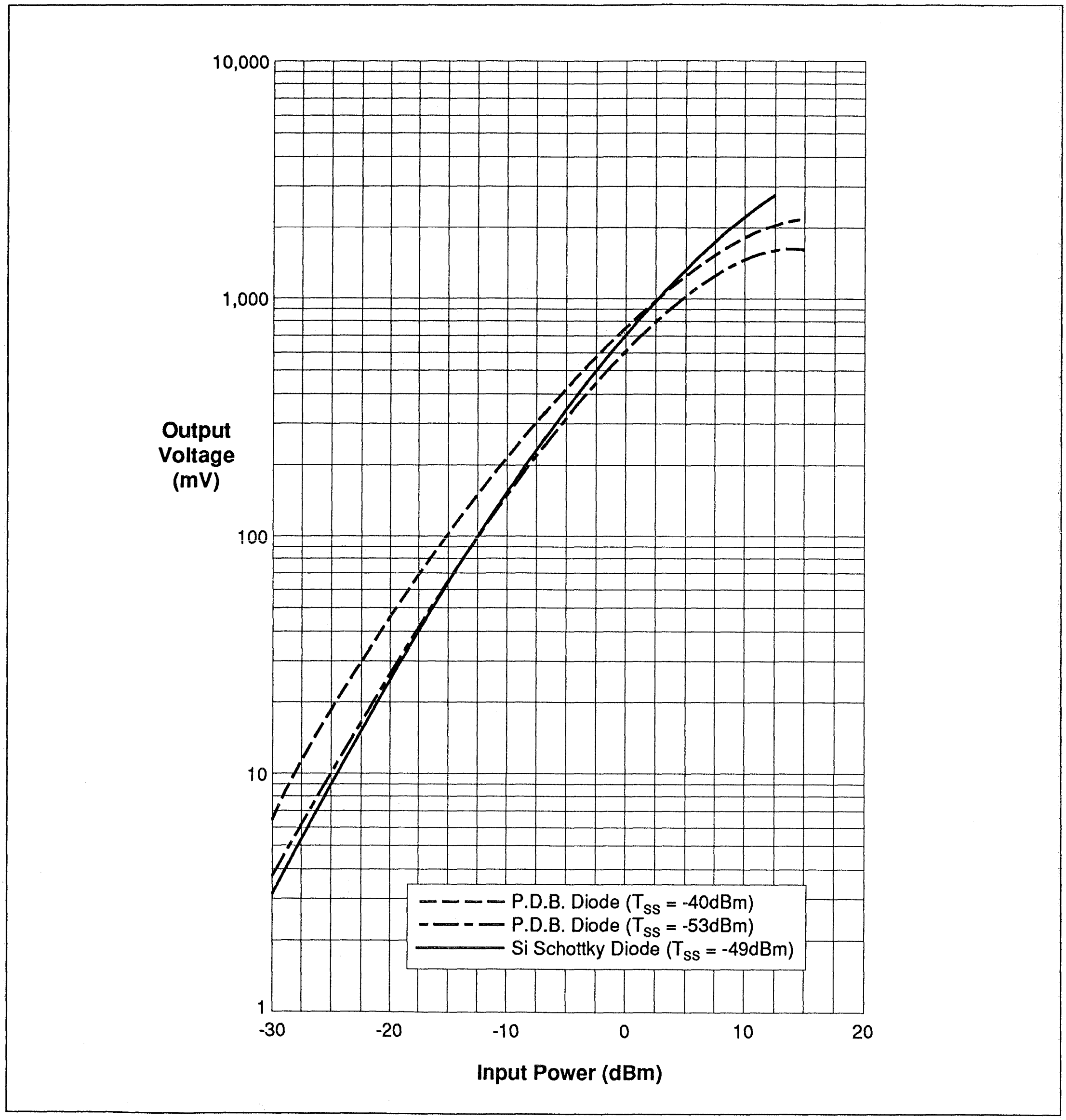
TYPE NUMBER	DC1823
Test Frequency	35GHz
Tangential Sensitivity (Ibias = 50mA)	-54dBm
Video Impedance at 150µA	200Ω
Vout to Pin	250mV

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1823
L_P	0.1 nH
R_S	13Ω
C_j	30 fF
C_P	15 fF



Output Voltage vs Temperature for Q Band P.D.B. Beam Lead and Silicon Schottky Detector Diodes



Transfer Characteristics of Q Band PDB Microstrip and Silicon Schottky Detector Diodes (F_O = 35GHz)

GEC PLESSEY
SEMICONDUCTORS

DC1840 Series

PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID MIXER DIODES

Planar doped barrier (PDB) LID/MICROLID mixer diodes represent a major advancement in mixer/detector technology. These diodes offer good conversion loss at low local oscillator drive level, without the need to bias. In addition, the diodes have very high pulse burn-out limits, thereby reducing, and in some applications, negating the need for limiter protection. Finally, these diodes exhibit a close-to-carrier 1/f noise performance and temperature stability that is significantly better than that of gallium arsenide or silicon Schottky diodes.

FEATURES

- Low LO Drive Level (< 500μW)
- Excellent 1/f Noise
- Low Conversion Loss (< 6.0dB)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Frequencies up to 40GHz

APPLICATIONS

PDB LID/MICROLID mixer diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL DC CHARACTERISTICS Tamb 25°C

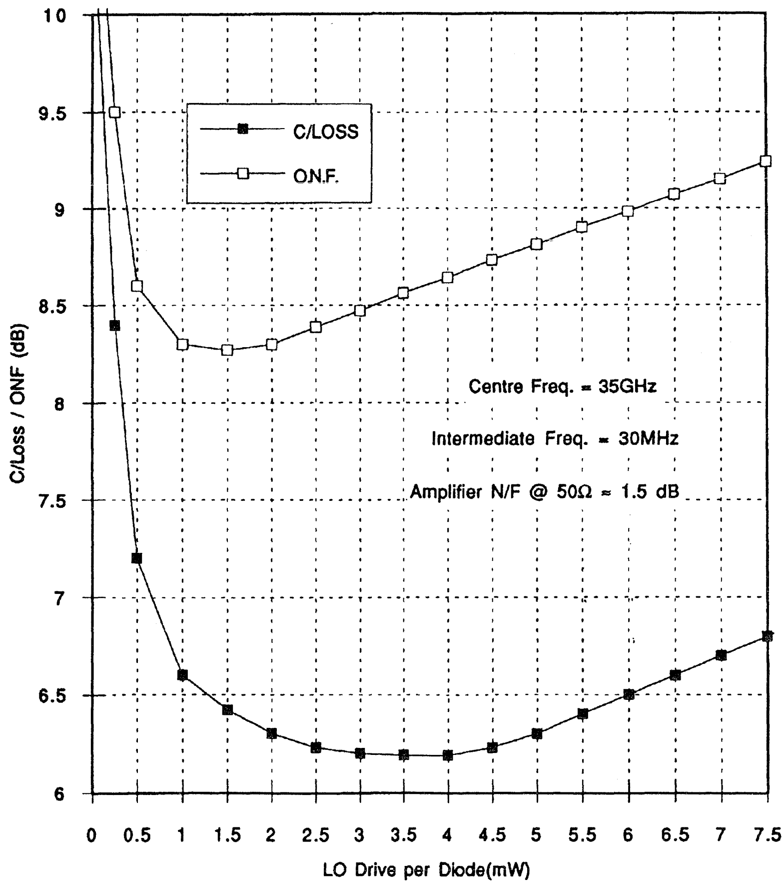
TYPE NUMBER	DC1840	DC1842	DC1843	DC1844
Frequency	X Band	J Band	J Band	Q Band
Forward Voltage (Vf) @ 100μA	0.1V	100mV	100mV	100mV
Reverse Voltage (Vr) @ 100μA	1.0V	1.0V	1.0V	1.0V
R_T (10mA to 20mA)	8Ω	8Ω	8Ω	8Ω
C_j @ 0V	TBA	TBA	50fF	TBA
Outline	20	20	59	111

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1840	DC1842	DC1843	DCI844
Test Frequency	9.375GHz	16.5GHz	16.5GHz	35GHz
LO Drive Level	0.75mW	1mW	1mW	2mW
IF Impedance at 150μA	200Ω	200Ω	200Ω	200Ω
Overall Noise Figure O.N.F.	6.5dB	8.0dB	8.0dB	8.5dB
Conversion Loss (Irec = 2mA)	5dB	6.5dB	6.5dB	7dB

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1840	DC1842	DC1843	DCI844
L_P	1 nH	1 nH	1 nH	1 nH
R_S	6Ω	6Ω	6Ω	6Ω
C_j	TBA	TBA	50 fF	TBA
C_P	35 fF	35 fF	TBA	TBA



Conversion Loss and Overall Noise Figure of the Q Band PDB Microstrip Mixer Diode

GEC PLESSEY

SEMICONDUCTORS

DC1841/45

PLANAR DOPED BARRIER MICROSTRIP LID/MICROLID DETECTOR DIODE

Planar Doped Barrier (PDB) diodes represent a major advancement in detector technology. These diodes offer very high tangential sensitivity, high compression point and very good temperature stability, especially when biased. The high pulse burnout of these diodes also increases overall reliability of detection systems.

APPLICATIONS

PDB LID/MICROLID detector diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents.

FEATURES

- High Tss (<-57dBm)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Frequency Operation up to 40GHz

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL DC CHARACTERISTICS Tamb 25°C

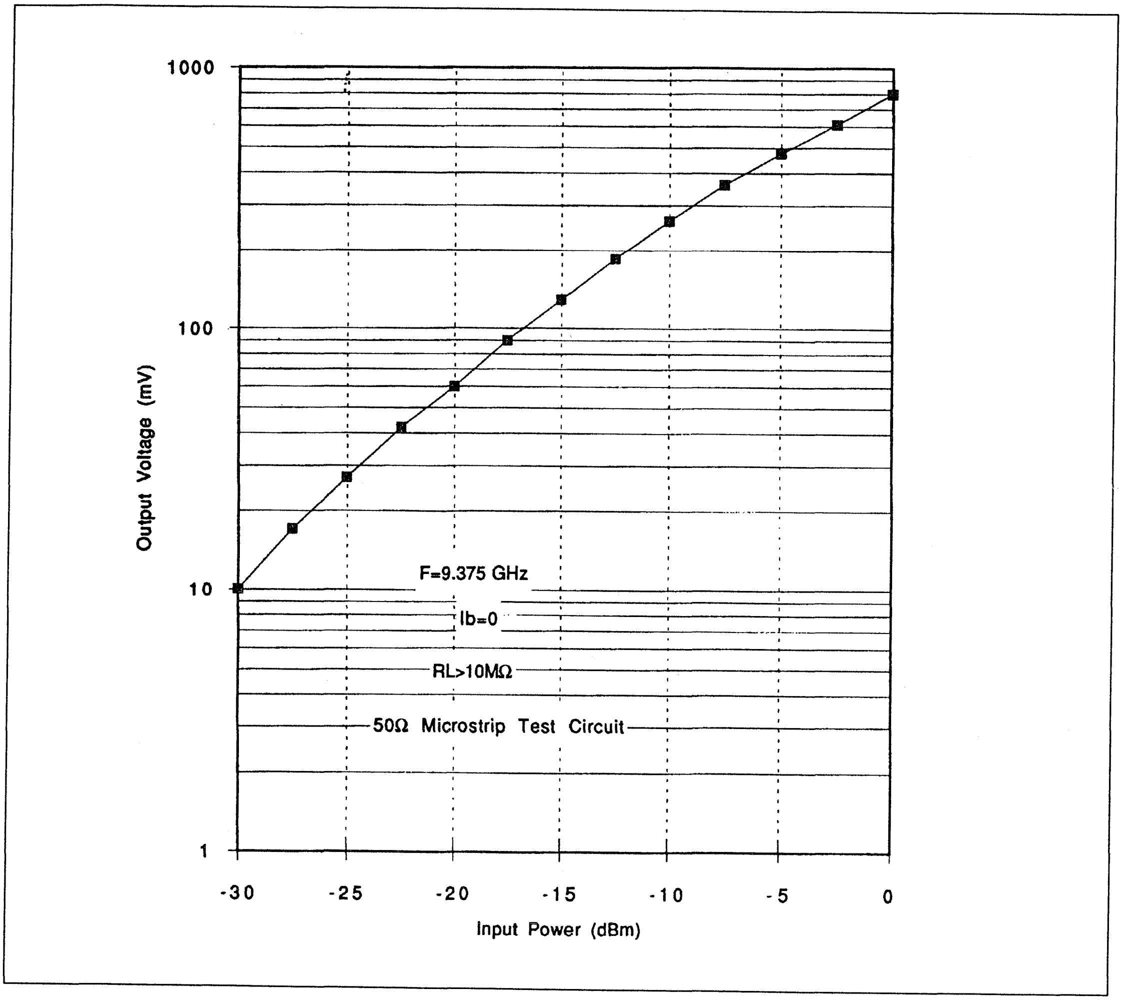
TYPE NUMBER	DC1841	DC1845
Frequency	X Band	Q Band
Forward Voltage (Vf) @ 100µA	100mV	100mV
Reverse Voltage (Vr) @ 100µA	1.0V	1.0V
R_T (10mA to 20mA)	8Ω	8Ω
C_j @ 0V	TBA	TBA
Outline	20	111

TYPICAL RF CHARACTERISTICS Tamb 25°C

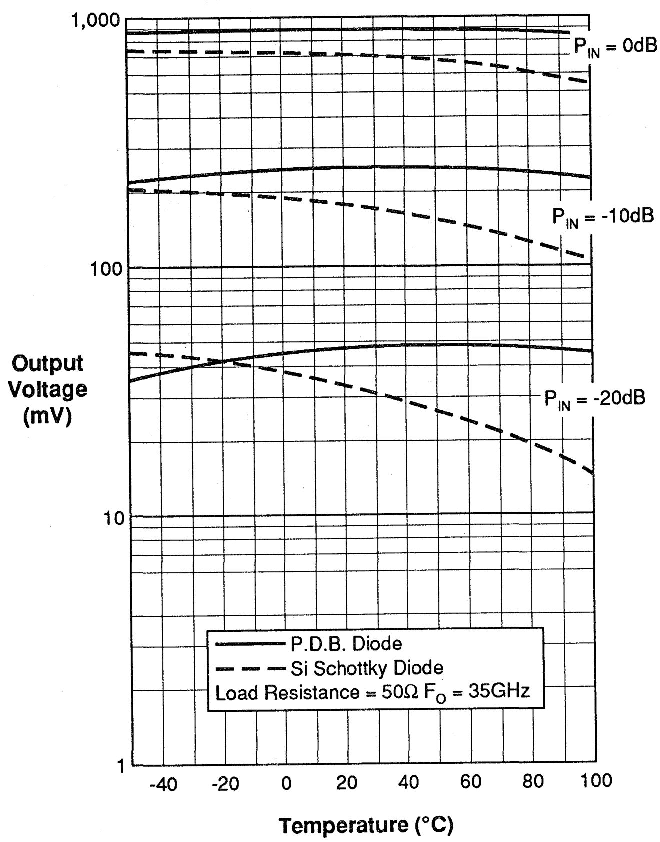
TYPE NUMBER	DC1841	DC1845
Test Frequency	9.375GHz	35GHz
Tangential Sensitivity (Ibias = 50mA)	-54dBm	-54dBm
Video Impedance at 150µA	200Ω	200Ω
Vout to Pin	250mV	250mV

EQUIVALENT CIRCUIT PARAMETERS

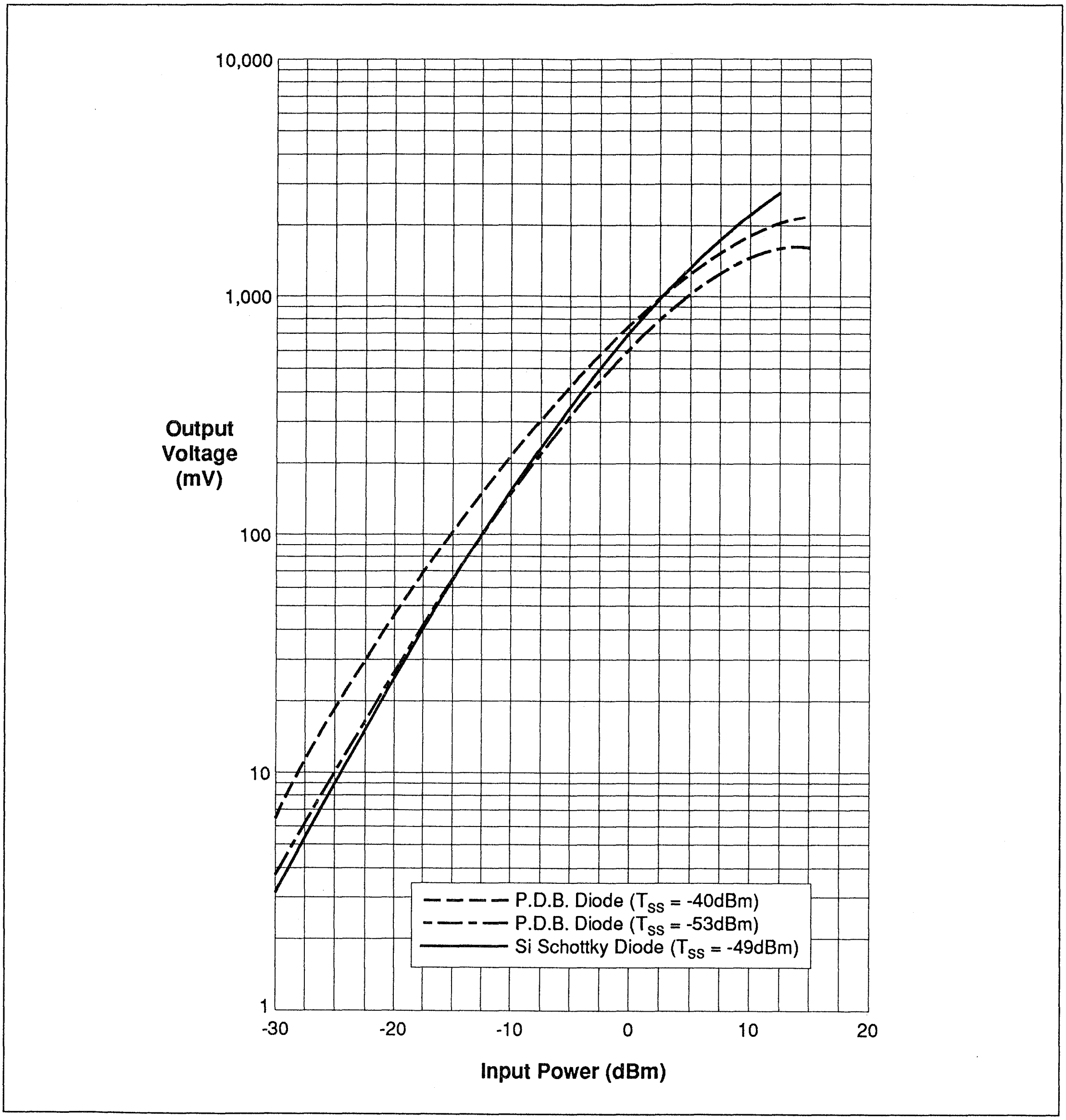
TYPE NUMBER	DC1841	DC1845
L_P	1 nH	1 nH
R_S	6Ω	6Ω
C_j	TBA	TBA
C_P	35 fF	35 fF



Output Voltage vs Input Power for X Band PDB Microstrip Detector Diode



Output Voltage vs Temperature for Q Band P.D.B. Beam Lead and Silicon Schottky Detector Diodes



Transfer Characteristics of Q Band PDB Microstrip and Silicon Schottky Detector Diodes (F_O = 35GHz)

DC1860

PLANAR DOPED BARRIER W BAND MICROSTRIP COPLANAR MIXER DIODE

Planar doped barrier (PDB) coplanar mixer diodes represent a major advancement in mixer/detector technology. These diodes offer good conversion loss at low local oscillator drive level, without the need to bias. In addition, the diodes have very high pulse burn-out limits, thereby reducing, and in some applications, negating the need for limiter protection. Finally, these diodes exhibit a close-to-carrier 1/f noise performance and temperature stability that is significantly better than that of gallium arsenide or silicon Schottky diodes. These diodes are offered in coplanar construction, minimising package parasitics, enabling the device to operate up to 100GHz, and are ideal for automated pick n' place surface mount assembly.

FEATURES

- Low LO Drive Level (<750µW)
- Excellent 1/f Noise
- Low Conversion Loss (<10dB)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>190W)
- W Band Operation

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1860
Frequency	W Band
Forward Voltage (Vf) @ 100µA	130mV
Reverse Voltage (Vr) @ 100µA	1.5V
R_T (10mA to 20mA)	25Ω
C_j @ 0V	35fF
Outline	-

APPLICATIONS

PDB coplanar mixer diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents. The coplanar construction is compatible with high volume, automated assembly techniques.

LIMITING CONDITIONS

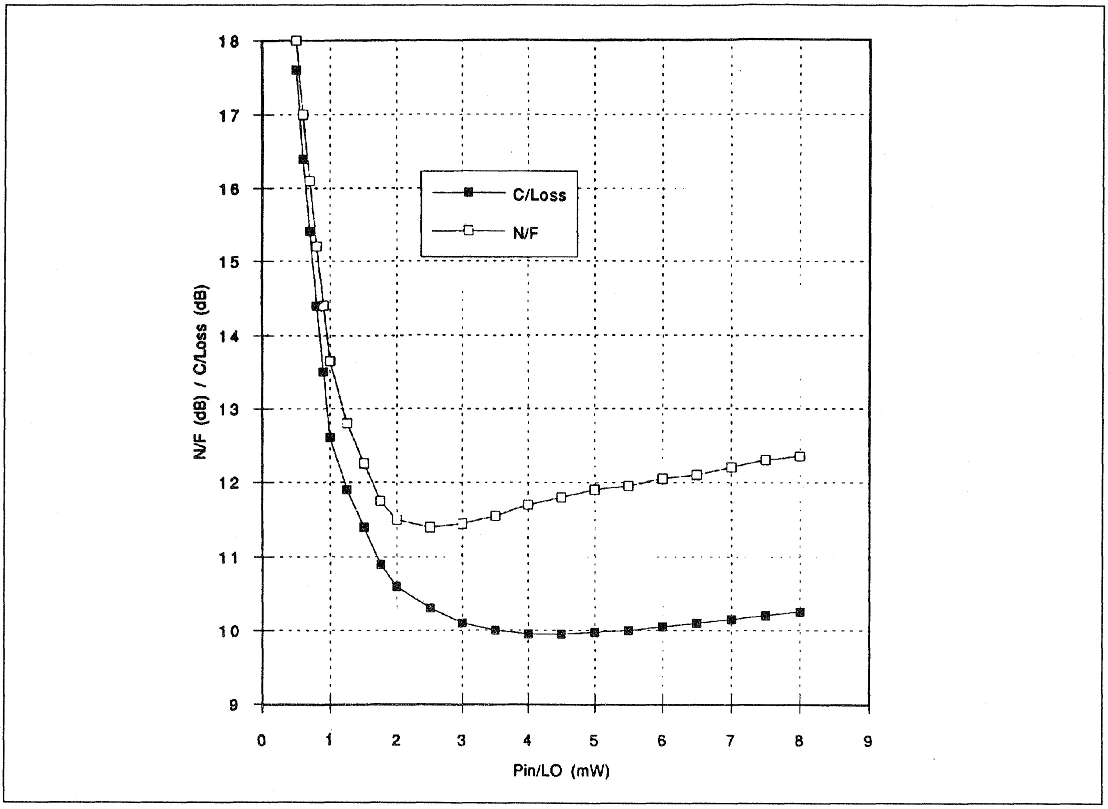
Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL RF CHARACTERISTICS Tamb 25°C

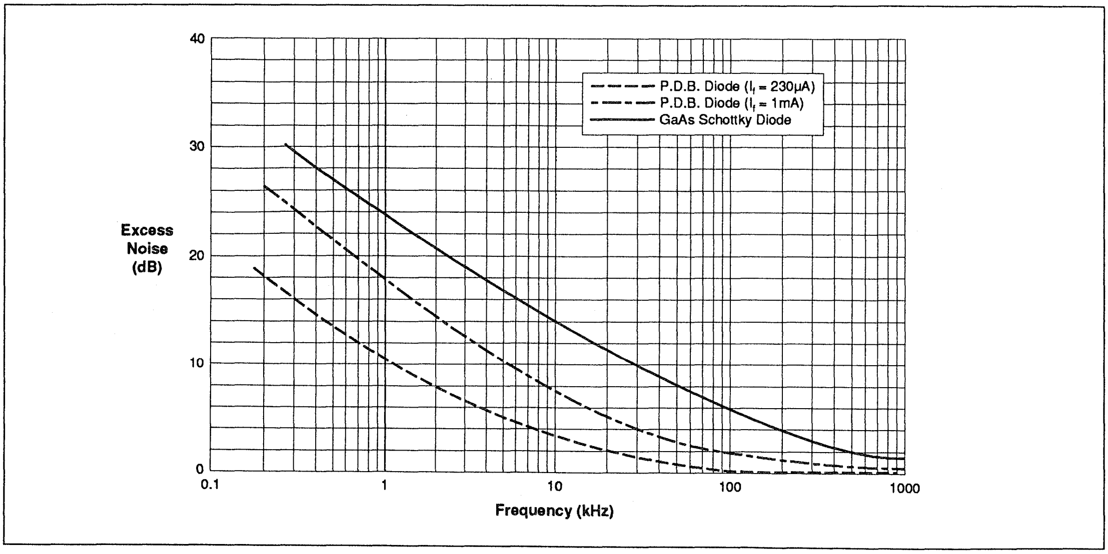
TYPE NUMBER	DC1860
Test Frequency	94GHz
LO Drive Level	0.75mW
IF Impedance at 150µA	200Ω
Overall Noise Figure O.N.F.	11.5dB
Conversion Loss (Irec = 2mA)	10dB

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1860
L_P	0.01 nH
R_S	23Ω
C_j	25 fF
C_P	15 fF



C/Loss and N/F of W Band Coplanar PDB Mixer Diode



Comparison of 1/F Noise Performance for W Band Coplanar Diodes

GEC PLESSEY
SEMICONDUCTORS

DC1870 Series

PLANAR DOPED BARRIER WAVEGUIDE MIXER DIODES

Planar doped barrier (PDB) waveguide mixer diodes represent a major advancement in mixer/detector technology. These diodes offer good conversion loss at low local oscillator drive level, without the need to bias. In addition, the diodes have very high pulse burn-out limits, thereby reducing, and in some applications, negating the need for limiter protection. Finally, these diodes exhibit a close-to-carrier 1/f noise performance and temperature stability that is significantly better than that of gallium arsenide or silicon Schottky diodes.

FEATURES

- Low LO Drive Level (< 500μW)
- Excellent 1/f Noise
- Low Conversion Loss (< 6.0dB)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- Frequencies Operation up to 18GHz

APPLICATIONS

PDB waveguide mixer diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents.

LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1870	DC1871	DC1874
Frequency	X Band	X Band	Q Band
Forward Voltage (Vf) @ 100μA	120mV	100mV	110mV
Reverse Voltage (Vr) @ 100μA	1.2V	1.0V	1.5V
R_T (10mA to 20mA)	8Ω	8Ω	15Ω
C_j @ 0V	TBA	TBA	35fF
Outline	51	102	106

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1870	DC1871	DC1874
Test Frequency	9.375GHz	9.375GHz	TBA
LO Drive Level	0.75mW	0.75mW	TBA
IF Impedance at 150µA	200Ω	200Ω	TBA
Overall Noise Figure O.N.F.	9.0dB	6.5dB	TBA
Conversion Loss (Irec = 2mA)	7.5dB	5.0dB	TBA

EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1870	DC1871	DC1874
L_P	1 nH	1 nH	1 nH
R_S	6Ω	6Ω	6Ω
C_j	TBA	TBA	TBA
C_P	TBA	TBA	TBA

DC1872/3

PLANAR DOPED BARRIER X BAND WAVEGUIDE DETECTOR DIODES

Planar Doped Barrier (PDB) diodes represent a major advancement in detector technology. These diodes offer very high tangential sensitivity, high compression point and very good temperature stability. The high pulse burnout of these diodes also increases overall reliability of detection systems.

FEATURES

- High Tss (<-57dBm)
- Very Good Temperature Stability
- Very High Pulse Burn Out (>100W)
- X Band Operation

TYPICAL DC CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1872	DC1873
Frequency	X Band	X Band
Forward Voltage (Vf) @ 100µA	100mV	100mV
Reverse Voltage (Vr) @ 100µA	1.0V	1.0V
R_T (10mA to 20mA)	8Ω	8Ω
C_j @ 0V	TBA	TBA
Outline	51	102

TYPICAL RF CHARACTERISTICS Tamb 25°C

TYPE NUMBER	DC1872	DC1873
Test Frequency	9.375GHz	9.375GHz
Tangential Sensitivity (Ibias = 50mA)	-55dBm	-55dBm
Video Impedance at 150µA	200Ω	200Ω
Vout to Pin	250mV	250mV

APPLICATIONS

PDB waveguide detector diodes are finding increasing applications in instrumentation; military; civil and marine radar and communication systems. In most systems these diodes can directly retrofit existing protected or unprotected gallium arsenide or silicon Schottky diode equivalents.

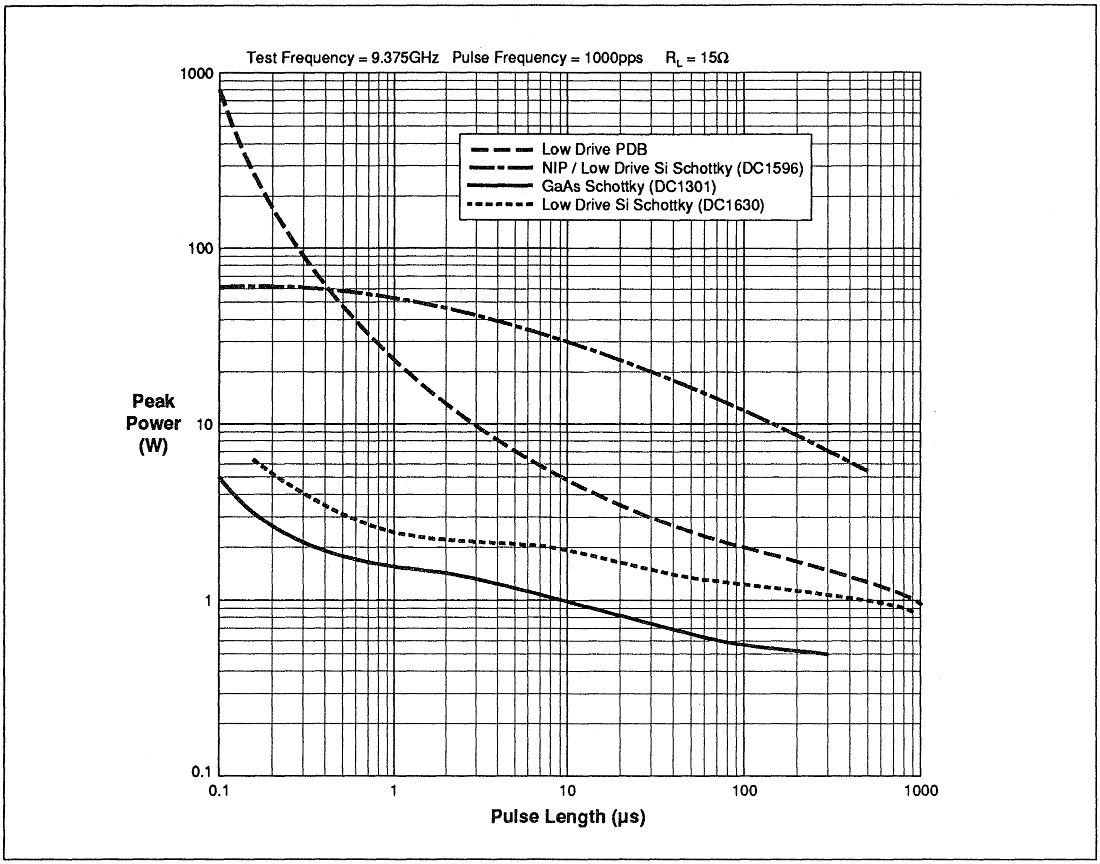
LIMITING CONDITIONS

Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +150°C
Pulse Burn Out (Duty cycle 0.01%)	100W
CW Burn Out	0.5W

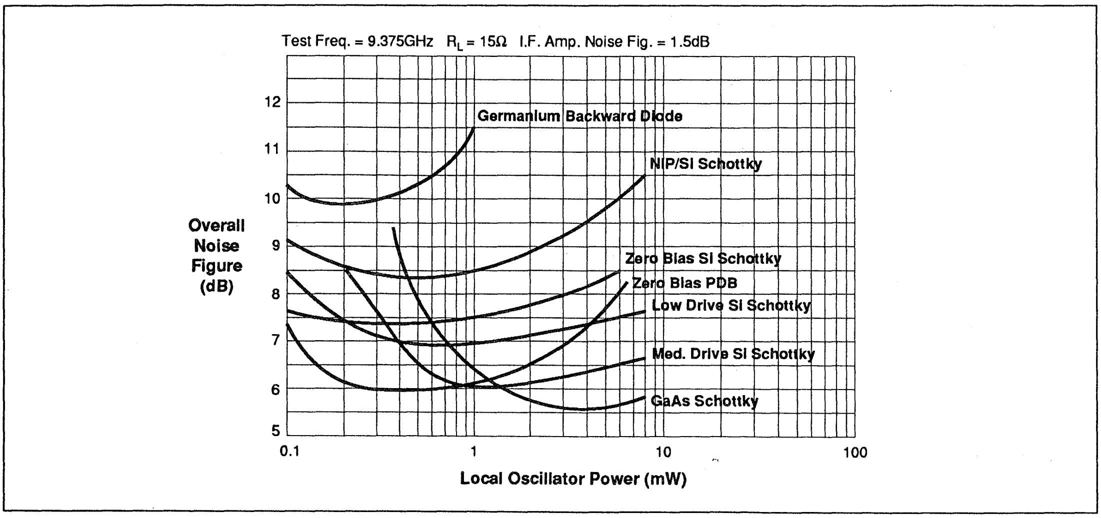
EQUIVALENT CIRCUIT PARAMETERS

TYPE NUMBER	DC1872	DC1873
L_P	1 nH	1 nH
R_S	6Ω	6Ω
C_j	TBA	TBA
C_P	50 fF	50 fF

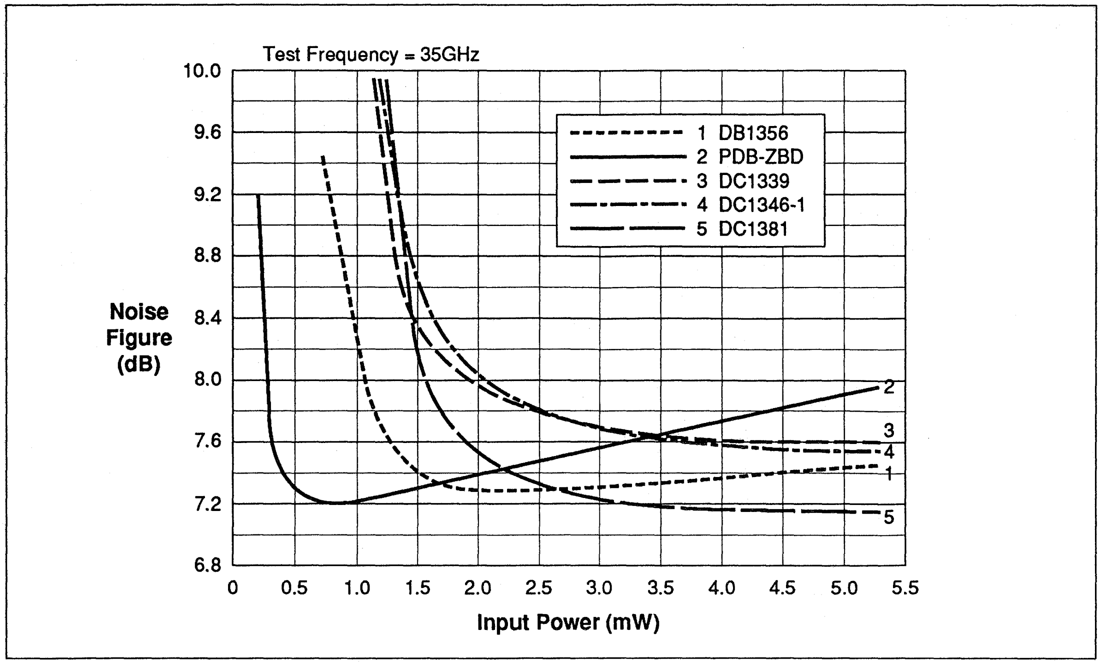
GENERAL GRAPHS



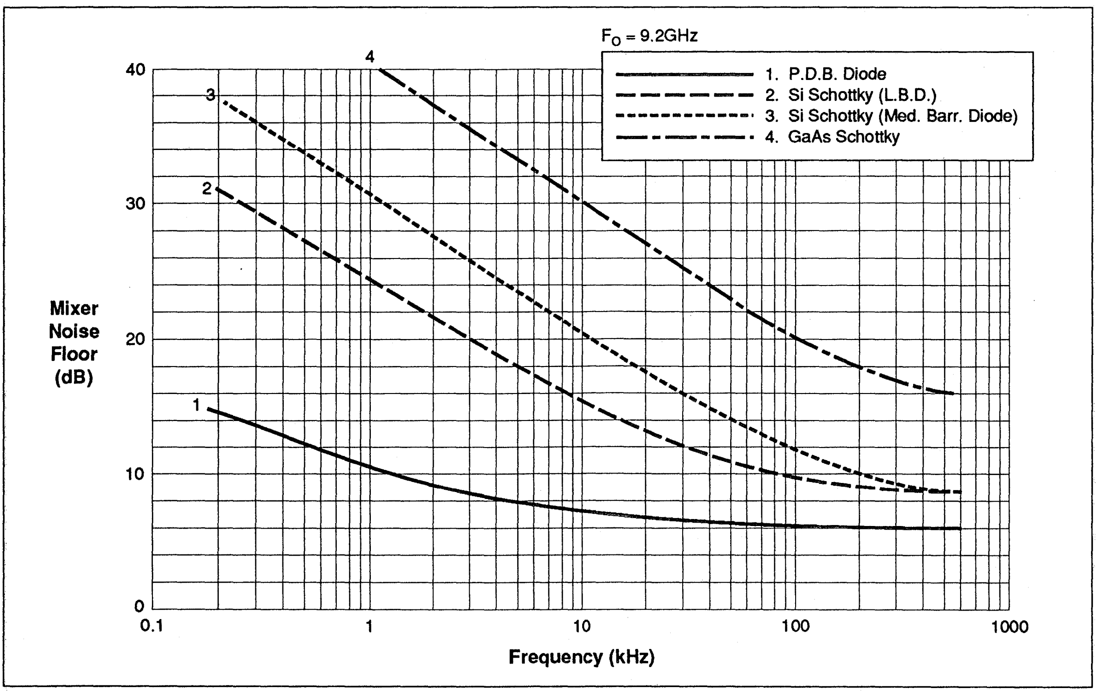
Peak Power v Pulse Length



Overall Noise Figure v Local Oscillator Power

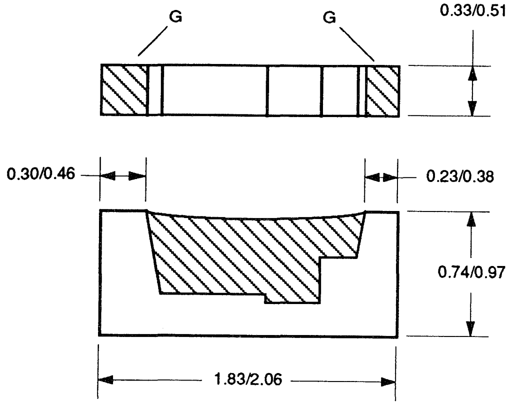


Noise Figure v Input Power for GaAs Schottky and Planar Doped Barrier Diodes



Comparison of Balanced Noise Floor Measurements

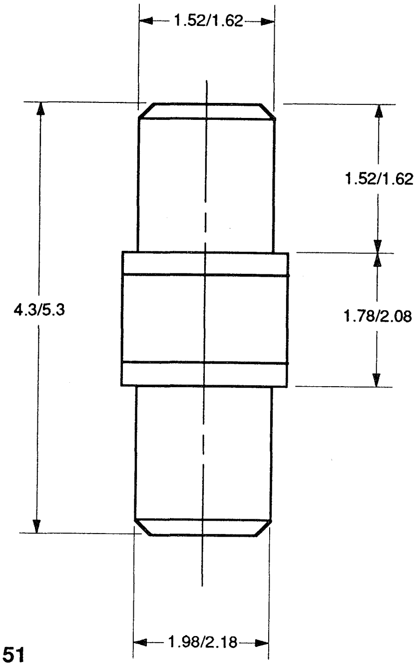
PACKAGE DETAILS



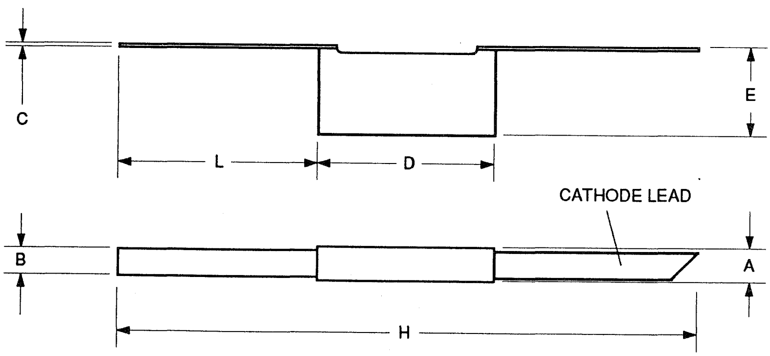
G - GOLD PLATE, 5 MICRONS MIN.
OVER 1.27 MICRONS OF NICKEL.

CATHODE - RED

20

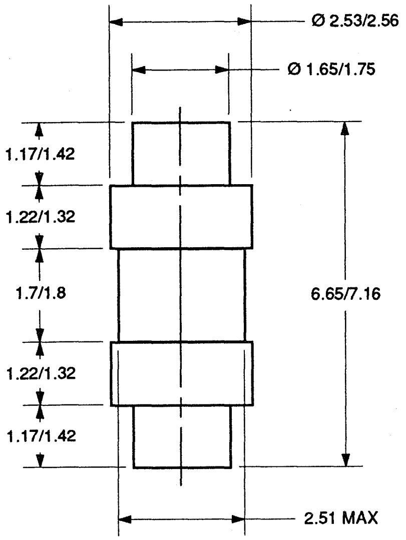


51

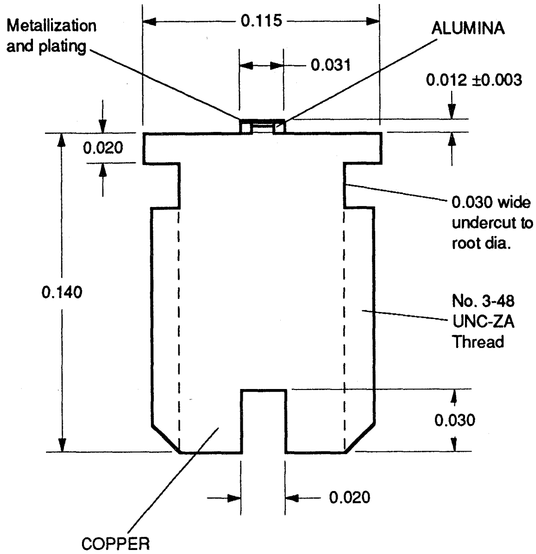


REF	MIN	MAX
A	0.33	0.75
B	0.33	0.55
C	0.07	0.17
D	1.83	2.10
E	0.74	1.25
H	4.52	8.90
L	1.05	3.15

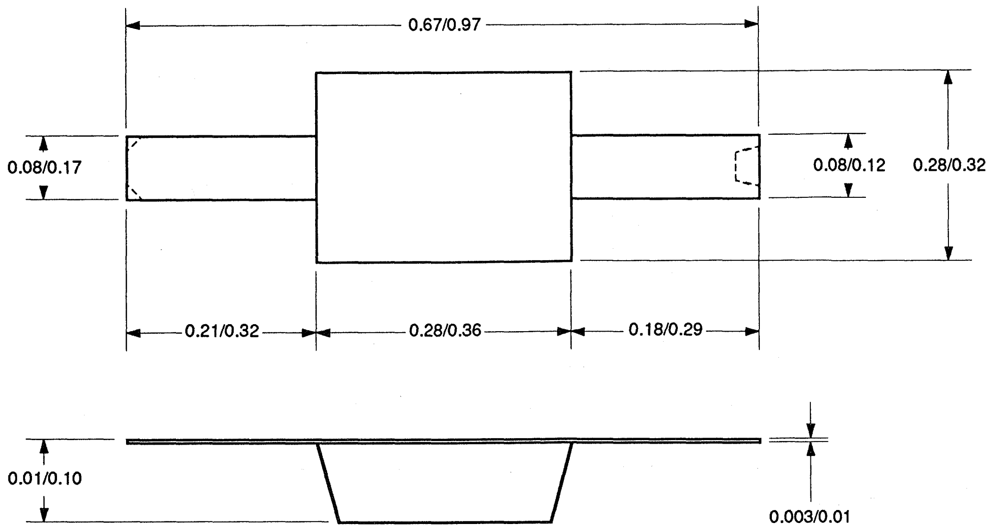
59


Ø 2.53/2.56
Ø 1.65/1.75
1.17/1.42
1.22/1.32
1.7/1.8
6.65/7.16
1.22/1.32
1.17/1.42
2.51 MAX

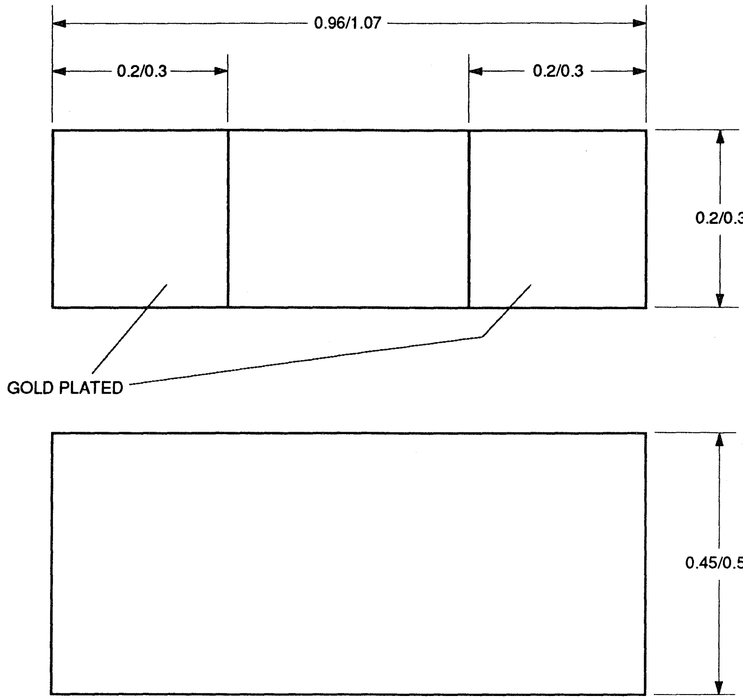
102


Metallization
and plating
0.115
ALUMINA
0.031
0.012 ±0.003
0.020
0.030 wide
undercut to
root dia.
0.140
No. 3-48
UNC-ZA
Thread
0.030
0.020
COPPER

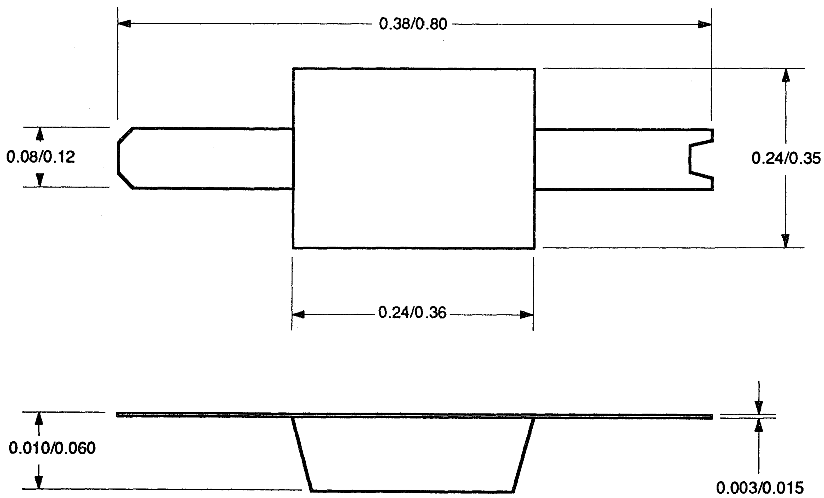
106


0.67/0.97
0.08/0.17
0.08/0.12
0.28/0.32
0.21/0.32
0.28/0.36
0.18/0.29
0.01/0.10
0.003/0.01

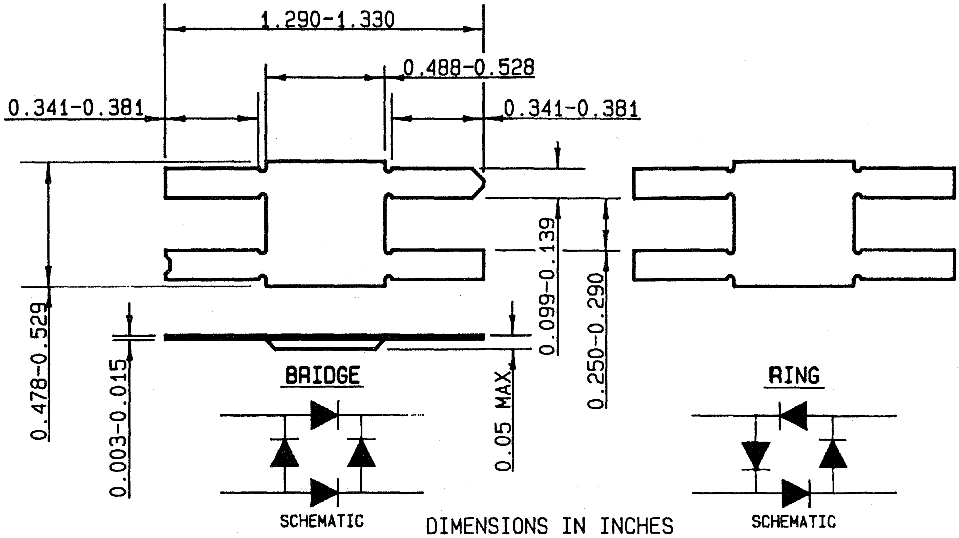
107


0.96/1.07
0.2/0.3
0.2/0.3
0.2/0.3
GOLD PLATED
0.45/0.56

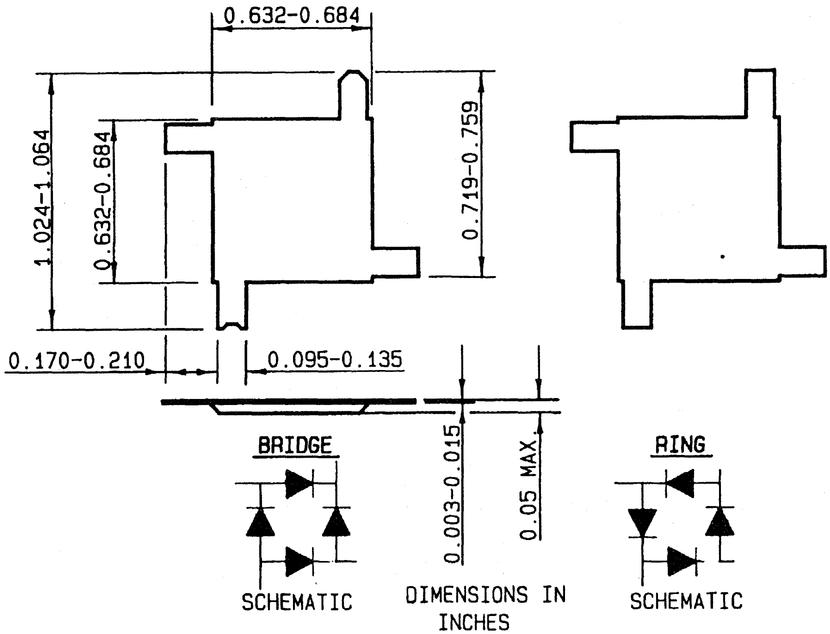
111


0.38/0.80
0.08/0.12
0.24/0.35
0.24/0.36
0.010/0.060
0.003/0.015

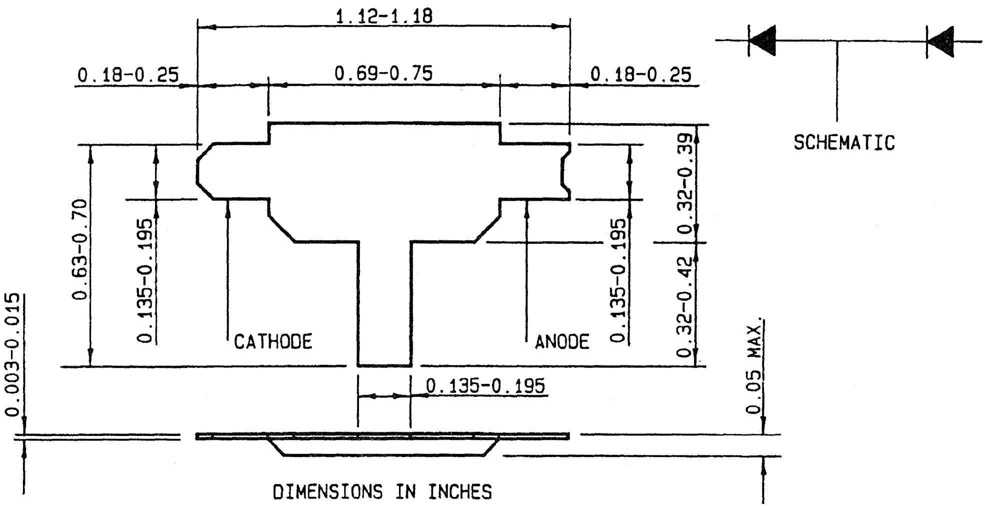
115


1.290-1.330
0.488-0.528
0.341-0.381
0.341-0.381
0.478-0.529
0.003-0.015
0.05 MAX
0.099-0.139
0.250-0.290
BRIDGE
RING
SCHEMATIC
DIMENSIONS IN INCHES
SCHEMATIC

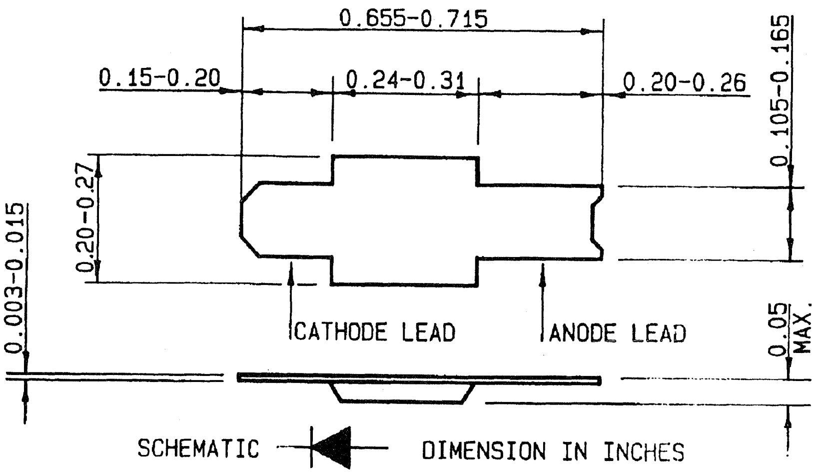
231


0.632-0.684
1.024-1.064
0.632-0.684
0.719-0.759
0.170-0.210
0.095-0.135
BRIDGE
0.003-0.015
0.05 MAX
RING
SCHEMATIC
DIMENSIONS IN INCHES
SCHEMATIC

232


1.12-1.18
0.18-0.25
0.69-0.75
0.18-0.25
SCHEMATIC
0.63-0.70
0.135-0.195
0.135-0.195
0.32-0.39
0.32-0.42
0.003-0.015
CATHODE
ANODE
0.135-0.195
0.05 MAX.
DIMENSIONS IN INCHES

233


0.655-0.715
0.15-0.20
0.24-0.31
0.20-0.26
0.105-0.165
0.20-0.27
0.003-0.015
CATHODE LEAD
ANODE LEAD
0.05 MAX.
SCHEMATIC
DIMENSION IN INCHES

234

DS3415-1.2 August 1992

DC3000 Series

BROADBAND BACK DIODE DETECTORS

These detector modules consist of a germanium back diode chip with integrated thin film capacitor and broadband matching cicuit on a microstrip tile.

The MiMAC (Microwave Monolithic Alumina Circuit) technology employed offers high reliability and excellent tracking between devices. Back diode detectors have excellent temperature stability combined with good sensitivity but without the need for DC bias. Low video impedance gives excellent RF match, fast pulse response and extremely wide bandwidths (100MHz to 20GHz for the DC3033/34 tile version) without compromising output sensitivity.

These detectors are available as fully RF tested tiles or in various package configurations.

FEATURES

- **0.1 to 20GHz frequency range**
- **High reliability MiMAC technology**
- **High dynamic range**
- **Output variation <±0.5dB over 0.1 to 20GHz**
- **High zero bias sensitivity**
- **Excellent temperature stability**
- **Available in a variety of packages**

APPLICATIONS

These devices are designed for RF power monitoring and signal processing where a very flat, broadband frequency response over a wide temperature range is important. Typical applications include power monitors, detector log video amplifiers (DC and AC coupled), automatic levelling circuits and built-in test equipment (BITE) applications. Two basic configurations of input matching are available.

Resistive matching yields low VSWR and excellent flatness over a wide bandwidth, while reactive matching yields high sensitivity. Matched pairs and batches of detectors can also be supplied if required. In general, a wide variety of performance characteristics can be achieved by modifying device configurations, padding and load conditions.

LIMITING CONDITIONS OF USE

Operating Temperature Range	-55°C to +110°C
Storage Temperature Range	-65°C to +125°C
RF Power at 25°C	+17dBm
Soldering Temperature	230°C for 5 seconds

ELECTRICAL CHARACTERISTICS At T_{amb} = 25°C

Parameter	Typical Value Reactive Match	Typical Value Resistive Match	Test Conditions
Output Sensitivity (mV/mW)	900	450	f = 2-18GHz P_{IN} = -20dBm $R_L = \infty$
Maximum Tangential Sensitivity T_{SS}, (dBm)	-52	-49	f = 9GHz R_L = 1MΩ NF = 4dB BW = 1MHz
VSWR Maximum	3.5:1	1.8:1 (Note 1)	f = 2-18GHz P_{IN} = -20dBm
Output Flatness (dB) Maximum	<±0.5	<±0.2 (Note 2)	f = 2-18GHz P_{IN} = -20dBm
Output Variation with Temperature (dB) Minimum	<±0.3	<±0.3	f = 10GHz -55°C to +100°C P_{IN} = -20dBm
1dB Compression-point (dB)	-5	-2.5	R_L = 430Ω f = 2-18GHz
RF/Video Isolation (dB)	20	20	P_{IN} = -20dBm f = 2-18GHz
Video Resistance R_V(Ω)	160	240	P_{IN} = -20dBm f = 1KHz
Video Capacitance (pF)	20	20	f = 1MHz

NOTES:
1. VSWR Maximum = 2:1 for DC3031/32 and 2.2:1 for DC3037/38
2. Output Flatness Maximum = <±0.3 for DC3031/32 and DC3037/38
3. This specification applies to the tile. Slight degradation may be expected beyond these results dependent on the package style employed. Devices are tested over 0.1 to 18GHz frequency range but the resistive type devices will operate over 0.1 to 20GHz.

DETECTOR TERMINOLOGY

Video Resistance:	Measure of video source impedance of a detector which is determined by the AC slope of diode characteristic at a bias level set by external RF signal.
Tangential Sensitivity:	Measure of input power relative to OdBM as defined by a signal to noise ratio of 2.6:1, within a known bandwidth.
Output Sensitivity:	Ratio of detector output voltage to RF input power in the square law region of the device, measured at a input power and frequency.
Flatness:	Measure of the variation of RF input power required to maintain a constant output voltage over a known RF bandwidth.
Transfer Function:	A plot of DC output voltage against RF input power. For low level signals (square law range) out voltage is proportional to input power and a liear plot is obtained on a log/log scale.
1dB Compression Point:	Point at which output deviates from square law response by 1dB on a dynamic range curve.

ELECTRICAL CONFIGURATION

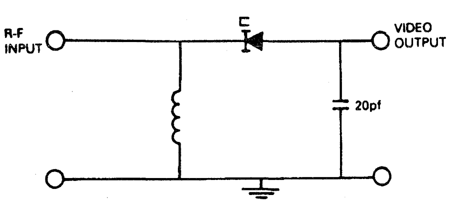


Figure 1. Reactive Input

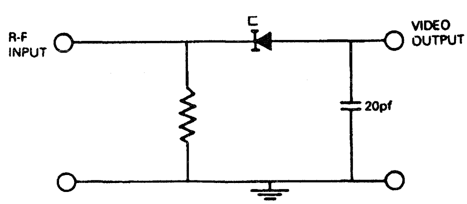
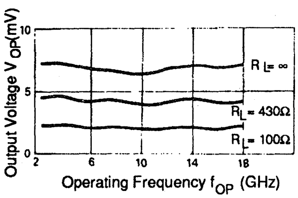


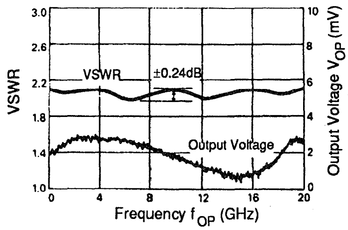
Figure 2. Resistive Input

TYPICAL PERFORMANCE

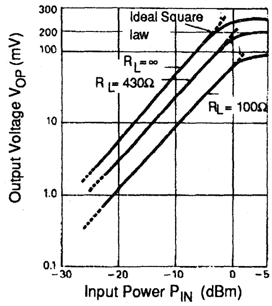
RESISTIVE MATCHING



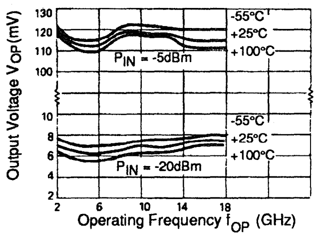
Graph 1. Output Voltage vs. Operating Frequency



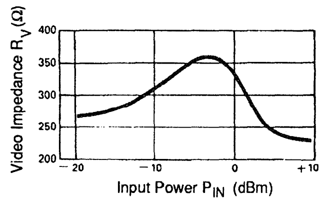
Graph 2. VSWR and Operating Output Voltage vs. Frequency



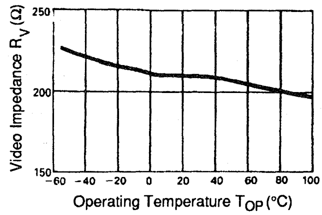
Graph 3. Output Voltage P_{IN} = -20dBm vs. Input Power F_{OP} = 10 GHz



Graph 4. Output Voltage vs. Operating Frequency

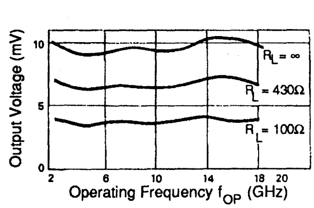


Graph 5. Video Impedance P_{IN} = -20dBm vs. Input Power T_{OP} = +25 °C

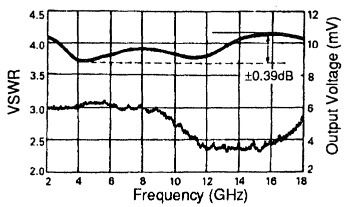


Graph 6. Video Impedance P_{IN} = -20dBm vs. Operating Temperature F_{OP} = 10 GHz

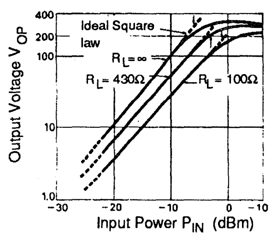
REACTIVE MATCHING



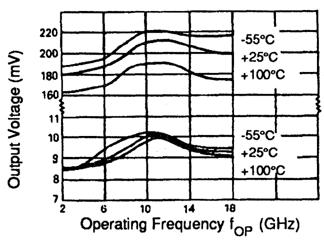
Graph 7. Output Voltage vs. P_{IN} = -20dBm Operating Frequency T_{OP} = +25°C



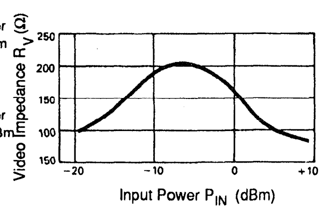
Graph 8. VSWR and Output Voltage vs. Frequency



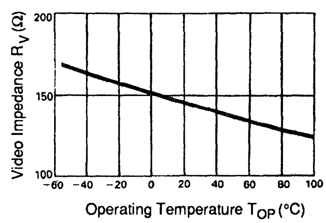
Graph 9. Output Voltage P_{IN} = -20dBm vs. Input Power F_{OP} = 10 GHz



Graph 10. Output Flatness vs. Operating Frequency



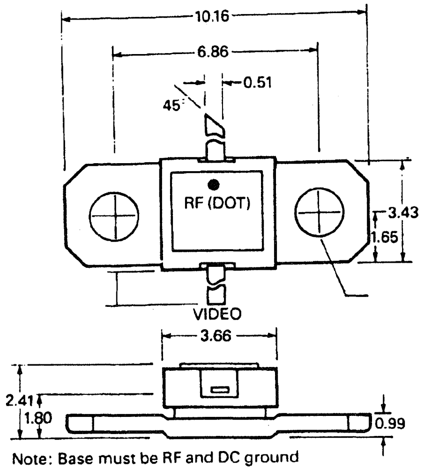
Graph 11. Video Impedance P_{IN} = -20dBm vs. Input Power T_{OP} = +25 °C



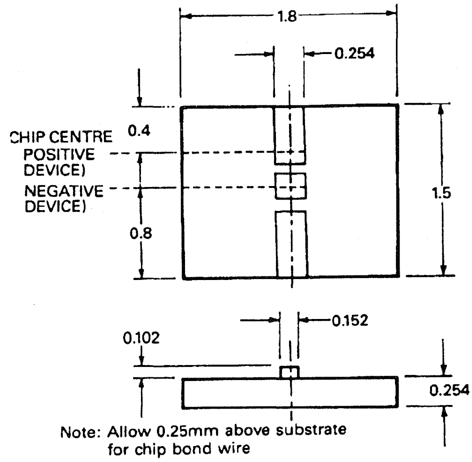
Graph 12. Video Impedance P_{IN} = -20dBm vs. Operating Temperature F_{OP}= 10 GHz

OUTLINES AND DIMENSIONS

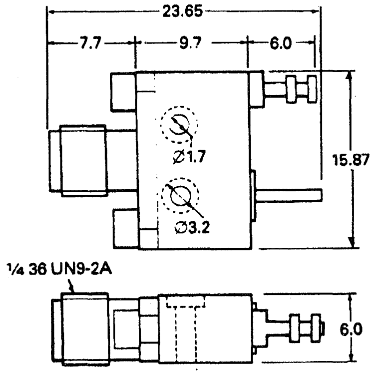
OUTLINE 161
DC3031/DC3032 (Resistive matching)
DC3041/DC3042 (Reactive matching)



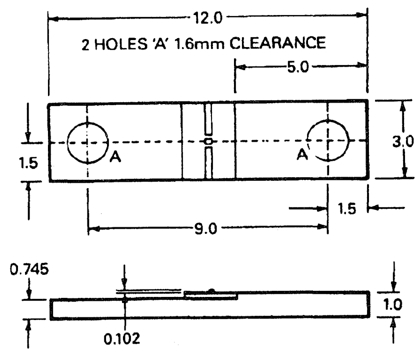
OUTLINE 201
DC3033/DC3034 (Resistive matching)
DC3043/DC3044 (Reactive matching)



OUTLINE 221
DC3037/DC3038 (Resistive matching)
DC3047/DC3048 (Reactive matching)



OUTLINE 203
DC3039/DC3040 (Resistive matching)
DC3049/DC3050 (Reactive matching)



CT3551-1.2 August 1992

PIN DIODES - INTRODUCTION

INTRODUCTION

PIN diodes are devices whose impedance to high frequency signals can be controlled by a d.c. or low frequency bias signal. They can be supplied as unencapsulated chips or in a wide variety of packages suitable for applications from less than 1 MHz to millimetric frequencies, and for incorporation into all types of feeder or circuit.

BASIC PIN ACTION

The PIN diode consists of a layer of weakly doped silicon between two highly doped regions of opposite doping type, Fig. 1. The weakly doped "I" layer has a very low conductivity, which is reduced still further if a reverse bias is applied (P layer negative) and which increases rapidly when a forward current is passed through the diode. Resistance changes of greater than 5000:1 are commonly obtainable; the resistance under forward bias varies approximately according to the formula

$$R = \text{const.} \times I^{-0.9} + R_S.$$

where R_S is the residual series resistance.

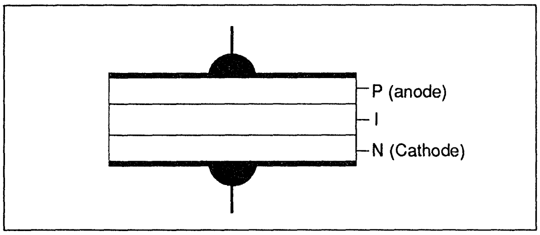


Figure 1

By varying the area and thickness of the 'I' layer one can make diodes exhibiting a range of speed and power handling characteristics. All the standard semiconductor processing methods—diffusion, alloying, epitaxy, etc. are used to make PIN diodes .

THE PIN DIODE AS A SWITCH

The high ON/OFF resistance ratios obtainable can be used to make switches with insertion losses of a few tenths of a dB and isolation up to 30 dB from a single diode. However, the behaviour of a PIN diode as a switch is affected as much by its reactive components as by the resistive components of its impedance, and due consideration must be taken of these.

The major reactive elements are (a) the intrinsic capacitance C_I of the I layer, which acts as a dielectric layer of K= 11.8 between the P and N electrodes, and (b) the inductance L_P of the leads connecting the chip to the package terminals and the capacitance C_P of the package.

The equivalent circuit is thus as shown in Fig 2 (a), which reduces approximately to that of Fig 2 (b) for the zero or reverse-biased state, and to Fig 2 (c) for the forward-biased state. However, the results of the transformation from Fig 2 (a) to Figs. 2 (b) and (c), as well as intrinsic semiconductor effects, may mean that the elements Cp, Lp and Rs vary substantially with frequency, particularly at very high or very low frequencies (see below).

Standard tuning procedures may be used to optimise the switching performance over a limited bandwidth.

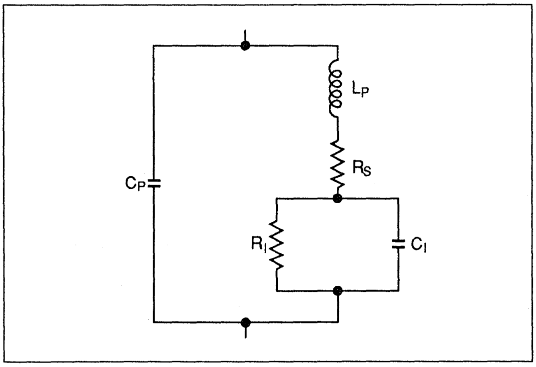


Figure 2(a). Equivalent circuit of PIN diode

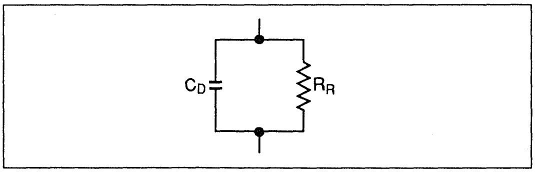


Figure 2(b). Equivalent circuit - zero or reverse bias

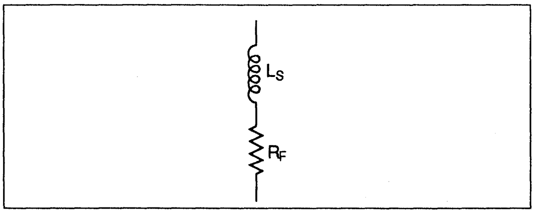


Figure 2(c). Equivalent circuit - forward bias

POWER RATINGS OF PIN DIODES

PIN diodes can be operated at r.f. currents and voltages greatly in excess of the d.c. bias levels, and diodes can be made which will switch many kilowatts (e.g. the DC2130-5 series). However, certain limitations must be observed. These may be set by electronic or thermal considerations, depending on the circumstances.

Electronic Limitations

FORWARD BIASED STATE: The effect of forward biasing is to flood the intrinsic (I) layer of a PIN diode with electrons and holes, thereby reducing its impedance. The amount of stored charge is given by

$$Q_S = I_F \times T_{eff}$$

where I_F is the bias current and T_{eff} the effective carrier lifetime; T_{eff} lies between a few nanoseconds and a few microseconds, depending on how the PIN diode is made. The diode impedance will be independent of the r.f. signal level provided that the amount of charge flowing in a half cycle is small compared with Q_S; experimentally, it is found that no effect is observed until the charge flowing exceeds 1 or 2 per cent of Q_S. This limit can be expressed as

$$I_{rf} < \frac{\pi f T_{eff}}{100} \times I_{dc}$$

where I_{rf} is the peak r.f. current and f the frequency.

If T_{eff} is 1 microsecond, then at X-band I_{rf} may be over 300 times I_{dc}, but at 10 MHz effects will be observed if I_{rf} is only one-third of I_{dc}.

At higher values of I_{rf}, the effective resistance will rise and some distortion will occur. The limit in practice will depend on how much loss and/or distortion can be tolerated.

REVERSE BIASED STATE: The I layer is depleted of free charges under reverse bias; if $V_{rf} > V_{dc}$, the terminal voltage becomes positive during part of the cycle and carriers will start to flow into the I layer, reducing its impedance. This is clearly most important at low frequencies. As a guide, one should not allow the peak forward voltage (i.e $V_{pkrf} - V_{dc}$) to exceed 1 volt per MHz for high voltage types ($V_B > 200$ volts) or 0.1 volt per MHz for high speed ($T_{eff} < 100$ nsec) types.

At high frequencies, where the distance travelled by carriers in a half-cycle is small compared with the I layer width, one can allow the terminal voltage to reach high positive values during part of the cycle. The cyclical injection and extraction of carriers leads to an energy loss, which can be related to an equivalent parallel resistance R_P.

Experimentally measured values of R_P are plotted in Fig. 3 for a range of diodes with I layer thickness in the range 100-200μm

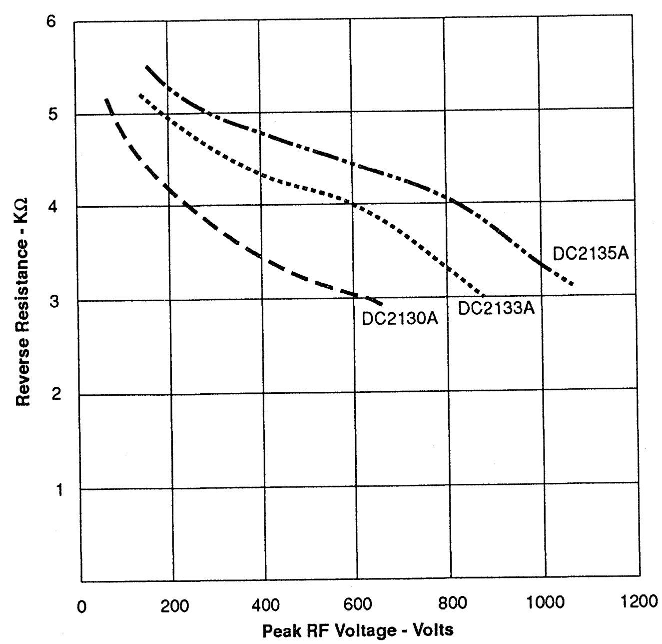


Figure 3. Typical reverse resistance of DC2130/3/5A as a function of peak r.f. voltage

Thermal Limitations

Heat will be generated in a PIN diode due to both the d.c. and r.f. currents.

The dc component is equal to Vdc x Idc; this is usually negligible under reverse bias, when Idc is seldom more than a few microamps, but will be significant under forward bias, when Vdc is about 1 volt.

The r.f. component is given by

$P_{rf} = T \times I_{rms}^2 \times R_F$ (for forward bias)

$= (I - T) \times V_{rms}^2 \div R_P$ (for reverse bias)

where I_{rms}, V_{rms} are the r.m.s. r.f. current and voltage, R_F and R_P the forward biased resistance and reverse biased shunt resistance, and T the duty cycle.

If the maximum temperature the semiconductor chip may run at is Øm. (usually 150°C) and the ambient temperature is Øa, the maximum power that can be dissipated will be given by $P_{max} = (Ø_m—Ø_a)/R_{th}$.

where R_{th} is the thermal resistance,

The thermal resistance of a diode depends on the type of encapsulation and may be different to each terminal. It is usually specified assuming an infinite heat-sink at a given plane and the user must add to this the contribution due to the mounting method.

It is nearly always possible to arrange for shunt diodes to be adjacent to a good heat-sink, but series diodes present greater difficulties.

Under short pulse conditions (e.g. 1 µSec or less) the temperature rise will be determined largely by the thermal capacity of the PIN chip. This is between 1 and 10 x 10^{-2}deg. C per microsecond per watt dissipated for a typical diode.

FREQUENCY LIMITATIONS AND SWITCHING SPEED

As charge-controlled devices, PIN diodes take a finite time to change from one impedance level to another. This affects both the speed at which they can be switched and the frequency at which they will begin to react to an impressed signal.

As indicated above (under Power Ratings), the power handling capacity of a PIN diode in both states is dependent on the frequency. As a general guide, one can say that signals of a few milliwatts can be switched at frequencies down to 1 MHz, and a few watts down to 10MHz. Above 100MHz, thermal considerations may be more important.

The equivalent circuit of a reverse-biased PIN diode will vary with frequency and bias, particularly at frequencies below 100MHz. Figs. (2a) and (2b) show typical figures for two types of diode, but considerable variation from diode to diode may occur at low frequencies.

Above 1 GHz, the characteristics of PIN diodes are largely independent of frequency up to the level at which skin effects become apparent. These limit the chip diameter to about Imm at 3GHz, 0.5mm at 10GHz and 0.2mm at 40GHz. This is seldom a serious limitation, as capacitance considerations are usually more important.

The switching action depends on the injection or extraction of charge. As stated above, the charge stored in the forward biased state is equal to

$I_F \times T_{eff}$

If the current is interrupted this charge will decay exponentially, until it reaches the equilibrium concentration due to the residual impurities in the I layer. The latter is typically less than 1/1000 of the injected concentration, so that it would take about 10 times T_{eff} before the impedance is back to its equilibrium value.

This recovery can be speeded up enormously by passing a reverse current. If a current I_R ($>I_F$) is available, the stored charge will be cleared in a time t_r where

$t_r \approx I_F/I_r \times T_{eff}$

Switching speeds below 10nSec can be obtained with low lifetime diodes such as the DC211OA, DC2412A or DC2621A.

The voltage necessary to effect the clearance of all the injected charge may vary from diode to diode. A figure for the switching speed under specified conditions is quoted in this book for certain diodes. For others, a voltage of 20—50 volts will usually be sufficient to switch the diode quickly to a high impedance state.

To get fast switching it is obviously necessary for T_{eff} to be made very small. This will cause the stored charge to be small for a given bias current, which will give a high value of R_F unless the I layer thickness is reduced.

Reducing the thickness of the I layer has two consequences:

(i) the diode breakdown voltage will be reduced, and
(ii) the capacitance per unit area will be increased.

The latter can, of course, be compensated by reducing the diode area.

It is therefore an inevitable consequence of reducing the switching time that fast PIN diodes have lower breakdown voltages and higher thermal resistances than slower types—i.e. speed is obtained only at the expense of power handling capability.

In designing circuits for high speed switching, it will obviously pay to limit I_F to as low a level as is compatible with other requirements. In many cases it will be found that reducing the bias current from, say, 100 mA to 20 mA will not have a large effect on attenuation (in a shunt diode) or insertion loss (in a series diode).

PIN DIODE CIRCUIT TECHNIQUES

Low frequency applications (f<1GHz)

Appiications below 1 GHz usually involve printed circuit boards or conventional discrete wiring methods, and wire or tape-ended diodes are usually favoured for low power applications and screwbased types where dissipation is greater.

The miniature glass packaged diodes of the DC2800 and DC2900 families are widely used where the dissipation is less than 3W. A wide variety of types are available.

The DC2850E has very low losses at low bias currents (R_F typically 0.7 ohm at 5 mA), and has a capacitance of typically 1 pF. It will switch in a few nanoseconds and has a breakdown voltage of 35V (minimum)—i.e. is limited to low power applications.

The DC2849E has a typical lifetime of 1.5µS, and is designed for low-distortion a.g.c. applications or as a current-controlled resistor.

Between these extremes, a number of options are available, with breakdown voltages up to 250V and switching speeds in the range 1Ons to 1 uS.

Two miniature epoxy packages are also available. The 08 outline has gold plated copper tape leads suitable for use in printed circuit boards or thick film circuits, while the 36 outline has silver leads capable of conducting several watts to a suitable heatsink.

A range of diodes is available in the screw-based 90 outline; this has a thermal resistance of less than 15°C/watt to the stud, enabling one to switch mean power levels of hundreds of watts.

All these devices have capacitances in the range 0.25-0.75pF, suitable for broad-based applications up to about 1OOMHz and are usable with tuning up to at least 1 GHz.

Stripline and Microstrip Applications above 1 GHz

Broadband assemblies are available for use in stripline (outline 68) or microstrip (outline 30). In these, the chip capacitance is designed into a low pass filter structure, enabling them to be used at frequencies up to 18GHz.

Alternatively, one can use unencapsulated chips, or chips mounted on metal bases. Beam lead diodes may also be used.

WAVEGUIDE AND COAXIAL LINE APPLICATIONS

(a) Waveguide

Diodes may be introduced across a waveguide feeder by mounting them in a coaxial stub coupled to the wave-guide through an E-plane post as in Fig.4. This arrangement permits the diode capacitance to be tuned out and makes a range of transformations available, but the bandwidth tends to be narrow. Subject to the careful tuning out of the parasitics, suitable packages for use in waveguide are the miniature pill types (outline 00, 04, 12, 39) or (in coaxial stubs) the coaxial cartridge (outline 32). Switching ratios of 1—20 dB can be obtained over a limited bandwidth at X-band.

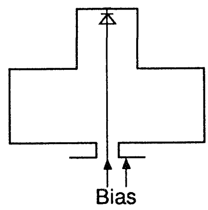


Figure 4. Method of mounting diodes in waveguide

(b) Co-axial Line

Wire or tape ended diodes may be used in series configurations especially at the lower frequencies. Care must be taken when using tape-ended diodes that the shunt capacitance between the ends of the inner conductor on either side of the diode is allowed for.

Stub arms can be used with advantage sometimes for tuning, transformation and inversion.

HIGH RELIABILITY DEVICES

A number of GPS PIN diodes are available to DEF STAN and BS (CV) specifications. These call for batch sample testing prior to release and full mechanical, environmental and endurance testing, in accordance with the requirements of BS9300. Qualification Approval to these specifications has been granted by the Ministry of Defence following an exercise supervised by the Electronic Quality Directorate, and NATO Stock Nos. have been allocated to these products.

Similar specifications have been drawn up for other devices in agreement with customers. Where no formal quality control is specified. GPS apply their own inspection procedures as appropriate to the device category, with the aim of ensuring that the device characteristics comply with the published data and that a high standard of quality and reliability is maintained.

All devices can be released to EQD or CAA conditions on request.

BROADBAND MODULES AND PACKAGED ASSEMBLIES

GPS PIN diodes are available in broadband modules for direct incorporation into Triplate (DC2400A series) and Microstrip (DC2600A series).

PIN limiters can be supplied in sealed metal boxes with OSM connectors (DA2000 series). Other switching modules can be supplied to meet special customer requirements.

CT3550-1.2 August 1992

DC1016 & DC1028A

MINIATURE EPOXY PIN DIODES

DESCRIPTION

The DC1016 utilises an epoxy encapsulation to give the best combination of power handling and low parasitics. It can pass over 1A r.m.s., or block over 60V r.m.s., at 30MHz (0.5A and 20V at 10MHz) without loss of performance. The 0.7mm silver wires are joined directly to the silicon chip and up to 3W can be dissipated in the diode. The DC1028A is a very small tape ended diode. Switching ratios of 0.3 - 1.8dB can be obtained at 400MHz when operating between zero bias and 50mA.

FEATURES

- Low Resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range
- Mesa and Planar versions available

APPLICATIONS

DC1016 PIN diodes are designed for transmit/receive switching in mobile radios. DC1028A is ideal for PCB and stripline applications.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPICAL DC CHARACTERSITICS T_{amb} 25°C

Miniature Epoxy PIN Diodes

TYPE NUMBER	Outline No.	V_R min.	R_F max. (at 100mA)	Cd max.	t_{rr} (typ)	R_{th}
		V	Ohms	pF	nS	°C/W
DC1016	36	150	0.75	0.7	1000	40
DC1028A	08	250	1.1	0.45	2000	350

DC2000, DC2500 & DC2600 Series

MIC PIN DIODES

DESCRIPTION

PIN Diodes for MICs are available in four formats for direct insertion into microstrip circuits.

1. Unencapsulated chips in outlines 41, 44, abcd. 44e and 44f.
2. Unencpasulated chips monted on small carriers in outlines 50.
3. Unencapsulated chips mounted in capacitor and carrier in outline 46.
4. Beam Lead Diodes in outline 115.

FEATURES

- Low Resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range 10MHz - 18GHz
- Mesa and Planar versions available

APPLICATIONS

Suitable for use in MICs.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPICAL DC CHARACTERSITICS T_{amb} 25°C

TYPE NUMBER	Outline No.	V_R min.	C_d max. pF @ mA	R_F max. ohm @ mA	Typical minority carrier lifetime	Cathode terminal °C/W
		V			(µs)	
DC2011	44	100	0.2 @ 50	3 @ 25	2	gold
DC2011A	50	100	0.2 @ 50	3 @ 25	2	tip
DC2011AR	50	100	0.2 @ 50	3 @ 25	2	base
DC2012	46	100	0.2 @ 50	3 @ 25	2	

TYPICAL DC CHARACTERSITICS T_{amb} 25°C

TYPE NUMBER	Outline No.	V_R min.	C_d max. pF @ mA	R_F max. ohm @ mA	Typical minority carrier lifetime	Cathode terminal °C/W
		V			(μS)	
DC2013	41	100	0.1 @ 50	3 @ 50	1000	gold
DC2013A	50	100	0.1 @ 50	3 @ 50	1000	tip
DC2013AR	50	100	0.1 @ 50	3 @ 50	1000	base
DC2510A	50	50	0.25 @ 10	2 @ 25	50	base contact
DC2512A	50	25	0.15 @ 10	2 @ 25	30	base contact
DC2518A	50	50	0.15 @ 10	1 @ 100	500	base contact
DC2519A	50	50	0.15 @ 10	1 @ 100	500	top contact
DC2552A	50	25	0.12 @ 20	2 @ 25	30	top contact
DC2602	115	40	0.03 @ 20	10 @ 10*	5	notched lead
DC2603	115	40	0.05 @ 20	10 @ 10*	5	notched lead
DC2604	115	20	0.03 @ 20	10 @ 10*	5	notched lead
DC2605	115	20	0.05 @ 20	10 @ 10*	5	notched lead
DC2608	115	40	0.07 @ 20	3 @ 10*	15	notched lead
DC2609	115	70	0.04 @ 20	5 @ 10*	40	notched lead

GEC PLESSEY
SEMICONDUCTORS

DC2020/23, DC2171H/72H & DC2600 Series

MICROSTRIP PIN DIODES

DESCRIPTION

DC2020/DC2600 Series are a range of broadband microstrip PIN diodes. Both switching modules and passive limiters are available. In the passive limiters the chip and encapsulation parasitics are incorporated in the composite filter designs to provide low insertion loss over a broad frequency band. Some types include a d.c. return path and/or a d.c. block.

FEATURES

- Low Resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range up to 18GHz
- Mesa and Planar versions available

APPLICATIONS

Suitable for use as active switching modules and passive limiters for such applications as protection for sensitive receiver front-ends, including video detectors, superheterodyne mixers and transistor amplifiers.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPICAL DC CHARACTERSITICS T_{amb} 25°C
Switches

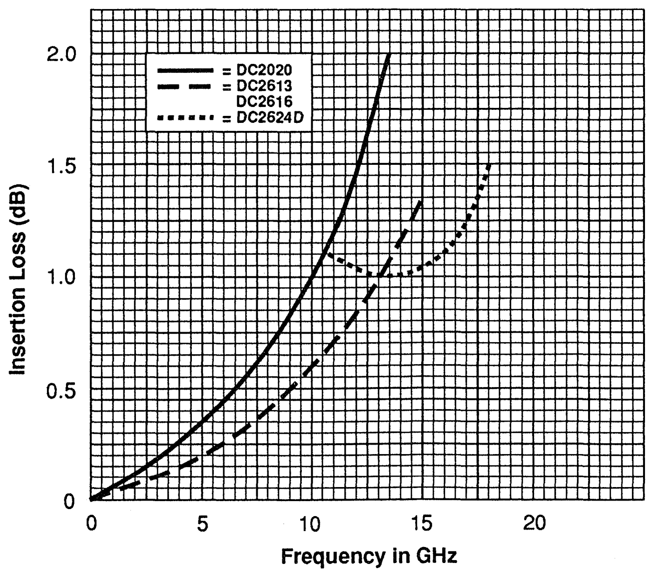
TYPE NUMBER	Outline No.	V_R min.	Frequency range	Insertion loss at -20V, f = 12GHz	Isolation loss at 20mA f = 9.5GHz	Power Handling peak	Power Handling mean	Switching Speed Typ.
		(Volts)	(GHz)	(dB)	(dB)	(W)	(W)	(ns)
DC2610A	30	50	1 - 12	0.6	20	100	10	6
DC2611	31A	50	1 - 12	0.6	20	100	10	6
DC2612A	30	20	1 - 12	0.6	20	10	1	3
DC2613	31	20	1 - 12	0.6	20	100	1	3
DC2614	31	100	1 - 12	0.5	20	100	25	40
DC2615*	31	100	1 - 12	0.5	20	100	25	40
DC2616*	31	20	1 - 12	0.6	20	10	1	3
DC2618A	30	100	1 - 12	0.5	20	100	25	40
DC2619A*	30	100	1 - 12	0.5	20	100	25	40
DC2652A*	30	20	1 - 12	0.6	20	10	1	3

Polarity: Cathode is the base unless marked *, where the anode is the base.

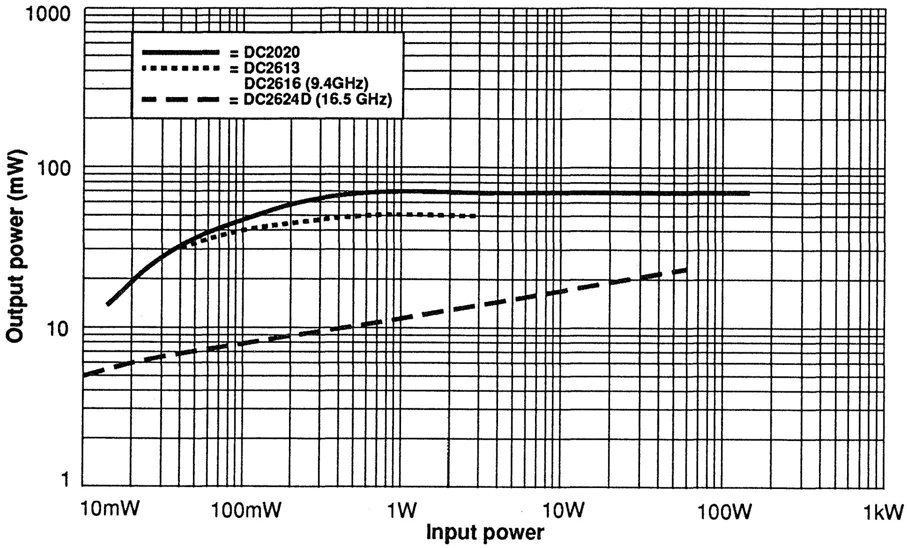
TYPICAL DC CHARACTERSITICS T_{amb} 25°C
Passive Limiters

TYPE NUMBER	Outline No.	Frequency range	Insertion loss	Leakage Power max.	Power Handling		Requirement for Rectified current
					peak	mean	
		(GHz)	(dB)	mW @ W	(W)	(W)	
DC2020	30	1 - 12	1.9	100 @ 100	100	1	a
DC2023	31	1 - 12	1.9	100 @ 100	100	1	a
DC2620	30	1 - 12	1.0	100 @ 5	5	1	a
DC2622	31	1 - 12	1.0	100 @ 5	5	1	a
DC2623	31	1 - 12	1.0	100 @ 5	5	1	a
DC2624D	76	12 - 18	1.6	100 @ 50	50	5	b
DC2628	30	1 - 12	1.0	100 @ 5	5	1	a
DC2171H	90A	0.01 - 1	0.5	300 @ 10	100	10	b
DC2172H	90A	0.01 - 0.8	0.2	1000 @ 30	300	30	b

Note: a) Requires external D.C. return for correct operation.
b) External D.C. return not required.



Typical variation of insertion loss with frequency.



Typical variation of output power with input power.

DC2100 Series

CERAMIC WAVEGUIDE PIN DIODES

DESCRIPTION

The DC2100 Series PIN diodes are variable resistance diodes. The R.F. resistance can be varied between about 1 ohm and 10^4 ohms by a d.c. or a modulated bias current. The DC2100G family of devices can be chassis mounted for lower frequency applications.

FEATURES

- Low Resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range 10MHz - 18GHz
- Mesa and Planar versions available

APPLICATIONS

PIN diodes are suitable for use as switches, modulators, attentuators and limiters.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPICAL DC CHARACTERSITICS T_{amb} 25°C
General Purpose and High Power Types (all available in both polarities).

TYPE NUMBER	Outline No.	V_R min.	R_F max. (@ 100mA)	C_d max. (TOTAL)	Lifetime τ_G (typ)	R_{th}
		V	Ohms	pF	ns	°C/W
DC2101A	00	250	1.2	0.5	700	15
DC2101B	39	250	1.2	0.5	700	15
DC2101C	04	250	1.2	0.5	700	15
DC2101G	90	250	1.2	0.5	700	15
DC2103A	00	500	1.2	1.0	2000	15
DC2103B	39	500	1.2	1.0	2000	15
DC2103C	04	500	1.2	1.0	2000	15
DC2103G	90	500	1.2	1.0	2000	15
DC2104A	00	250	1.2	0.7	700	15
DC2104B	39	250	1.2	0.7	700	15
DC2104C	04	250	1.2	0.7	700	15
DC2104F	23B	250	1.2	0.7	700	15
DC2104G	90	250	1.2	0.7	700	15

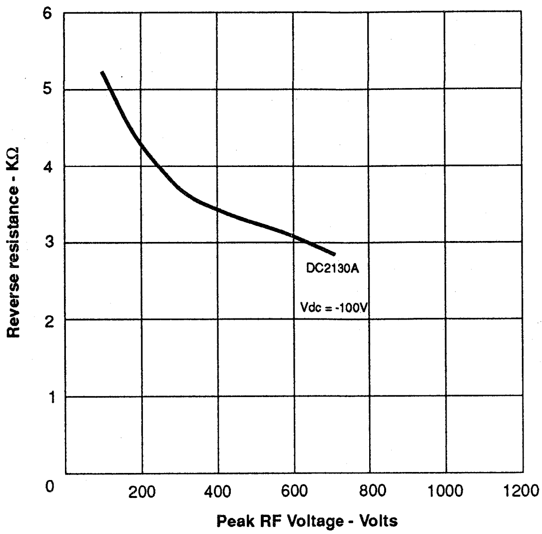
TYPICAL DC CHARACTERSITICS T_{amb} 25°C

General Purpose and High Power Types (all available in both polarities).

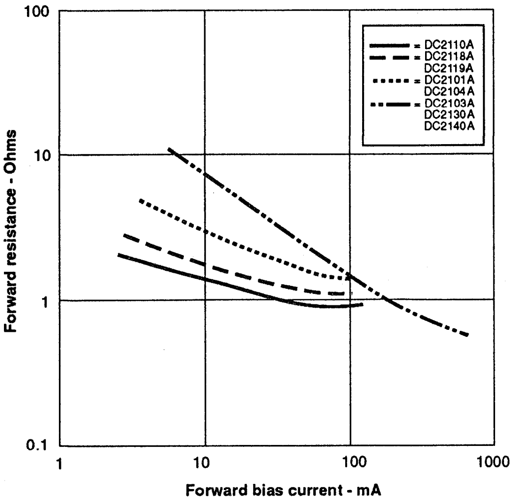
TYPE NUMBER	Outline No.	V_R min.	R_F max. (@ 100mA)	C_d max. (TOTAL)	Lifetime τ_G (typ)	R_{th}
		V	Ohms	pF	ns	°C/W
DC2130A	00	500	0.8	0.55-0.75	2000	15
DC2130G	90	500	0.8	0.55-0.75	2000	15
DC2130G-1	90	600	1.0	0.9	2000	15
DC2140A	00	400	1.0	1.0	4000	15
DC2140G	90	400	1.0	1.0	4000	15

High Speed Types

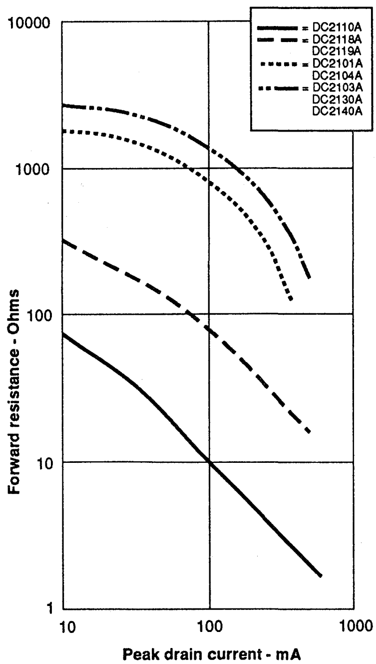
TYPE NUMBER	Outline No.	V_R min.	R_F max. (@ 100mA)	C_d max. (TOTAL)	Lifetime τ_G (typ)	R_{th}
		V	Ohms	pF	(nS)	°C/W
DC2110A	00	50	2.0 (@ 20mA)	0.4	5	50
DC2110B	39	50	2.0 (@ 20mA)	0.4	5	50
DC2110C	04	50	2.0 (@ 20mA)	0.4	5	50
DC2110G	90	50	2.0 (@ 20mA)	0.4	5	50
DC2118A	00	100	1.0	0.4	50	30
DC2118B	39	100	1.0	0.4	50	30
DC2118C	04	100	1.0	0.4	50	30
DC2118G Flanged end is positive	90	100	1.0	0.4	50	30
DC2119A	00	100	1.0	0.4	50	30
DC2119B	39	100	1.0	0.4	50	30
DC2119C	04	100	1.0	0.4	50	30
DC2119G Flanged end is negative	90	100	1.0	0.4	50	30



Typical reverse resistance of DC2130/3/5A as a function of peak r.f. voltage.



Typical variation of forward resistance as a function of d.c. bias.



Rise time (10% - 90%) of r.f. waveform when shunt diode is switching off - i.e. from low to high impedance, as a function of drain current (typical values).

DC2200 & DC2300 Series

DOUBLE DIFFUSED PIN DIODES

DESCRIPTION

Advanced material processing techniques have enabled the production of a new range of pin diodes with excellent electrical characteristics. Devices can now be fabricated from hyper pure silicon without the requirement for a substrate. This results in a high reverse breakdown voltage, low capacitance, low residual resistance and excellent power handling.

FEATURES

- Unique Double Diffused Structure
- Low Forward Resistance
- High Breakdown voltage
- Excellent power handling
- Multilayer passivation

APPLICATIONS

Suitable for use as active switching modules and passive limiters for such applications as protection for sensitive receiver front-ends, including video detectors, superheterodyne mixers and transistor amplifiers.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPE NUMBER	Outline No.	V_R min.	C_d max. pF @ V	R_F typ ohm @		Typical minority carrier lifetime	Cathode terminal °C/W
		V		10mA	80mA	ns	
DC2211	41	100	0.23 @ 50	2.5	1.1	275	base contact
DC2262	50	100	0.04 @ 50	5.0	2.0	150	base contact
DC2210	50	100	0.115 @ 50	2.0	1.0	500	base contact
DC2363	50	100	0.115 @ 10	2.5	1.1	275	top contact
DC2367	50	100	0.06 @ 10	2.0	1.0	500	top contact
DC2310	50	100	0.115 @ 10	2.0	1.0	150	top contact
DC2316	50	100	0.175 @ 10	2.0	1.0	600	top contact

GEC PLESSEY
SEMICONDUCTORS

DC2400 Series

TRIPLATE STRIPLINE PIN DIODES

DESCRIPTION

The DC2400 series triplate PIN diodes incorporate the chip and encapsulation parasitics in the overall design and are designed for easy insertion into the triplate feeder. Low insertion losses are maintained up to 18GHz and can be reduced further for narrow bandwidth or fixed frequency applications. Fast switching is available and isolation in excess of 30dB can be obtained from a single diode. The facility exists for meeting customer specific requirements which may lie outside the existing range.

APPLICATIONS

The DC2400 series PIN diodes are suitable for fast switching, narrow bandwidth or fixed frequency applications.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

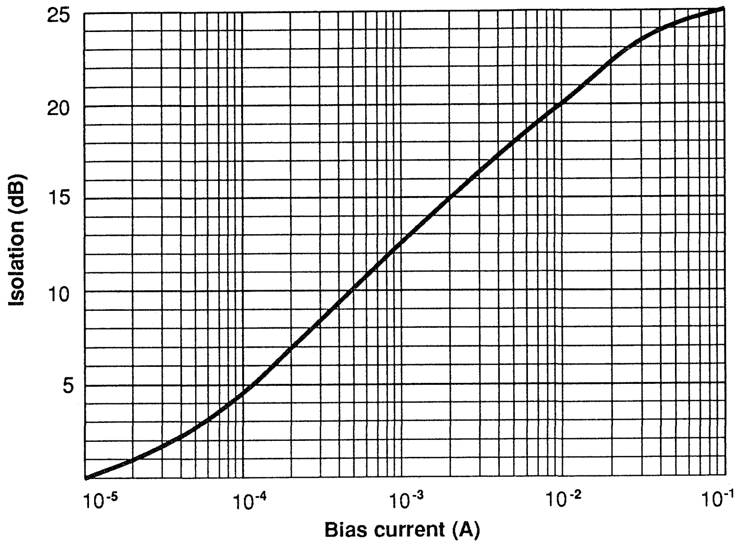
FEATURES

- Low resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range up to 18GHz
- Mesa and Planar versions available

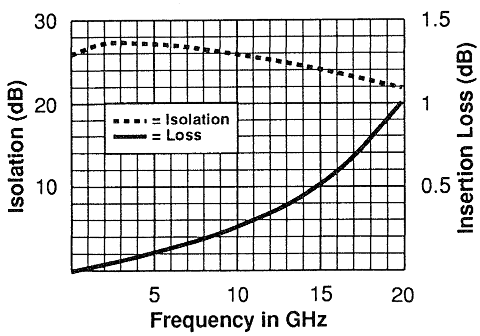
TYPICAL DC CHARACTERSITICS T_{amb} 25°C

Triplate Stripline Pin Diodes - A range of broadband pin diodes suitable for use in triplate up to 18GHz.

TYPE NUMBER	Outline No.	Meas. freq.	Insertion loss max. 0V	Isolation min. at 100mA	Power Handling		t_{rr} typ.	Heatsink Polarity
					Peak	Mean		
		GHz	dB	dB	W	W	ns	
DC2403A	68	10	2.0	20	1000	25	2000	Cathode
DC2443A	68	10	2.0	20	1000	25	2000	Anode
DC2410A	68	10	1.0	20 @ 20mA	30	-	8	Cathode
DC2412A	68	10	1.0	20 @ 20mA	12	-	3	Cathode
DC2418A	68	10	0.5	20	30	-	50	Cathode
DC2418A/1	68	10	0.5	25	30	-	50	Cathode
DC2419A	68	10	0.5	20	30	-	50	Anode
DC2419A/1	68	10	0.5	25	30	-	50	Anode



Typical variation of isolation with forward bias current for triplate switching diodes in Outline 68.



Typical variation of Isolation with frequency for triplate diodes in Outline 68.

DC2800 Series

GLASS PACKAGE PLANAR PIN DIODES

DESCRIPTION

The DC2800 range of DO-35 Wire-Ended glass packaged diodes use a planar passivated chip. Devices can be supplied with specific resistance current laws. This series includes versions optimised for low loss, long lifetime and fast switching.

FEATURES

- Low Resistance
- Low Capacitance
- High Breakdown voltage
- Frequency range 1MHz upwards
- Mesa and Planar versions available

APPLICATIONS

PIN diodes are designed for switching, attenuating and modulating at r.f. signals of 1MHz and upwards.

LIMITING CONDITIONS

Storage conditions	-55°C to +150°C
Operating temperature	-55°C to +150°C
Power dissipation	250mW

TYPICAL DC CHARACTERSITICS T_{amb} 25°C
General Purpose Types

TYPE NUMBER	V_R min.	Capacitance		Series Resistance		Lifetime (min)
	(V)	C_T (pF)	V_R (V)	R_S (Ω)	I_F (mA)	(µs)
DC2817	200	0.5	50	1.3	100	0.6
DC2825E	200	0.4	50	1.0	100	0.5
DC2839	250	0.4	50	1.8	30	1.0
DC2840E	250	0.3	100	1.0	100	0.5
DC2841E	200	0.4	100	1.5	100	0.5
DC2842E	200	0.25	100	2.0	100	0.5
DC2843E	100	0.4	100	1.0	100	0.3
DC2844E	100	0.4	100	1.5	100	0.3
DC2845E	150	0.3	100	3.5	100	2.0
DC2846E	150	0.4	100	2.5	100	2.0
DC2847E	100	0.3	50	2.0	25	0.5
DC2848E	100	0.4	50	1.2	100	0.5
DC2848E-1	100	0.4	50	1.2	100	0.5

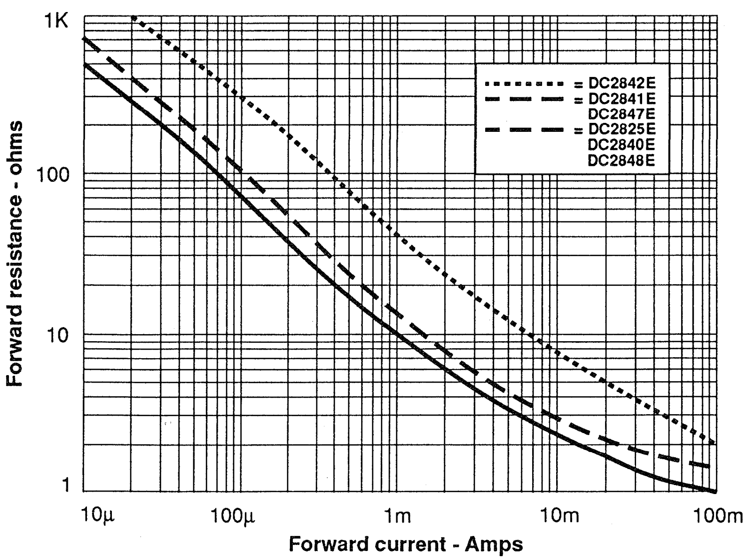
TYPICAL DC CHARACTERSITICS T_{amb} 25°C
General Purpose Types

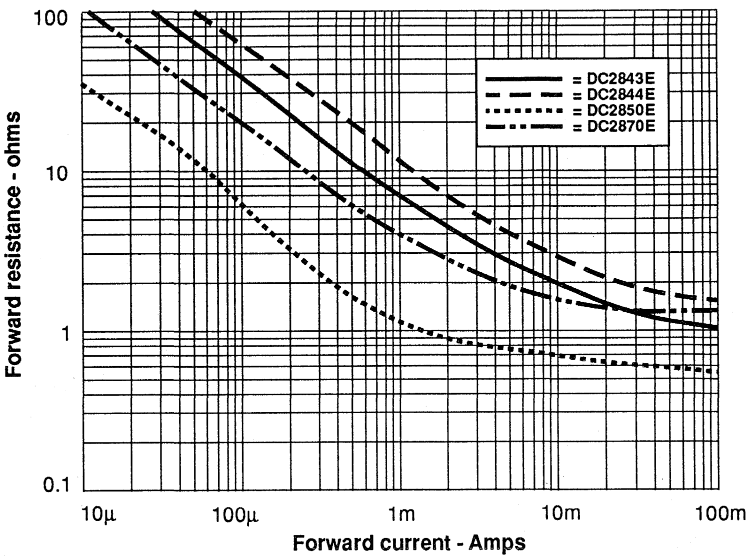
TYPE NUMBER	V_R min.	Capacitance		Series Resistance		Lifetime (min)
	(V)	C_T (pF)	V_R (V)	R_S (Ω)	I_F (mA)	(μs)
DC2848E-2	100	0.4	50	1.2	100	0.5
DC2848E-3	100	0.4	50	1.0	100	0.5
DC2849E	100	0.4	50	3.5	100	2.0
DC2849E-1	100	0.4	50	3.5	100	2.0
DC2849E-2	100	0.4	50	2.5	100	2.0
DC2849E-3	100	0.4	50	3.5	100	2.0
DC2850E	35	1.2	20	0.8	5	0.05
DC2850E-1	35	1.4	20	1.0	5	0.05

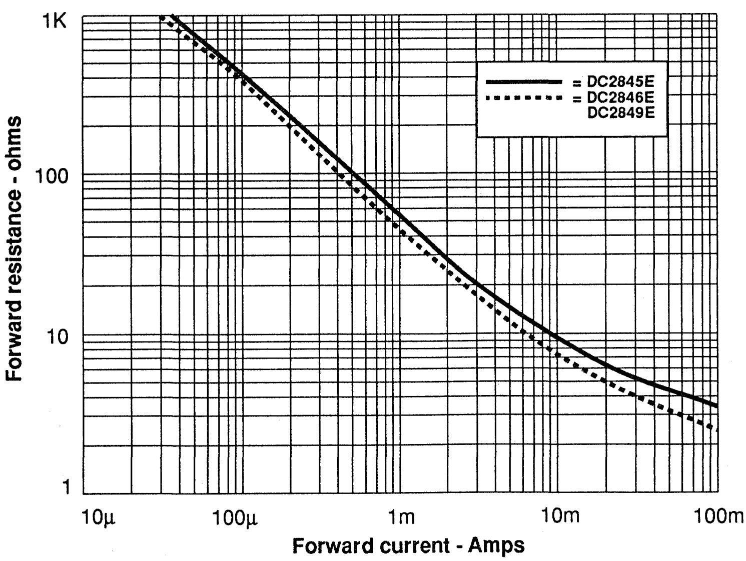
Test conditions I_R = 10μA, f = 1MHz, f = 40 MHz.

Maximum CW Power Dissapation: Ambient rated 0.35W
Case rated 0.48W

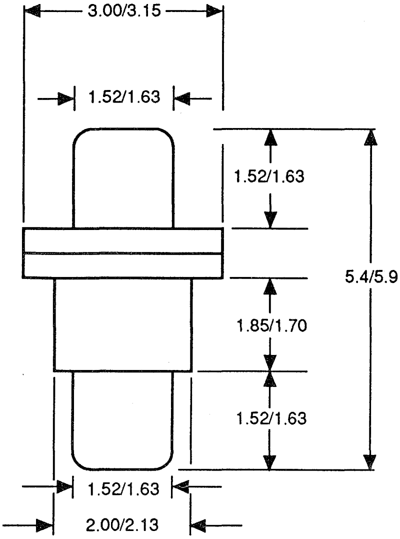
Package outline No. (all devices): 35




100
10
1
0.1
Forward resistance - ohms
10µ
100µ
1m
10m
100m
Forward current - Amps
= DC2843E
= DC2844E
= DC2850E
= DC2870E


1K
100
10
1
Forward resistance - ohms
10µ
100µ
1m
10m
100m
Forward current - Amps
= DC2845E
= DC2846E
DC2849E

OUTLINES



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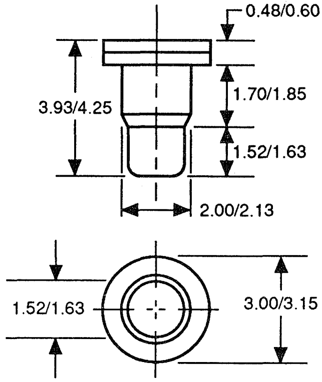
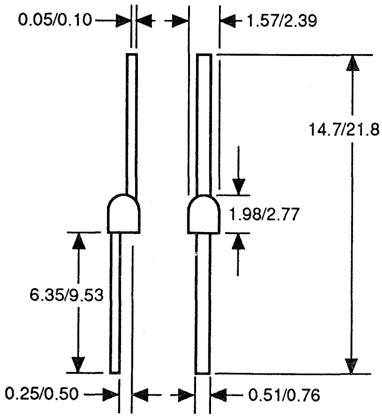
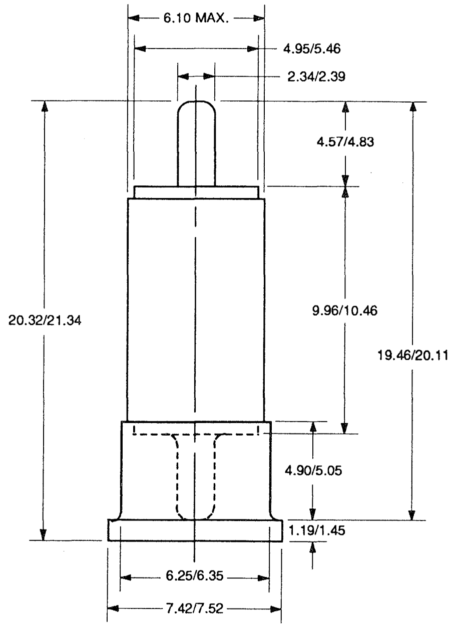


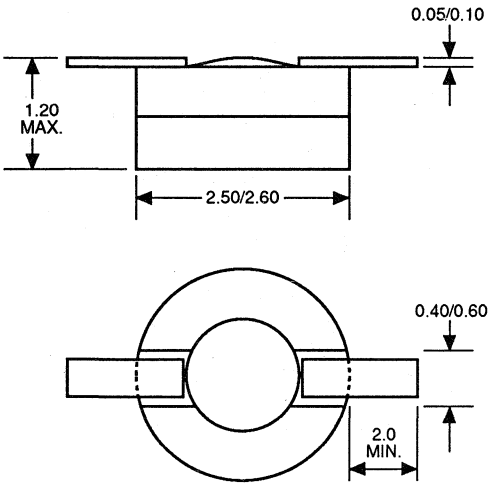
04



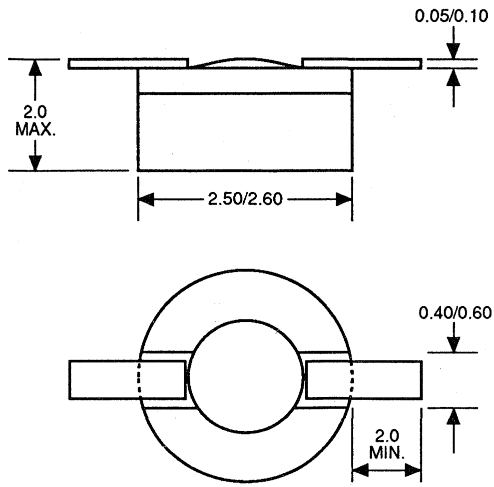
08



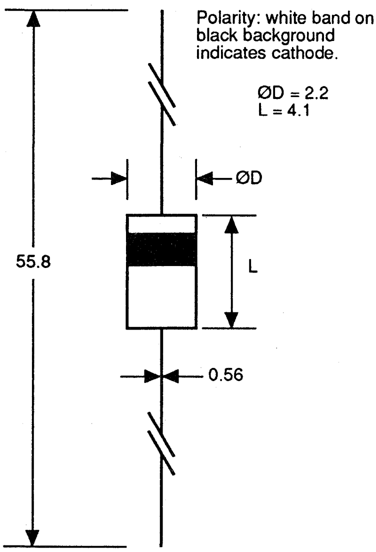
23


0.05/0.10
1.20
MAX.
2.50/2.60
0.40/0.60
2.0
MIN.

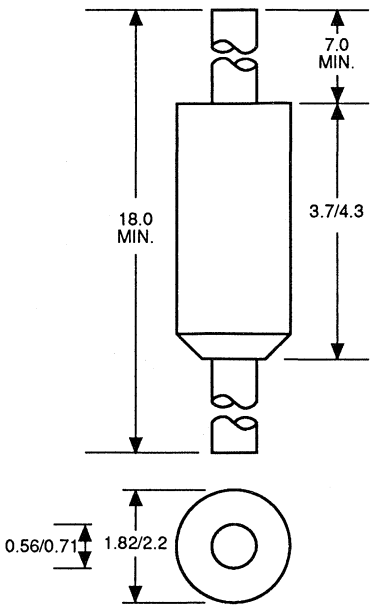
30


0.05/0.10
2.0
MAX.
2.50/2.60
0.40/0.60
2.0
MIN.

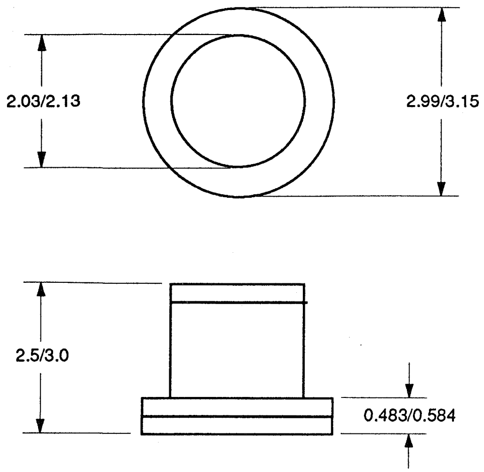
31


Polarity: white band on
black background
indicates cathode.
ØD = 2.2
L = 4.1
ØD
55.8
L
0.56

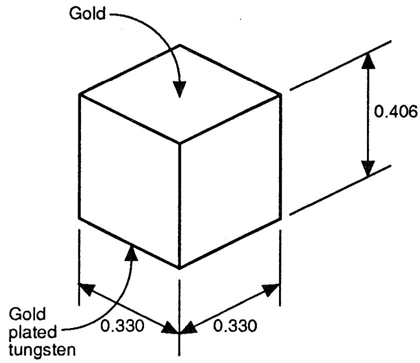
35


7.0
MIN.
18.0
MIN.
3.7/4.3
0.56/0.71
1.82/2.2

36

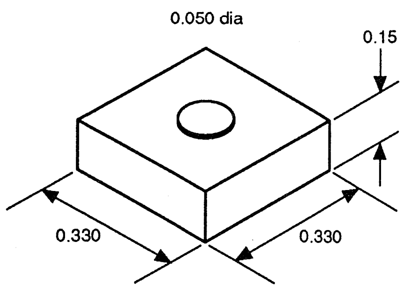


39



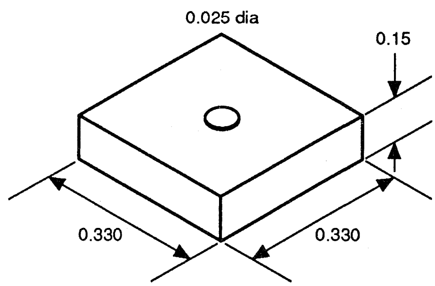
Gold plated tungsten is anode.

41



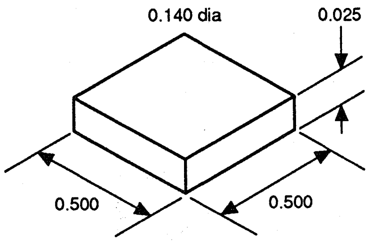
Top aluminium dot is anode.

44A



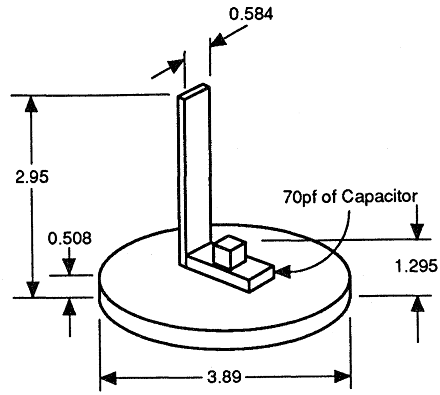
Top aluminium dot is anode.

44B

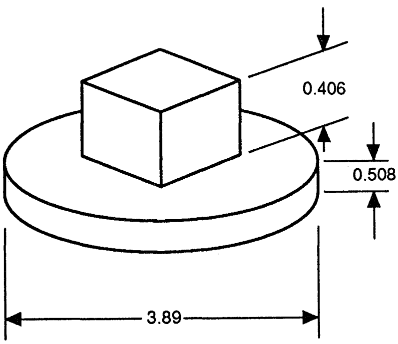


Gold base is cathode for P100, anode for P200.

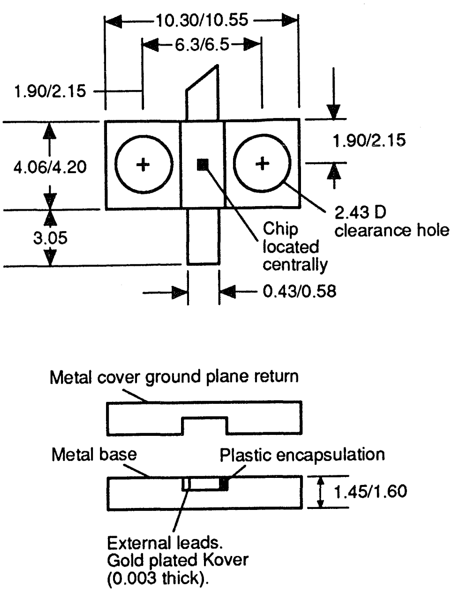
44C



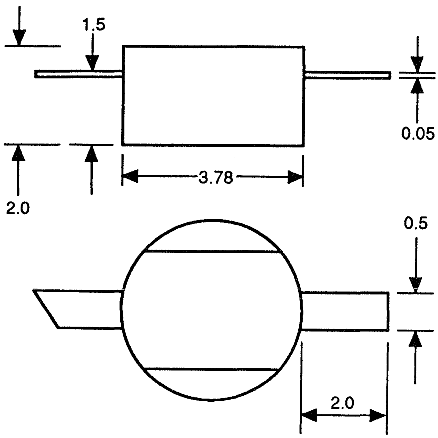
46



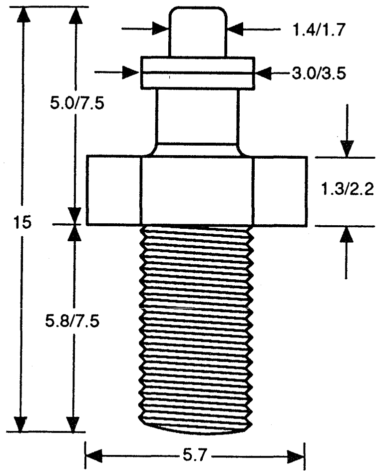
50



68



76



Thread cathode
4 - 4 OUNC 2A

90

GEC PLESSEY
SEMICONDUCTORS

DS3416-1.2 August 1992

DC2900 Series

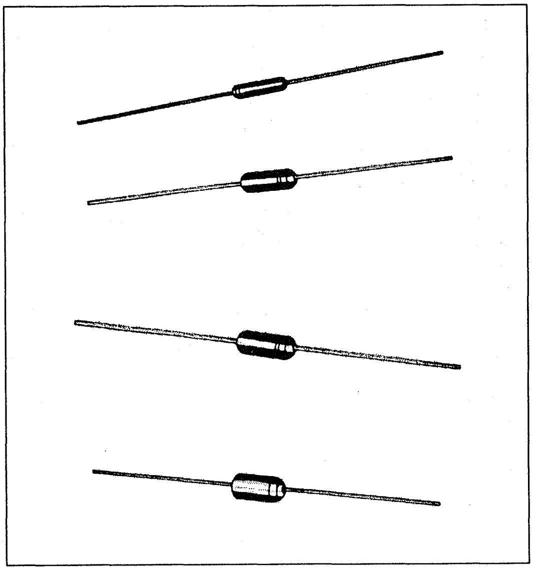
UHF/VHF PIN DIODES

These RF diodes form part of our extensive range of PIN diodes and have been especially designed with 'long minority carrier lifetime'. They also exhibit good linearity and low harmonic distortion at frequencies as low as 1MHz.

The low capacitance and series resistance of these devices impart high isolation and low insertion losses at frequencies up to and exceeding 1GHz. The thin passivated 'mesa' structure affords them very high breakdown voltages and minimum fringing capacitance.

The PIN diode is an extention of the conventional PN junction diode. It contains an intrinsic I layer of high restivity silicon sandwiched between the P and N layers. Varying the bias current through the diode controls the charge in the I region and hence the diode's RF resistance. It can be made to act almost as a pure resistor at RF frequencies.

The DC2900 Series are available in four packages - two 'C-Crimp' and two 'Double-Stud' devices in "Double-Stud" packages are capable of higher power dissipation and have a lower inductance. Devices in 'C-Crimp' packages have a lower capacitance. The larger the package size the better the power handling capability.



FEATURES

- Long minority carrier lifetime
- Good linearity
- Low harmonic distortion
- Very high breakdown voltages
- Low capacitance and series resistance
- Low thermal impedance
- Choice of four packages
- Hard glass chip passivation for relaibility

APPLICATIONS

DC2900 series diodes are designed for use as medium power current controlled resistors and on/off switches.

As switches they are ideal for antenna switching matrices, duplexers, digital phase shifters and time multiplex filters.

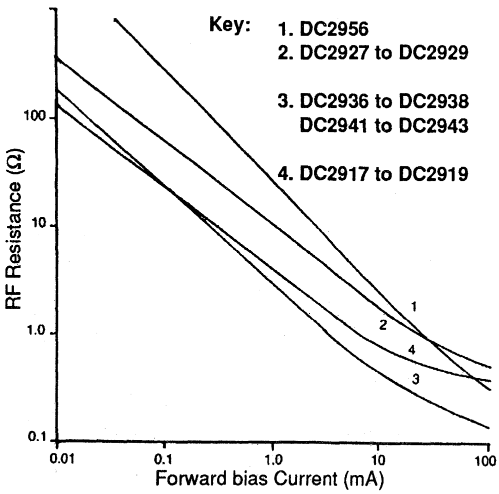
As current controlled resistors they are excellent in such applications as variable attenuators, AGC circuits, analog phase shifters and limiters.

LIMITING CONDITIONS OF USE

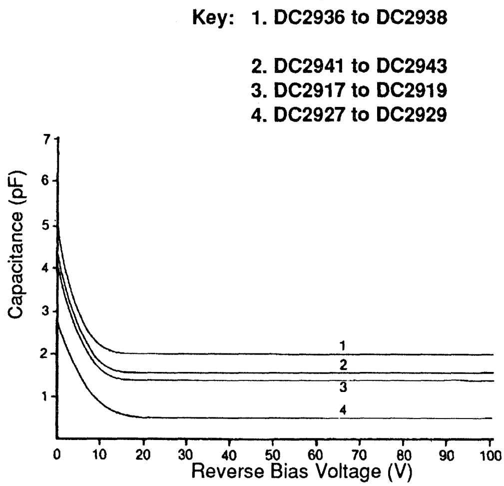
CW power Dissipation at 25°C	See Selection Table
Storage Temperature Range	-55° to +200°C
Operating Temperature Range	-55° to +200°C

ELECTRICAL CHARACTERISTICS - PROVISIONAL DATA

Type No.	Outline No.	Min Breakdown Voltage V_B (V)	Max Total Capacitance C_T (pF)	Max Series Resistance R_S (Ω)	Min Minority Carrier Lifetime τ_L (μS)	Maximum CW Power Dissipation (W) Amb. Rated	Case* Rated
DC2916	32	200	2.0	0.60 @ 10mA	0.5	2.30	3.10
DC2917	33	200	2.0	0.60 @ 10mA	0.5	0.75	1.00
DC2918	07	200	2.0	0.60 @ 10mA	0.5	0.50	1.00
DC2919	35	200	2.0	0.60 @ 10mA	0.5	0.35	0.48
DC2926	32	200	1.2	0.94 @ 10mA	0.6	2.30	3.10
DC2927	33	200	0.8	0.94 @ 10mA	0.6	0.75	1.00
DC2928	07	200	0.7	0.94 @ 10mA	0.6	0.50	1.00
DC2929	35	200	0.7	0.94 @ 10mA	0.6	0.35	0.48
DC2929-2	35	200	0.7	0.70 @ 10mA	0.5	0.35	0.48
DC2936	32	200	1.7	0.50 @ 10mA	1.5	2.30	3.10
DC3636-1	32	200	1.7	0.50 @ 10mA	0.5	2.30	3.10
DC2936-2	32	200	2.0	0.50 @ 10mA	0.6	2.30	3.10
DC2937	33	200	1.7	0.50 @ 10mA	1.5	0.75	1.00
DC2938	07	200	1.7	0.50 @ 10mA	1.5	0.50	1.00
DC2939	35	200	1.7	0.50 @ 10mA	1.5	0.35	0.48
DC2941	32	200	2.5	0.25 @ 80mA	1.5	2.30	3.10
DC2943	07	200	2.5	0.25 @ 80mA	1.5	0.50	1.00
DC2956	32	200	1.2	0.45 @ 80mA	2.0	2.30	3.10
DC2956-1	32	400	1.2	0.45 @ 80mA	2.0	2.30	3.10
DC2957	14	200	1.4	0.50 @ 50mA	6.0	0.50	1.00
DC2958	07	200	1.0	0.50 @ 100mA	2.0	0.50	1.00
DC2958-2	07	500	0.95	0.45 @ 100mA	2.0	0.50	1.00
DC2962	33	200	1.5	0.55 @ 10mA	0.5	0.75	1.00
DC2972	33	100	2.0	0.50 @ 10mA	0.5	0.75	1.00
Test Conditions		$I_R < 10\mu A$	$V_R = 100V$ f = 1MHz	f = 100MHz	$I_F = 10mA$ $I_R = -6mA$	*Infinite heatsink mounted 5mm from diode body	



Graph 1. *Typical RF Resistance vs Forward Bias*



Graph 2. *Typical Capacitance vs Reverse Voltage*

MINORITY CARRIER LIFETIME (τ_L)

τ_L is the average time of recombination of electrons and holes within the I region and reflects a PIN diode's ability to store charge. It is important for characterising PIN diodes since it defines the minimum frequency ($f_O = 1/2\tau\pi_L$) for linear behavior of the diode. Operation of the diode below this frequency results in considerable harmonic distortion, although this is not important for switching applications. DC2900 series diodes are relatively long lifetime types and can be used down to 1 MHz without significant distortion.

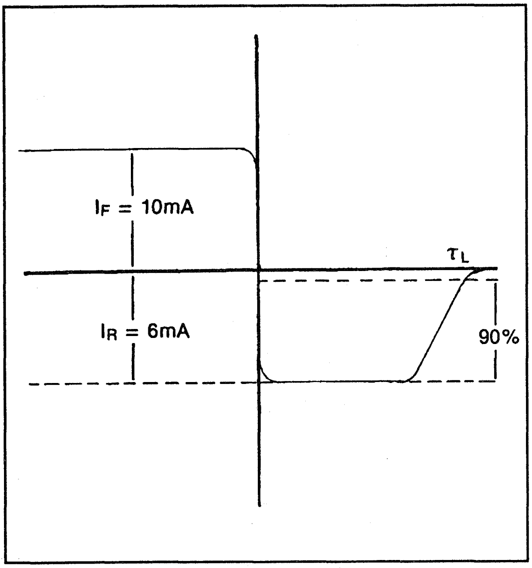


Figure 2

To measure τ_L, a known charge is stored in the I region by applying a forward bias current of 10mA, and this is extracted by applying a negative pulse so that a reverse current of peak value 6mA flows through the diode. A measure of τ_L is obtained by defining the time taken to extract charge to a predefined level. τ_L is then specified at 90% decay of the reverse current. (Figure 2).

ADDITIONAL SCREENING

All diodes will be subject to the screening procedure below prior to testing:

1. Rapid change of temperature BS2011Na
   5 cycles -55° to +150°C
2. High temperature storeage BS2011Ba
   48hrs. 150°C

REVERSE BREAKDOWN VOLTAGE (V_B)

VB is the value of reverse voltage at which current flow increases dramatically due to impact ionization. It is characterised by the sharp knee in plot (Figure 1). In practice there is a small reverse leakage current due to surface contaminants, (minimised by oxide and glass passivation of the diode). For this reason V_B is measured with $I_R = 10\ \mu A$.

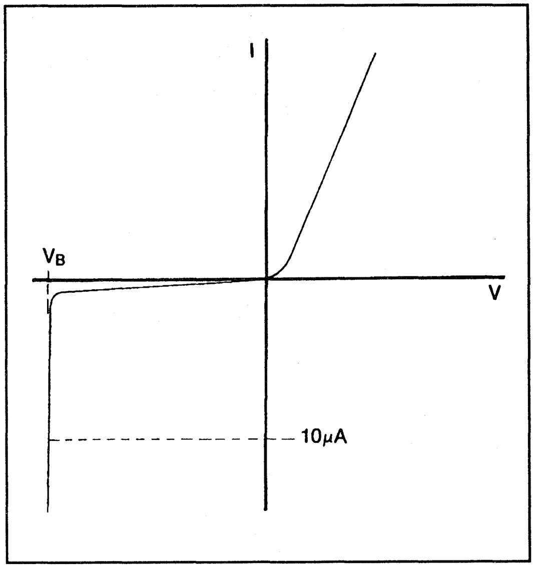


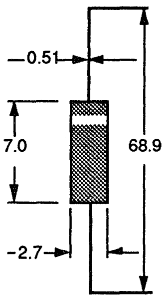
Figure 1

TOTAL CAPACITANCE (C_T)

The values given represent the total capacitance of the packaged diode.

Typical capacitance/reverse voltage characteristics of DC2900 series diodes are shown in Graph 2. Practical Intrinsic material contains a small number of charge carriers and at zero bias the I region of a PIN diode is only partially depleted of charge. When a reverse bias is applied the width of the 'depletion layer' increases and the capacitance decreases. Eventually at the 'punch through' voltage (V_{PT}) the layer is fully depleted and the capacitance reaches its minimum value. Capacitance is measured beyond 'punch through' at V_R = 50V to ensure that the I layer is fully depleted.

British Standard SO-6
JEDEC DO-7



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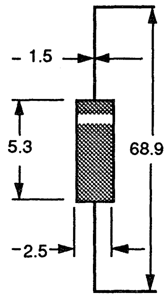

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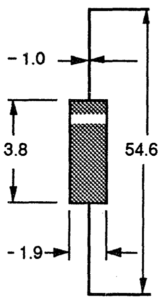

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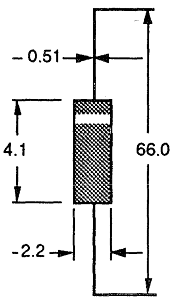
JEDEC DO-35



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1. All dimensions are in mm.
2. White band indicates cathode.
3. Outline numbers shown correspond to catalogue No. M08 and M15
4. Chip versions and surface mount versions in MELF and Mini MELF are available. Details on request.

TUNING VARACTORS - INTRODUCTION

INTRODUCTION

Varactor tuning diodes are voltage variable capacitors, designed to provide electronic tuning of oscillators and filters. The device employs the variable depletion capacitance of a reverse biased semiconductor junction. This may be either a PN junction or a metal semiconductor (Schottky barrier) junction and can be formed within either silicon or gallium arsenide.

Silicon is favoured for lower cost and lower Q applications from VHF through microwave frequencies. Gallium arsenide diodes provide higher Q, because of their inherently higher mobility, and may be used for higher microwave frequency applications such as parametric amplifiers and millimetre wave multipliers.

Within the general family of tuning varactors, there are two major categories, each designed for particular applications and at differing costs:

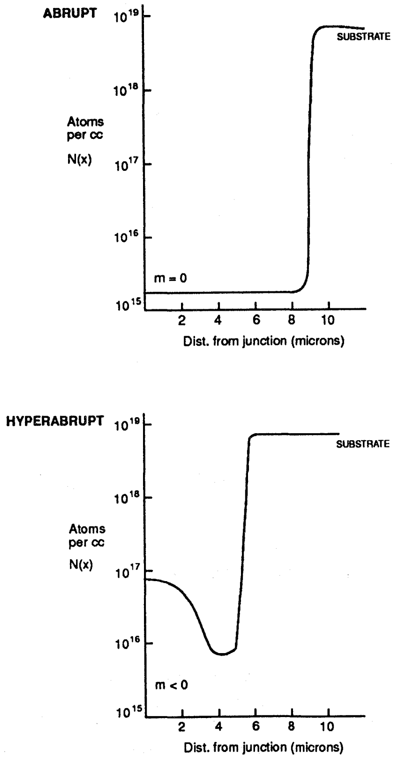
Abrupt junction

An abrupt junction diode is one in which the interface width at the junction is short compared to the epitaxial layer thickness, and the doping level of the epitaxial layer is constant over its thickness. This is shown in Fig.1, with the corresponding C-V curve in Fig.2. This type of profile provides a capacitance variation which is roughly proportional to the inverse square root of the reverse bias voltage and can be represented by the following equation:

$$C(V) = K.A.\,(V + \varnothing)^{-n} \qquad (1)$$

where:

C(V)	= capacitance of the diode at voltage V
K	= constant
A	= area of the diode
V	= voltage applied to the diode
Ø	= built in potential of the diode (0.6-0.8 volts for silicon 1.2-1.3 volts for gallium arsenide)
n	= the capacitance - voltage slope exponent ($n \approx 0.5$ for an abrupt diode)



$$N(x) = B.x^{m}$$

where: $m = 1$, linear profile
$m = 0$, abrupt profile
$m < 0$, hyperabrupt profile

Figure 1. Tuning Varactor Doping Profiles

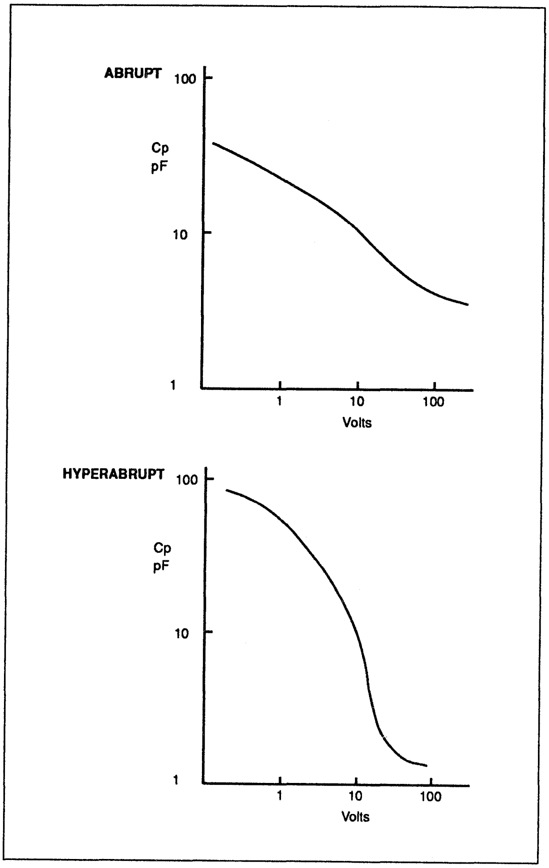


Figure 2. Tuning Varactor C-V Curves

Hyperabrupt junction

Many applications require a linear (or nearly linear) variation of frequency with applied voltage. The inverse square root dependence of the abrupt junction capacitance provides an inverse fourth root frequency dependence. To provide linearity, it is necessary to add a linearizer to convert the applied control signal to a non-linear diode bias voltage. This results in complexity, increased cost and inherently slower modulation capability.

Hyperabrupt varactors were designed to produce a C-V variation that has, at least over a proportion of the curve, an inverse square capacitance law. This provides narrow band linear frequency variation. The structure of the hyperabrupt diode is shown in Fig.1 and can be seen to be an abrupt junction profile with an additional, increased doping level as the junction is approached. The corresponding C-V curve is shown in Fig.2. This is a typical curve, the details depending on the exact shape of the more highly doped region near the junction.

The capacitance - voltage relationship for this type of junction is more usually described by the equation:

$$C(V) = C(0).\left(1 + \frac{V}{\text{Ø}}\right)^{-\gamma} \qquad (2)$$

where:

C(0)	=	mathematically extrapolated junction capacitance when V = 0
Ø	=	built in potential of the diode
γ	=	the capacitance - voltage slope exponent (gamma) ($\gamma > 0.5$ for a hyperabrupt diode)

Equations (1) and (2) are equivalent with the exception that γ is now a function of voltage and is generally in the range 0.5 to 2.0

Unfortunately, hyperabrupt diodes have a significantly reduced Q compared to abrupt designs with the same breakdown voltage and capacitance (fixed voltage). As a result, they can only be used at the lower microwave frequencies, upto a few GHz at best.

SELECTION GUIDE

Silicon v. Gallium Arsenide

Gallium arsenide diodes are generally used for higher microwave frequencies because of their superior Q factor. However, although thermal oxide and glass passivation can reduce surface states and 1/f noise in silicon varactors, no such passivation has been developed for gallium arsenide diodes. Thus, FM or phase noise close to the carrier is usually worse than for silicon diodes due to upconversion of surface noise. For this reason, silicon is a better choice than gallium arsenide for high-power or wideband VCOs if low noise is a consideration.

Gallium arsenide diodes also have relatively poor stability. Higher thermal resistance prevents gallium arsenide diodes from settling as fast as silicon diodes, and the high surface state density contributes to long term drift.

Planar v. Mesa Construction

The two basic constructions used to manufacture tuning diodes are planar and mesa. A cross-section of each of these techniques is shown in Fig.3.

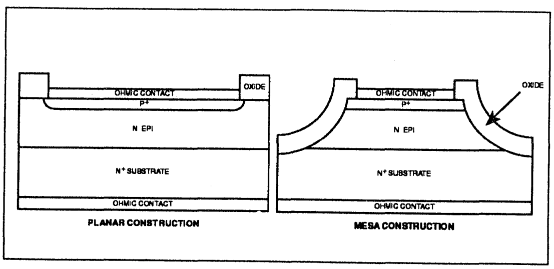


Figure 3. Cross sections of Planar and Mesa device constructions

VCO	Silicon abrupt	GaAs abrupt	GaAs hyperabrupt
Electronic counter measure			
below X-band/	✔		
above X-band			✔
Telecommunication			
phase locked oscillator			✔
transmitter			✔
Tuned synthesizer			
instrumentation & telecomm	✔		
radar		✔	
Radar local oscillator			
frequecy agile radar			✔
marine / weather radar		✔	
Missile seeker			✔
Doppler radar / motion detector			✔
Instrumentation	✔		
Police radar			
below 1 GHz		✔	
above 1 GHz			✔

Figure 4. Choice of Tuning Varactor by application.

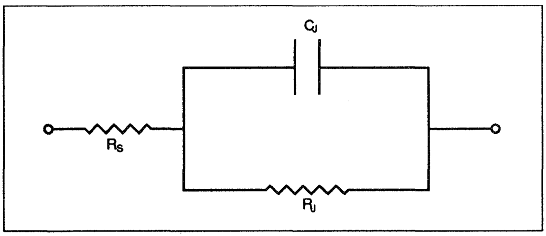
The planar process lends itself to large volume production techniques. Mesa processing, on the other hand, requires more processing steps and is generally done on a wafer-by-wafer basis. This results in a more expensive diode. Due to the radius of curvature at the junction edge of a planar diode, the electric field in this area is greater than the electric field in the centre of the junction. Thus, for a given breakdown voltage a planar diode must use higher resistivity epitaxial material than a mesa diode. The end result is that the planar diode has a greater series resistance than a mesa diode for the same capacitance and breakdown voltage, and thus lower Q. All microwave tuning diodes are of mesa design because of the greatly increased Q.

Selection Chart

The accompanying selection chart (Fig.4.) indicates the most commonly used varactor type by application. An approximate capacitance value (at 4 volts reverse bias) for the particular frequency of operation can then be obtained from the graph in Fig.5.

QUALITY FACTOR

A tuning varactor diode may be represented by the following, simplified equivalent circuit:



The general expression for the quality factor, Q, of the diode can then be derived as:

$$Q = \frac{wC_J R_J^2}{R_J + R_S [1 + (wC_J R_J)^2]} \qquad (3)$$

$$Q \approx \frac{wC_J R_J}{1 + w^2 C_J^2 R_J R_S} \quad \text{for } (wC_J R_J)^2 >> 1 \qquad (4)$$

It can be seen from equation (4) that the maximum value of Q is:

$$Q = \frac{1}{2}\sqrt{\frac{R_J}{R_S}} \quad (5) \qquad \text{when } w_O = \frac{1}{C_J\sqrt{R_J R_S}}$$

At frequencies appreciably below that for maximum Q, where $w^2 C_J^2 R_J R_S$ is negligable compared to unity, Q is approximately equal to $wC_J R_J$.

At frequencies appreciably above that for maximum Q, $wC_J R_J$ is much greater than unity and Q is approximately equal to:

$$Q = \frac{1}{wC_J R_S} \qquad (6)$$

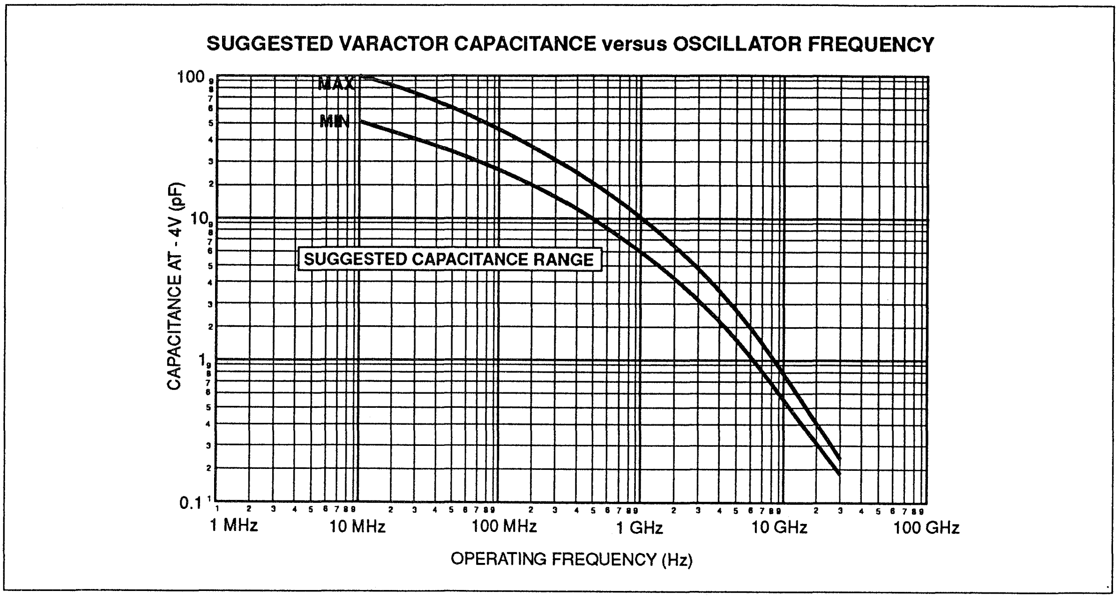


Figure 5. Suggested Varactor capacitance v Oscillator frequency

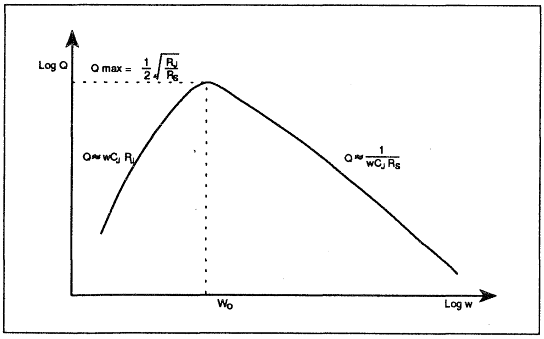


Figure 6. Variation of Q with frequency

The typical variation of Q with frequency is shown in Fig.6. In practice, a useful formula is:

$$Q = \frac{159}{fR_S C_J} \qquad (7)$$

where f is in GHz
R_S is in Ohms
C_J is in pF

which at 50 MHz becomes:

$$Q = \frac{3180}{R_S C_J} \qquad (8)$$

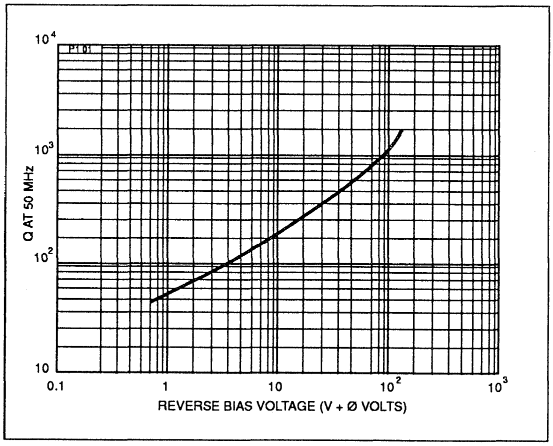


Figure 7. Typical variation of Q with Reverse Bias Voltage

The capacitance of the diode is inversely proportional to the width of the depletion layer. In addition, the series resistance of the diode is proportional to the width of the undepleted epitaxial layer. Thus, as diode reverse bias is increased, both parameters decrease and Q increases rapidly. A typical curve is shown in Fig.7.

CAPACITANCE TUNING RATIO

The diode capacitance C_T is equal to the sum of the junction and package capacitances. Thus:

$$C_T = C_J + C_P \qquad (9)$$

A plot of log C_J versus log (V + Ø) gives a straight line curve of slope - / over the working range of the diode. This is shown in Fig.8.

The nominal junction capacitance is usually specified at 4 volts reverse bias. The capacitance tuning ratio between any two reverse bias voltages equals:

$$\frac{C_T(V_1)}{C_T(V_2)} = \frac{C_J(V_1) + C_P}{C_J(V_2) + C_P} \qquad (10)$$

This may be calculated from the C (-4) value using the relationship:

$$C_J(V) = C_J(-4).\left(\frac{4 + \varnothing}{V + \varnothing}\right)^{\gamma} \qquad (11)$$

A low doping of the epitaxial layer will give a higher breakdown voltage and thus a larger tuning ratio at the expense of a lower Q. A more heavily doped layer will give a lower tuning range but a higher Q. With its higher /, a hyperabrupt device will give a larger tuning range but a lower Q than an abrupt device of the equivalent size. The slope, /, may be calculated from a graph like Fig.8 using the relationship:

$$\gamma = \frac{\log C_J(V_1) - \log C_J(V_2)}{\log(V_2 + \varnothing) - \log(V_1 + \varnothing)} \qquad (12)$$

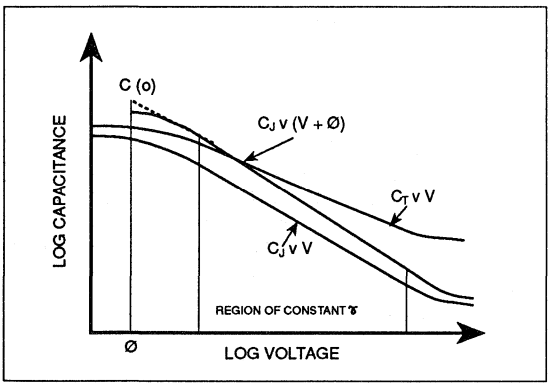


Figure 8. Typical capacitance versus voltage

TEMPERATURE EFFECTS

Capacitance

Tuning varactors exhibit a positive temperature coefficient of junction capacitance which is dependent upon reverse bias voltage.

The capacitance variation is due, mainly, to the temperature dependence of the contact potential, Ø, which has a negative coefficient. Thus the temperature coefficient of capacitance is large when the applied bias voltage is small (of the same order as Ø), but decreases rapidly as the bias voltage is increased, approaching an asymptotic value. This value corresponds to the temperature coefficient of the dielectric constant, and represents that part of the coefficient which is independent of bias voltage.

The average temperature coefficient of capacitance for silicone over the range -50°C to +100°C as a function of bias voltage is shown in Fig.9.

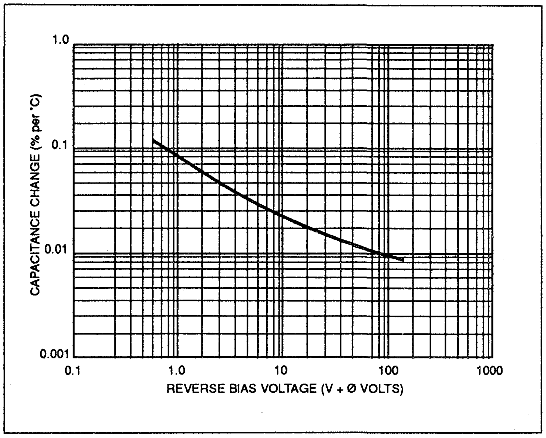


Figure 9. Temperature coefficient of capacitance

Leakage Current and Breakdown Voltage

The reverse leakage current of a varactor is the sum of two components:

a) The true bulk effect across the junction, which is dependent upon junction area and, hence, device capacitance.

b) The surface leakage at the edge of the junction which is dependent upon surface states.

Reverse leakage increases exponentially with temperature and, as an approximate rule, doubles its value for every 10° C to 20°C rise in temperature. Breakdown voltage, however, also has a positive temperature coefficient and increases as temperature and reverse leakage current increase. A typical plot for silicon is shown in Fig.10.

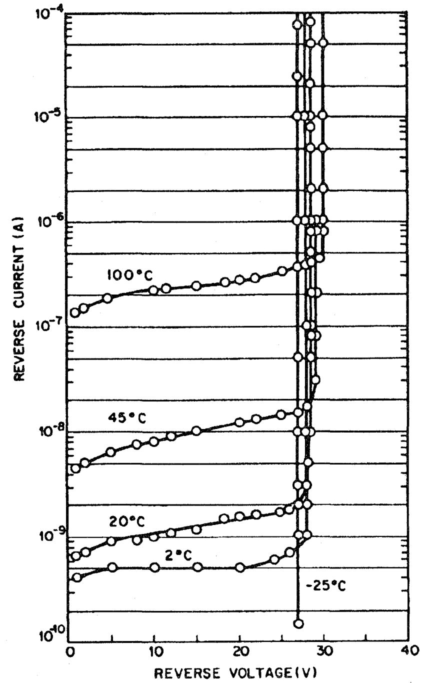


Figure 10. Reverse leakage current and breakdown voltage versus temperature.

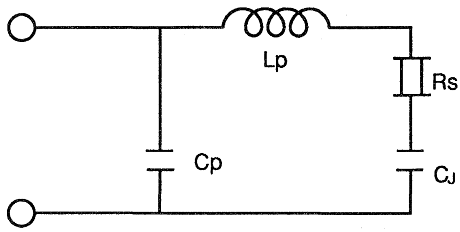


Figure 11. Varactor equivalent circuit

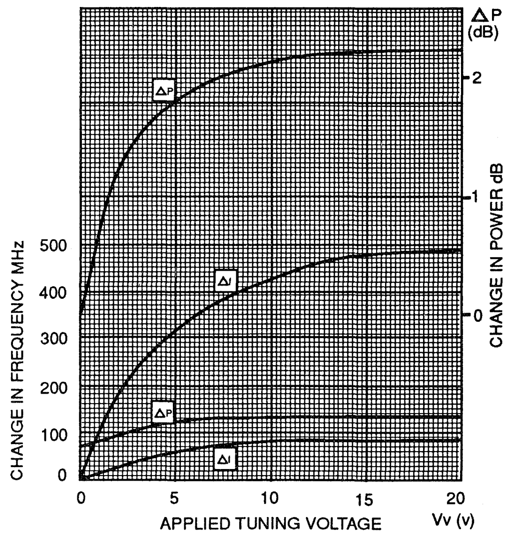


Figure 12a. Variation of power and frequency with tuning voltage in a half wavelength WG18 cavity oscillator at 13GHz

USE IN OSCILLATOR CIRCUITS

In the equivalent circuit of a packaged varactor diode, (Fig. 11) the parasitic components, Lp and Cp introduced by the package, affect both the Q-factor and capacitance ratio. The operating frequency and magnitude of capacitance are the main factors governing the choice of package. The larger, cheaper and more rugged packages have higher parasitics and are therefore useful for high capacitance devices. Low parasitic packages are needed for microwave operation.

The tuning range of an oscillator depends on the proportion of the electric stored energy that resides in the varactor. In a lumped component circuit this is simply a matter of deciding what proportion of the total capacitance is contributed by the varactor. In a cavity resonator the capacitance is not so easily identified., but as a rule a tightly coupled varactor in a low Q circuit will give the greatest tuning range. This is reduced by reducing the varactor coupling and increasing circuit Q. (see Fig. 12).

Typical Microwave Characteristics

These curves are valid up to a few tens of milliwatts output. At higher powers, forward conduction in the varactor can occur depending on the circuit configuration. This may reduce the tuning range and, in extreme cases, may cause thermal failure of the varactor. The performance in other oscillator geometries will also be different.

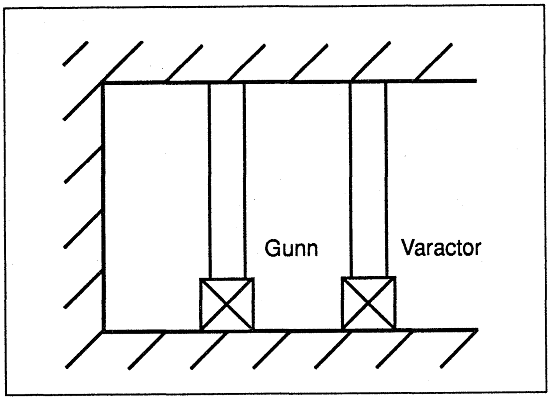


Figure 12b. WG18 cavity.

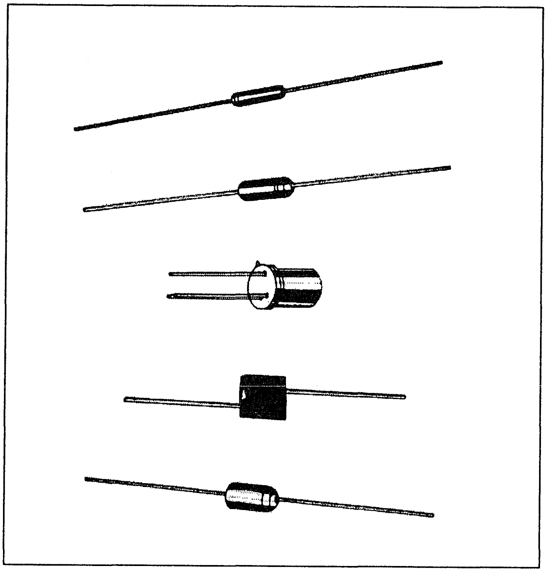
DS3414-1.2 August 1992

DC4200 Series

SILICON VHF/UHF TUNING VARACTORS

DC4200 Series varactors are abrupt junction devices of planar-epitaxial construction. They are intended for electronic tuning and other frequency control applications in the VHF/UHF region. Device performance has been optimised by careful attention to processing techniques. The use of oxide/nitride passivation produces varactors with good stability and low leakage.

Low substrate resistance and optimised metal contact schemes help to minimise series resistance, resulting in high values of Q. Capacitance values (C_T - 4V) from 2.2 to 350pF are available in a range of appropriate packages.



FEATURES

- High Q
- Large tuning range
- Designed for high reliability
- Wide range of capacitance values
- High capacitance tolerance
- Many special selections available

DC4200 Series varactors are designed for high quality and high reliability applications. GEC Plessey Semiconductors has a proven record of supplying high reliability devices for military programmes. Devices are produced to meet the strict standards of U.K. Ministry of Defence approval to NATO AQAP-1(Edit.3).

In addition, DB4200 series varactors are available to CECC 50 077. To qualify, devices undergo severe mechanical and environmental testing* similar to that required to MIL 202. This is backed up by long term reliability testing.

MTBF's (Mean Time Before Failure) of >10^7 hours are typical. Special screening can be performed on most device types and can be tailored to meet specific requirements.

Contact our local representatives for further information.

*BS2011 and IEC 68 series test programme.

LIMITING CONDITIONS OF USE

Maximum Reverse Voltage (V_R)	60V
Storage Temperature Range	-55° to +150°C
Operating Temperature Range	-55° to +100°C

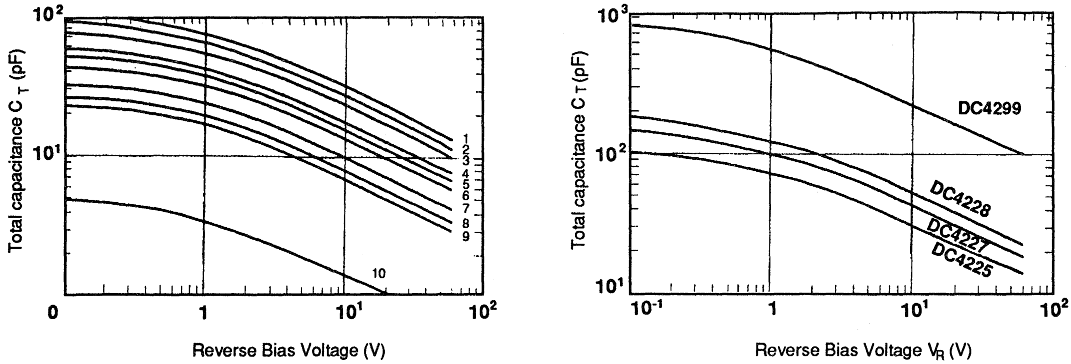
ELECTRICAL CHARACTERISTICS

At T_{amb} = 25°C

The table of electrical characteristics gives an appreciation of the range of varactors available. However, the range can be extended to meet individual customer requirements. Special features available include:

- Tighter tolerance and matched sets
- 100% burn-in
- Choice of minimum breakdown voltage
- Special reliability testing
- Higher Q
- Wider bandwidth tuning

Type No.	Outline No.	Total Capacitance C_T±10% (pF)	Capacitance Ratio (min)	Breakdown Voltage V_B (V) (min)	Quality Factor Q (min)	Test Frequency f (MHz)	Reverse Voltage V_R (V)
DC4255B	35	2.2	2.5	60	550	50	-4.0
DC4256B	35	3.3	2.7	60	450	50	-4.0
DC4257B	07	4.7	2.8	60	450	50	-4.0
DC4210B	07	6.8	2.9	60	450	50	-4.0
DC4211B	07	8.2	2.9	60	400	50	-4.0
DC4212B	07	10.0	3.0	60	350	50	-4.0
DC4213B	07	12.0	3.0	60	350	50	-4.0
DC4214B	07	15.0	3.1	60	300	50	-4.0
DC4215B	07	18.0	3.1	60	250	50	-4.0
DC4216B	07	22.0	3.2	60	250	50	-4.0
DC4217B	07	27.0	3.2	60	200	50	-4.0
DC4218B	07	33.0	3.2	60	200	50	-4.0
DC4224B	07	39.0	3.2	60	200	50	-4.0
DC4225B	07	47.0	3.2	60	200	50	-4.0
DC4226B	14	56.0	3.2	60	120	50	-4.0
DC4227B	14	68.0	3.2	60	120	50	-4.0
DC4228B	14	80.0	3.2	60	100	50	-4.0
DC4229D	14	80.0	3.2	100	200	50	-4.5
DC4229F	14	57.0*	3.85*	120	240	50	-15.0
DC4232B	18	100	3.2	60	200	10	-4.0
DC4233B	18	120	3.2	60	200	10	-4.0
DC4234B	18	150	3.2	60	200	10	-8.0
DC4298	10	200	3.2	100	200	25	-8.0
DC4299	10	335	3.2	100	200	25	-8.0
DC4244C	78	350	3.2	90	750	1	-4.0
Test Conditions		V = 4V f = 1MHz *V = 8V	4V to 60V f = 1MHz *4V = 85V	I_R = 10μA			



Key:

1 DC4225B	6 DC4215B
2 DC4224B	7 DC4214B
3 DC4218B	8 DC4213B
4 DC4217B	9 DC4212B
5 DC4216B	10 DC4255

Figure 1. Typical Capacitance vs. Tuning Voltage

CAPACITANCE LAW

The total capacitance C_T at an applied voltage V for a varactor is given by:

$C_T = A\,(V + \varnothing)^{-\gamma}$

where:

A = a constant relating to epilayer doping level and diode area
$\varnothing$ = built in junction potential (0.65V for silicon)
γ = 0.45 to 0.475

Q FACTOR

Q can be calculated from

$$Q = \frac{1}{2\pi fRC}$$

and is normally measured and specified at 50MHz for these diodes.

Q at any other frequency can be approximated by

$$Q(f_2) = \frac{f_1}{f_2}\,(Q_{(f_1)})$$

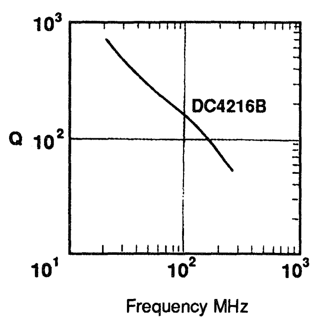


Figure 2. Typical Q vs. Frequency

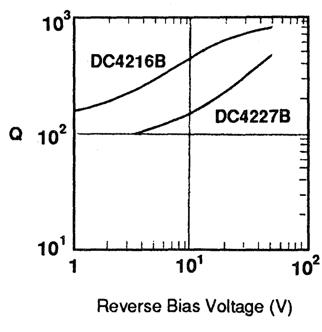
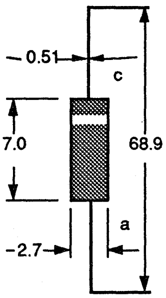


Figure 3. Typical Q vs. Reverse Bias Voltage

British Standard SO-6
JEDEC DO-7

White indicates cathode



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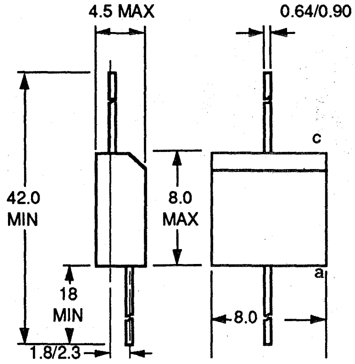

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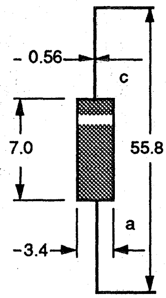

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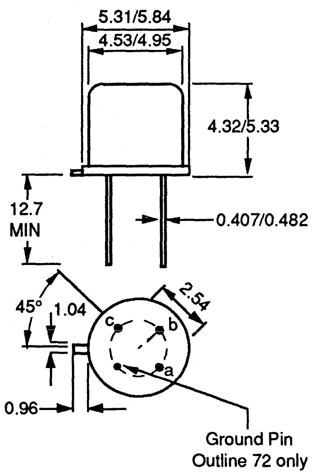

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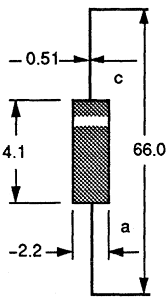
JEDEC DO-35



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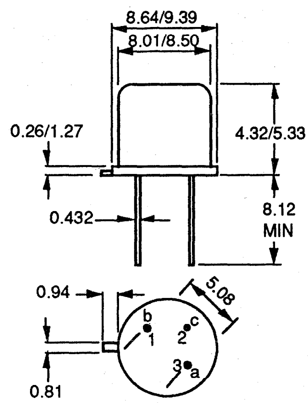


78

GEC PLESSEY
SEMICONDUCTORS

DS3485-1.2 August 1992

DC4200 Series

SILICON MICROWAVE TUNING VARACTORS

These ceramic packaged silicon tuning varactors are abrupt junction devices of passivated planar construction. They extend the existing DC4200 series of devices to cover microwave frequencies.They are intended as a low cost alternative to GaAs for tuning varactors for applications where a very high Q is not essential, and are suitable for use from VHF up to about 15GHz.

DC4200 series varactors are designed for high quality and high reliability applications. GEC Plessey Semiconductors has a proven record of supplying high reliability devices for military programmes. Devices are produced to meet the strict standards of U.K. Ministry of Defence approval to NATO AQAP-1 (Edit.3). To qualify devices undergo severe mechanical and environmental testing similar to that required to MIL 202. This is backed up by long term reliability testing. MTBF's (Mean Time Before Failure) of $>10^7$ hours are typical. Special screening can be performed on most devicetypes and can be tailored to meet specific requirements.

Contact our local representatives for further information.

FEATURES

- High Q
- Designed for high reliability
- Microwave frequency applications
- Ceramic 'taped ended' and 'PIL packages'
- Surface mount versions available

LIMITING CONDITIONS OF USE

Maximum Reverse Voltage (V_R)	60V
Storage Temperature Range	-55° to +150°C
Operating Temperature Range	-55° to +100°C

ELECTRICAL CHARACTERISTICS

At T_{amb} = 25°C

The following table gives a general guide to the range of varactors available. However, many selections are available to meet specific customer requirements.

Type No.	Typical packaged Capacitance C_J±10% (pF)	Minimum Capacitance Ratio	Typical Quality Factor Q	Outline Number
DC4265B	2.2	2.5	550	00
DC4285B	2.2	2.5	550	06
DC4266B	3.3	2.7	500	00
DC4286B	3.3	2.7	500	06
DC4267B	4.7	2.8	450	00
DC4287B	4.7	2.8	450	06
Test Conditions	V_R = 4V f = 1MHz	V_R = 4V to 60V f = 1MHz	V_R = 4V f = 50MHz	

Reverse breakdown voltages for all types = 60V.
Other breakdown voltages are available on request.

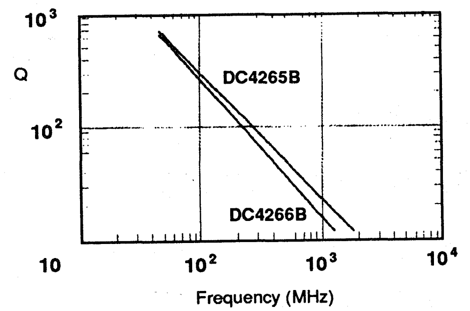


Figure 1. Typical variation of Q with frequency ($V_R = -4V$)

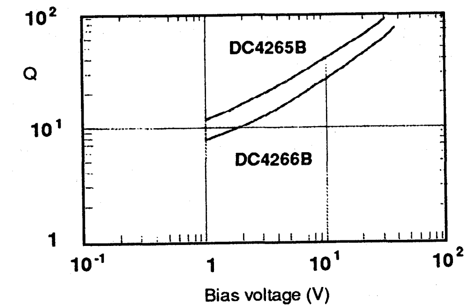


Figure 2. Typical variation of Q with bias voltage (f = 50MHz)

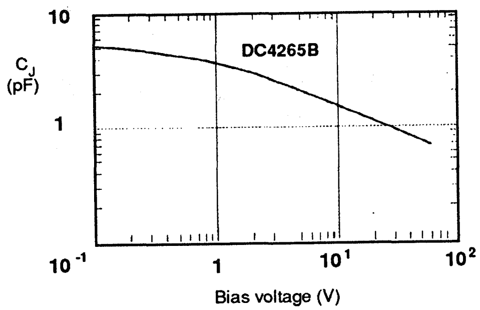
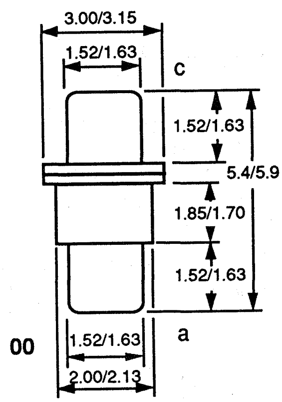
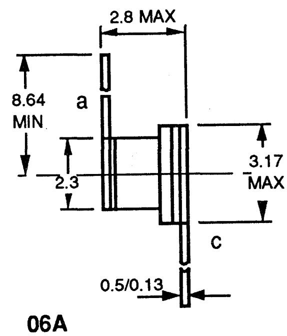


Figure 3. Typical variation of capacitance with reverse bias voltage (f = 1MHz)

OUTLINE DRAWINGS

Packages suitable for surface mount applications are currently under development. Contact your nearest Customer Service Centre for details.





Outline dimensions in mm

GEC PLESSEY
SEMICONDUCTORS

DS3413-1.2 August 1992

DC4300 Series

GALLIUM ARSENIDE MICROWAVE TUNING VARACTORS

This range of epitaxial gallium arsenide Schottky barrier variable capacitance diodes is designed primarily for electronic tuning of Gunn and transistor microwave oscillators. They have the advantage over silicon tuning diodes in that the required change in capacitance occurs over a lower tuning voltage range and, as such, is more compatible with Gunn and transistor power supplies. Gallium arsenide varactors also exhibit excellent low noise characteristics.

ELECTRICAL CHARACTERISTICS

The total capacitance includes the encapsulation capacitance which is approximately 0.25pF for outline 00, and 0.08pF for outline 20. Diodes can be supplied to smaller total capacitance spreads to special order. The suffix A or B must be added to the type number to specify the minimum breakdown voltage of 20 volts or 30 volts respectively.

Type Number	Outline Number	*MWV (V)	C_{TO} (pF)	Typical C_j Ratio 0 - 20V	0 - 30V	Q typ. at 10 GHz (0V)
DC4303A	00	20	0.8	4.5		6.6
DC4302A	00	20	1.3	4.5		6.0
DC4301A	00	20	2.2	4.5		4.3
DC4304A	00	20	3.3	4.5		3.4
DC4305A	00	20	4.7	4.5		3.3
DC4303B	00	30	0.8	4.5	6.0	6.6
DC4302B	00	30	1.3	4.5	6.0	6.0
DC4301B	00	30	2.2	4.5	6.0	4.3
DC4304B	00	30	3.3	4.5	6.0	3.4
DC4305B	00	30	4.7	4.5	6.0	3.3
DC4373A	20	20	0.8	4.5		6.6
DC4372A	20	20	1.3	4.5		6.0
DC4371A	20	20	2.2	4.5		4.3
DC4374A	20	20	3.3	4.5		3.4
DC4375A	20	20	4.7	4.5		3.3
DC4373B	20	30	0.8	4.5	6.0	6.6
DC4372B	20	30	1.3	4.5	6.0	6.0
DC4371B	20	30	2.2	4.5	6.0	4.3
DC4374B	20	30	3.3	4.5	6.0	3.4
DC4375B	20	30	4.7	4.5	6.0	3.3

*MWV - Minimum Working Voltage

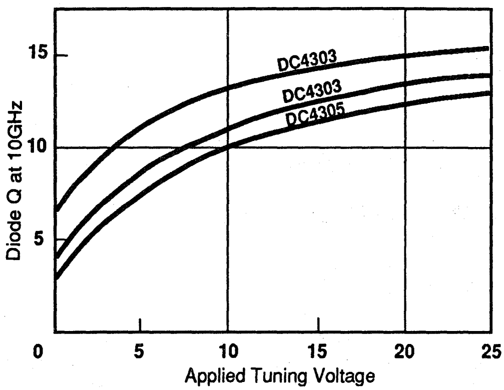


Figure 1. Variation of Diode Q at 10 GHz with Tuning Voltage

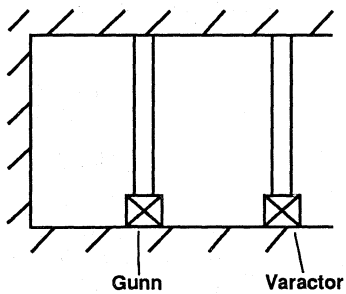
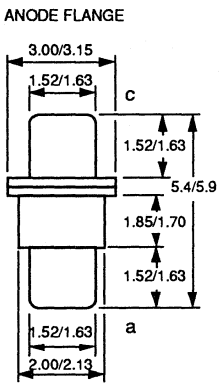


Figure 2. Waveguide Oscillator

OUTLINE DRAWINGS



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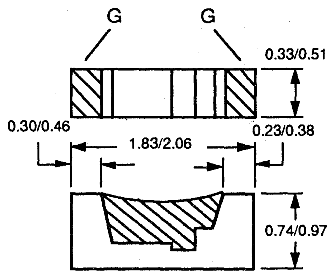


G GOLD PLATE, 5 MICRONS MIN.
OVER 1.27 MICRONS OF NICKEL

CATHODE RED

20

Outline dimensions in mm

DS3410-1.2 August 1992

DC4600/4700 Series

GaAs HYPERABRUPT TUNING VARACTORS

The introduction of hyperabrupt junction varactors brings the advantages of linear electronic tuning to the microwave circuit designer. GEC Plessy Semiconductors Microwave's hyperabrupt varactors are Schottky barrier devices of mesa construction. This leads to a lower series resistance and higher Q than an equivalent planar structure. The use of advanced molecular beam epitaxy techniques allows very close control of doping profiles enabling constant Gamma values to be achieved. Constant Gamma devices have linear voltage with frequency characteristics which eliminates the need for compensation networks. The DC4600 andDC4700 series have Gamma values of 1.0 and 1.25 respectively.

Hyperabrupt varactors have a larger capacitance ratio than abrupt junction varactors. As a consequence, a wider frequency tuning range is possible. The use of GaAs results in a higher Q than comparable silicon varactors. Q values of over 4000 (measured at 50MHz and -4V) are available, giving excellent results from VHF through to millimetric frequencies.

FEATURES

- Millimetre wave applications
- Constant gamma for linear tuning
- High C swing
- High Q
- Versions with gamma values 1.0 and 1.25 available
- Custom devices available
- Use MBE materials for high repeatability

APPLICATIONS

Designed for electronic tuning of voltage controlled oscillators, with moderate to wide tuning bandwidths, employing Field Effect Transistor, Gunn or IMPATT microwave sources. Other applications include voltage tuneable filters and phase modulators. The low parasitic and small dimensions of outlines 106 and 155 make them particularly suitable for use at millimetric frequencies.

LIMITING CONDITIONS OF USE

Maximum Reverse Voltage (V_R)	20V
Storage Temperature Range	-55° to +150°C
Operating Temperature Range	-55° to +100°C

GENERAL CHARACTERISTICS

The techniques used for processing hyperabrupt varactors allow the electrical characteristics to be tailored to meet individual requirements. A guide to the range of parameters achievable is given below.

Parameter	Test Conditions	Range of Values Avaialable
Capacitance C_J	f = 1MHz and V_R = -4V	from <0.5pF to 10pF
Minimum Q	f = 50MHz and V_R = -4V	from 500 to 4000
Breakdown Voltage V_{BR}	I_R = 10µA	20V min. Higher voltages available
Tuning Range		nominally 2 to 20V
Gamma Value available	extrapolated from C - V plot	available in 2 ranges: constant Gamma = 1.0 (DC4600 series) constant Gamma = 1.25 (DC4700 series)

TYPE NUMBER SELECTION

The type number fully specifies the diode characteristics:

Specifies Miniimum Q

Q Min.	No.
500	1
1000	2
1500	3
2000	4
3000	5
4000	6

Specifies

γ Value	No.
1.0	6
1.25	7

D	C	4	7	0	4	-	6

Specifies Package Style

Outline	No.	Capacitance (pF)
00	0	0.25
86	2	0.2
106	4	0.18
20	6	0.13
55	7	0.04
CHIP	9	-

Capacitance Range C_J (pF)	0.5 max.		1.00 to 1.49	1.50 to 2.49	2.50 to 3.49	3.50 to 4.49	5.00 to 6.49
Designation	0	1	2	3	4	5	6
Possible Q Values	1500 to 4000	1500 to 4000	1500 to 3000	1000 to 3000	1000 to 2000	1000 to 2000	500 to 1500

TYPICAL ELECTRICAL CHARACTERISTICS at T_{amb} = 25°C unless otherwise specified

Parameter	Range of Values Available	Test Conditions
Capacitance C_T (pF)	from <0.5 to 10	f = 1 MHz and V_R = -4V
Minimum Q	from 1000 to >4000	f = 50 MHz and V_R = -4V
Breakdown Voltage V_{BR} (V)	20V Min.	I_R = 10µA
Capacitance ratio $\frac{C_J \text{ when } V_R = 2V}{C_J \text{ when } V_R = 20V}$	from3.0 to10.0	f = 1MHz
Nominal tuning range (V)	2 to 20	
Gamma value γ	Available in 2 ranges: constant gamma = 1.0 (DC4600 series) constant gamma= 1.25 (DC4700 series)	extrapolated from C-V plot

DC4600 Series - CONSTANT GAMMA VALUE 1.0

Type Number	DC4601-4	DC4602-3	DC4603-2	DC4605-2	Test Conditions
Outline number	00	00			
Quality factor Q	138	94	73	61	V_R = -4V f = 1 GHz
Quality factor Q	2700	1800	1400	1200	V_R = -4V f = 50 MHz
Breakdown voltage V_{BR} (V)	20 Min.	20 Min.	20 Min.	20 Min.	I_R = 10µA
Total capacitance C_J (pF) when V_R = 4V	0.86	1.30	2.2	3.5	f = 1 MHz V_R = -4V
Gamma value γ	1.0	1.0	1.0	1.0	from C-V plot
Capacitance ratio $\frac{C_J \text{ when } V_R = 2V}{C_J \text{ when } V_R = 20V}$	7.8	7.8	7.8	7.8	f = 1 MHz V_R = -4V

DC4700 Series - CONSTANT GAMMA VALUE 1.25

Type Number	DC4702-3	DC4703-3		Test Conditions
Outline number	00	00		
Quality factor Q	80	74		V_R = -4V f = 1 GHz
Quality factor Q	1000	1500		V_R = -4V f = 50 MHz
Breakdown voltage V_{BR} (V)	>20 Min.	>20 Min.		I_R = 10µA
Total capacitance C_J (pF) when V_R = 4V	1.0	1.5		f = 1 MHz V_R = -4V
Gamma value γ	1.25	1.25		from C-V plot
Capacitance ratio $\frac{C_J \text{ when } V_R = 2V}{C_J \text{ when } V_R = 20V}$	9.9	9.9		f = 1 MHz V_R = -4V

TYPICAL EXAMPLES OF DIODES AVAILABLE

Type Number	Quality Factor Q	Quality Factor Q	Breakdown Voltage V_{BR} (V)	Junction Capacitance C_J (pF)	Gamma Value	Capacitance Ratio C_{J2}/C_{J20}
DC4600-4	130	2600	20	0.4	1.0	7.8
DC4601-4	138	2700	20	0.86	1.0	7.8
DC4602-3	94	1800	20	1.3	1.0	7.8
DC4603-2	73	1400	20	2.2	1.0	7.8
DC4605-2	61	1200	20	3.5	1.0	7.8
DC4702-3	80	1600	20	1.0	1.25	9.9
DC4703-3	74	1500	20	1.5	1.25	9.9
Test conditions	V_R = -4V f = 1 GHz	V_R = -4V f = 50 MHz	I_R = 10µA	V_R = -4V f = 1 MHz	–	-2 to -20V f = 1 MHz

1. All measures are of diodes mounted in outline 00. the electrical characteristics of varactors inother packages will be very similar with slightly better capacitance ratios due to lower parasitics.

2. Q is measured directly at 1 GHz and extrapolated to 50 MHz by means of relation:

$$Q(f_2) = \frac{f_1}{f_2} Q(f_1)$$

3. C_T is the total packaged capacitance of the diode and is the vector or real sum of the junction capacitance C_J and the package capacitance C_P.

4. Varactors are available with C_J within the ranges shown above. Customers may wish to further specify C_J. Their chosen value could then be guaranteed to ±10%.

5. Gamma values are constant over range 2 to 20 volts and have the following tolerances:

Gamma Value	Tolerance Range
= 1.0	From 0.90 to 1.13
= 1.25	From 1.13 to 1.40

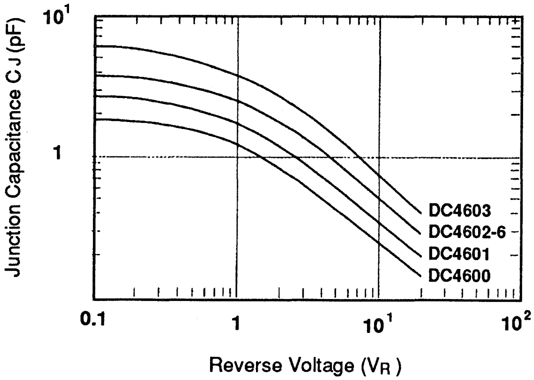


Figure 1. Typical Junction Capacitance vs. Reverse Bias Voltage

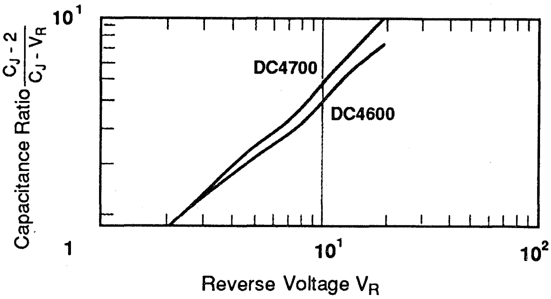


Figure 2. Typical Capacitance Ratio vs. Reverse Bias Voltage

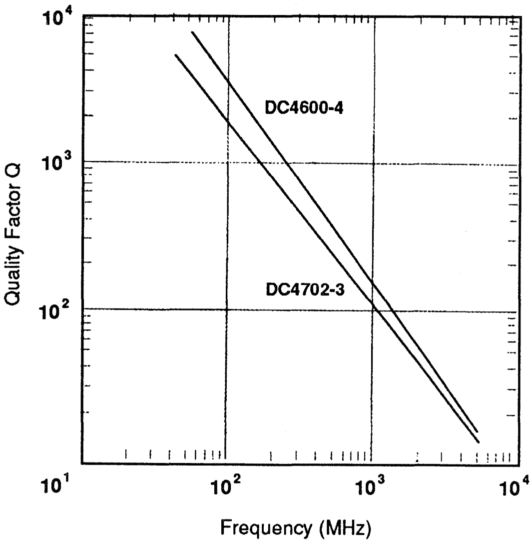


Figure 3. Typical Quality Factor vs. Frequency Measured at $V_R = -4V$

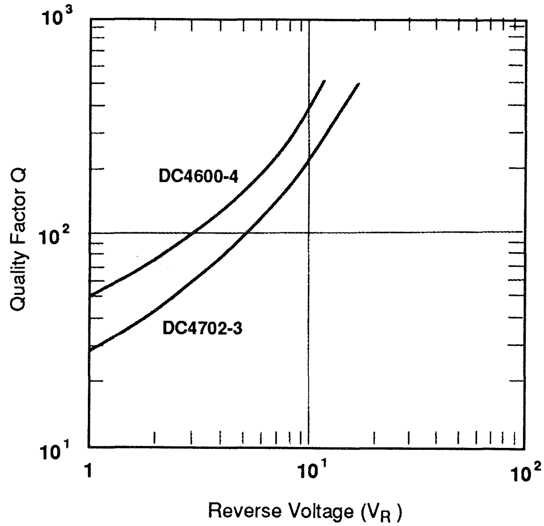


Figure 4. Typical Quality Factor vs. Reverse Bias Voltage at 1GHz

ADDITIONAL DESIGN DATA

Abrupt junction varactors have uniform epi-layer doping; as a consequence Gamma is constant and approximately equal to 0.5. For hyperabrupt junctions, the concentration of impurities increases towards the junction (Figure 5) resulting in a Gamma value >0.5 and a larger capacitance change.

By using molecular beam epitaxy techniques the imputity concentration profiles can be carefully controlled to produce devices with constant Gamma. Figure 6 shows how Gamma is derived from a typical C-V plot.

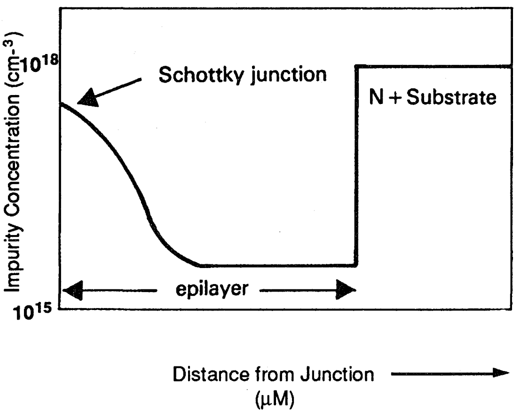


Figure 5. Hyperabrupt Junction

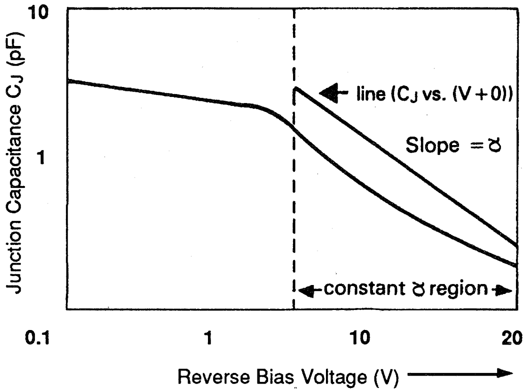


Figure 6. Determination of Gamma

CAPACITANCE LAW AND CONSTANT GAMMA

The junction capacitance, C_J, at an applied voltage, V for a varactor is given by:

$$C_J(V) = K\left(\frac{N}{V+\phi}\right)^{\gamma}$$

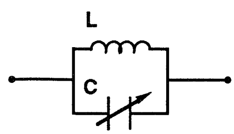
Where N = Doping level of epi-layer
ϕ = Built in junction potential (1.34V for GaAs)
γ = Slope exponent of C-V curve
K = Constant

To calculate a figure for total packaged capacitance C_T add the relevent package capacitance.

SELECTION OF GAMMA FOR LINEAR TUNING

For a simple resonant circuit,

$$f_{resonant} = \frac{1}{2\pi\sqrt{LC}}$$

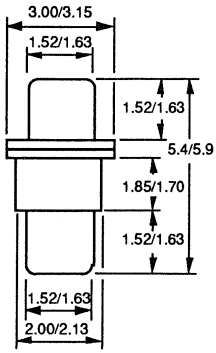


As stated previously C α $1/V^{\gamma}$ hence linear tuning with voltage will be achieved when Gamma = 2. However, for most practical applications there will be an additional series capacitance due to other circuit elements, parasitics, etc. There may also be a decoupling capacitance designed to improve circuit Q. This added capacitance has the added effect of lowering the optimum Gamma for linear tuning. As a general guide circuits with narrow tuning bands have an optimium Gamma of about 1.0, whereas Gamma values of about 1.25 are required for tuning over a wider frequency range.

OUTLINE DRAWINGS

These hyperabrupt tuning varactors are available in chip or packaged forms to suit a variety of circuit requirements. Examples are shown below:

Dimensions in mm



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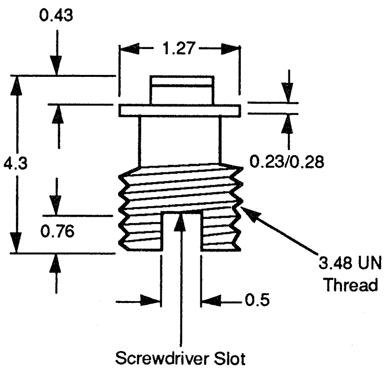

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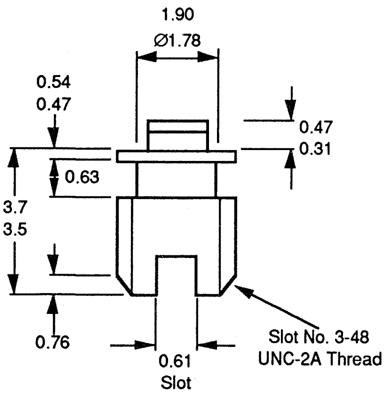

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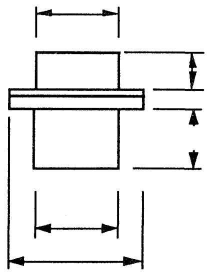


155

CT3513-1.2 August 1992

GUNN DIODES - INTRODUCTION

INTRODUCTION

1.1. Basic Gunn Diode Action

The variation of current with field for a perfect two terminal gallium arsenide device is shown in simplified form in Fig.1.

Below the saturation field E_s, the device acts as a passive resistance. However, above E_s the current decreases as the field increases producing a 'Negative Differential Resistance' (NDR).

Above the high field E_H, the current increases with field and the device behaves as a passive resistance again. This NDR characteristic is due to the special conductance band structure of n-type gallium arsenide as shown in Fig.2 (overleaf).

There are two energy levels A and B—also known as Valleys—with the following properties:

(1) In the lower valley A, electrons have a smaller effective mass and very high mobility μ_1.

(2) In the upper valley B, electrons have a larger effective mass and very low mobility μ_2.

(3) The two valleys are separated by a small energy gap ΔE.

(4) At very low fields $E < E_s$, most electrons are in the lower valley. At very high fields $E > E_H$, most electrons are in the upper valley.

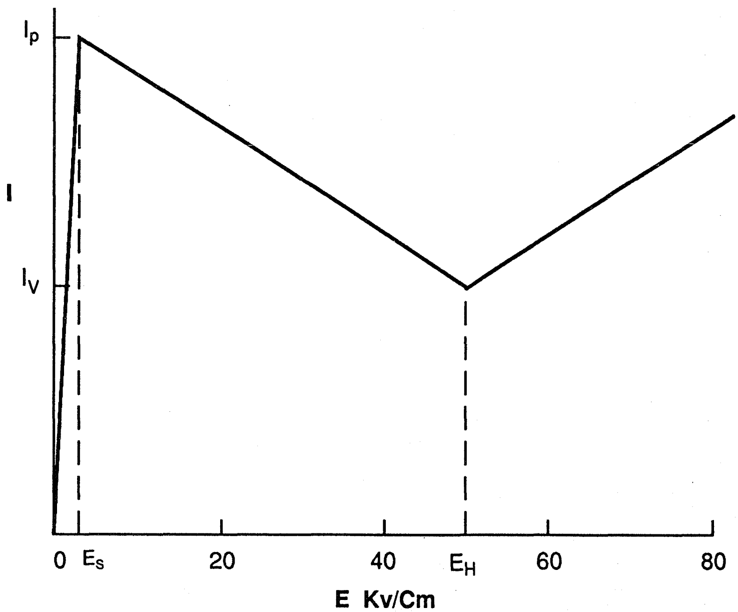


Figure 1. Simplified current versus field characteristic of GaAs device

At moderate fields E, both valleys will be populated by electrons. Then the average mobility ,μ is given by -

$$\mu = \frac{n_1 \mu_1 + n_2 \mu_2}{n_1 + n_2}$$

Where n_1 = Electron density in valley A at field E
n_2= Electron density in valley B at field E
and $n_1 + n_2 = n_O$= total number of electrons.

From these properties of GaAs material it can be seen that above a critical field E_s, which is determined by the energy gap ΔE, the device will produce a Negative Differential Mobility i.e. decreasing mobility with increasing field. For n-type gallium arsenide, E_s is about 3.2 x 10^3 V/cm which is much below the breakdown voltage.

1.2. The Transit Time Mode

This is the basic diode oscillation mode and is independent of the external circuit.

The cathode is a major plane of inhomogeneity in commercially available Gunn devices. As the applied voltage increases the field in the device increases. However in the vicinity of the cathode, the field is slightly higher and reaches the critical field E_s before the rest of the device. Electrons there jump to the higher valley and slow down. These slow electrons pile up together leading to an accumulated layer of electrons. Just in front of this layer the field is low and electron velocity high.

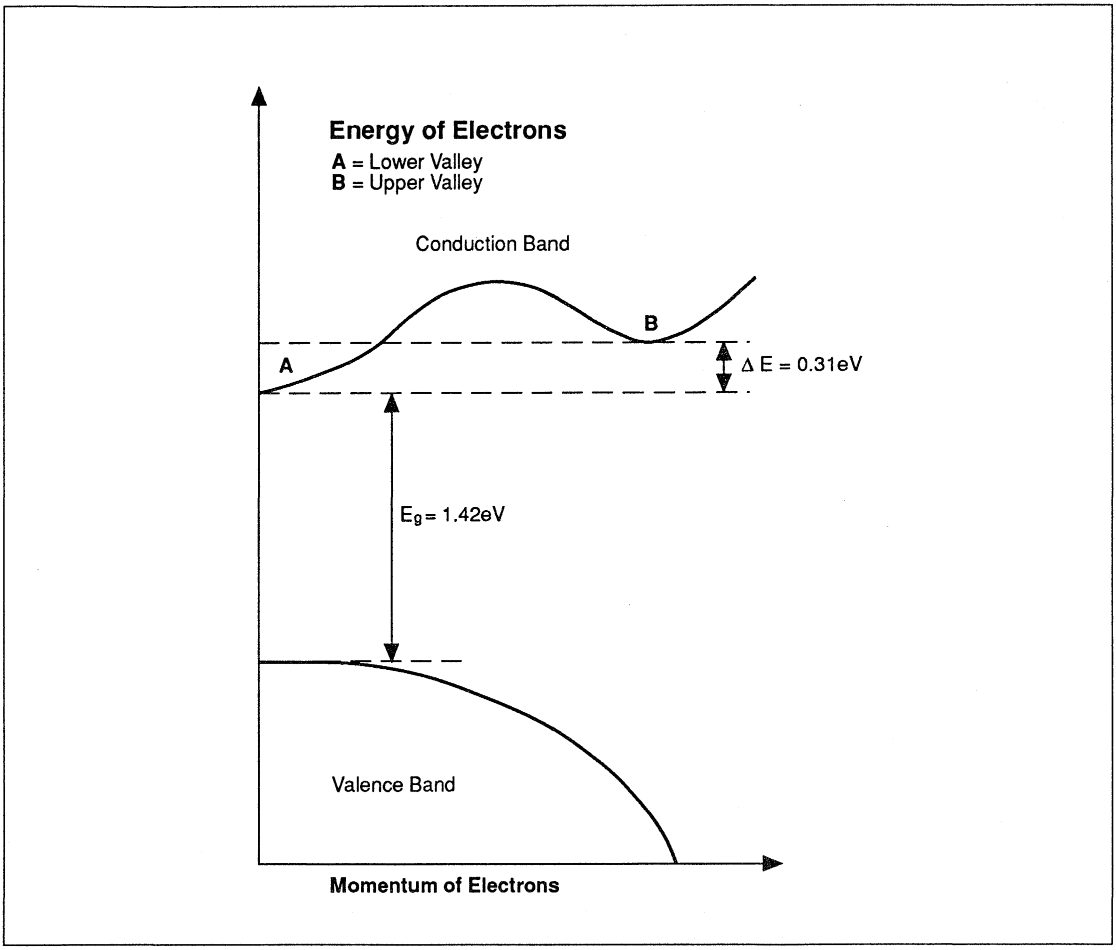


Figure 2. A schematic representation of GaAs band structure

These fast electrons leave behind a depleted layer of electrons. These accumulated and depleted layers of electrons constitute a dipole domain in which the field is high. This high field grows at the expense of the field in the rest of the device. Under the influence of the applied voltage the dipole domain - also known as High Field Domain - detaches itself from the cathode and travels towards the anode at a constant velocity (Fig. 3.).

While this domain is in transit the device current is constant. On arriving at the anode the dipole will discharge leading to a momentary rise in current. While this domain is decaying at the anode the field in the rest of the device will rise again towards E_s. A new domain will nucleate at the cathode as before and the whole process will repeat itself. (Fig.4.)

The period of repetition is the Transit Time of the dipole domain given by—

$$T_t = \frac{L}{V} \qquad \text{...........(1)}$$

Where L = length of the device
V= velocity of the domain

This leads to an important parameter - the Transit Time Frequency of the device given by -

$$f_t = \frac{1}{T_t} = \frac{V}{L} \qquad \text{...........(2)}$$

This mode of operation is the Transit Time Mode and was first observed by J. B. Gunn. Hence the name Gunn device. The main characteristics of this mode are -

(1) Total electric field across the device at any time is above the saturation field—(Fig. 4.) (overleaf)

(2) Current waveforms consist of narrow spikes indicating high harmonic content and low efficiency at fundamental frequency.

(3) RF field across the device is small indicating low impedance.

(4) Transit time frequency is a strong function of operating voltage and temperature.

The transit time mode therefore has poor stability and efficiency.

1.3 The Delayed Domain Mode

Better efficiency and stability can be achieved by operating the Gunn device in the Delayed Domain Mode. Fig. 5 shows the basic voltage and current wave shapes for this mode of operation.

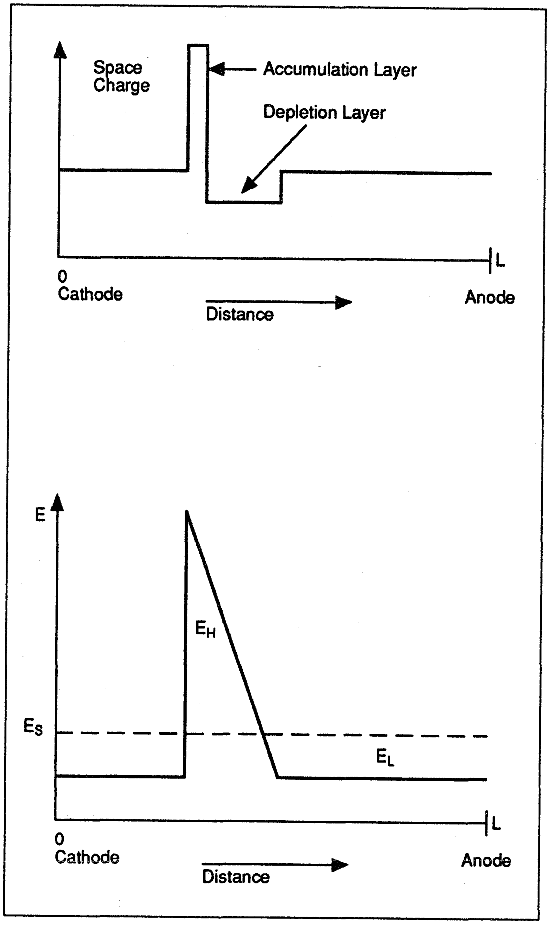


Figure 3. Space charge and field distribution within a device with a domain

Unlike the Transit Time Mode, over a part of the RF cycle, the total electric field across the device is below the critical field E_s, during which no fresh domain can nucleate. As soon as this field rises above E_s, a new domain nucleates at the cathode and travels across the device. When this field is about to swing below E_s, the domain just arrives at the anode and decays its charge, but a new domain cannot start at the cathode until the field rises above E_s again. This delay time between extinction of a domain and the formation of a new domain modifies the operating frequency to -

$$f_o = \frac{1}{T_t + T_d} \qquad \text{...........(3)}$$

Where T_t = transit time
T_d = delay time.

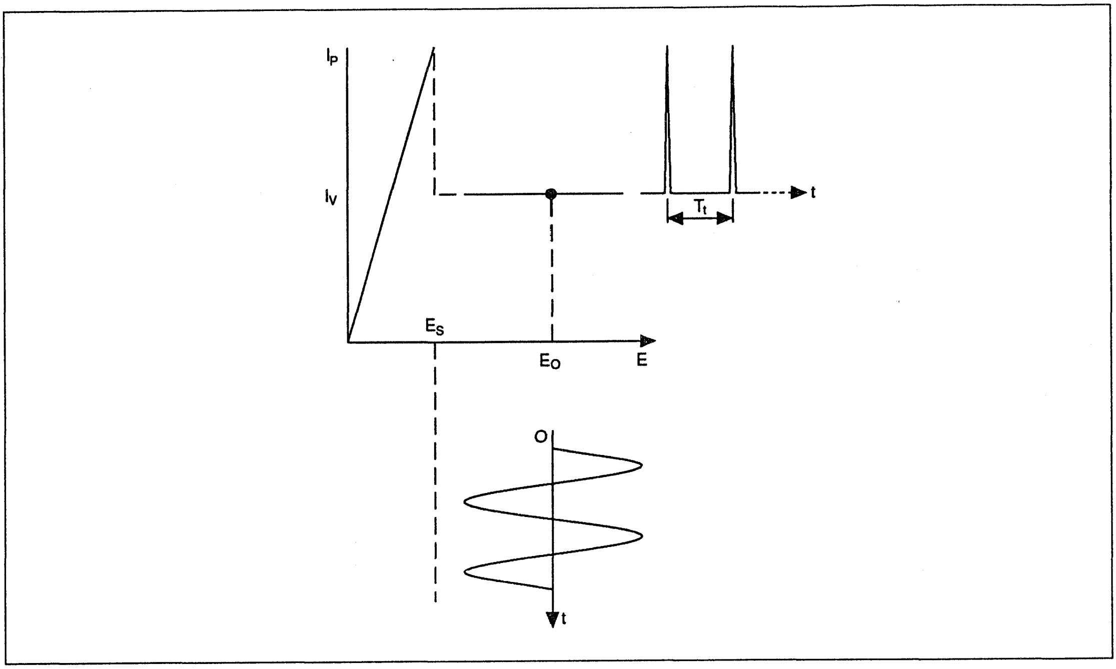


Figure 4. Current and field waveforms for transit time mode

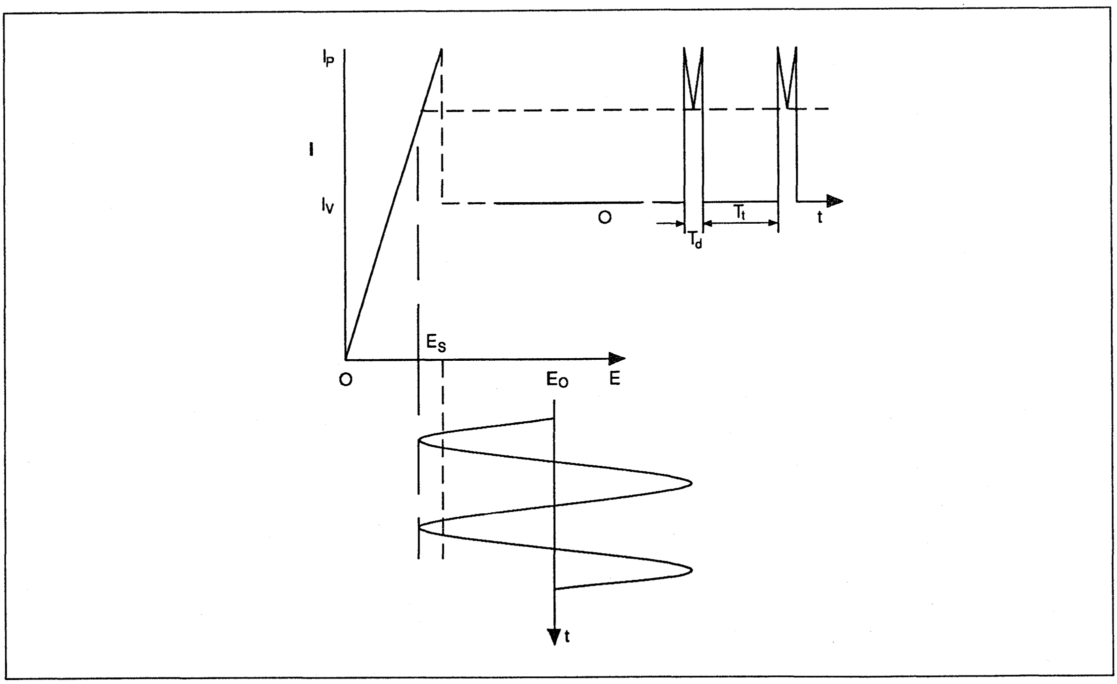


Figure 5. Current and field waveforms for delayed domain mode

The transit time is a fixed quantity for a given device but the delay time is a function of the RF voltage which in turn is determined by an external circuit It follows from equation (3) that the operating frequency is always below the transit time frequency

The important characteristics of this mode of operation are

(1) Total electric field across the device is below the critical field E_s over a part of the RF cycle (Fig. 5).

(2) Current waveforms consist of broad spikes indicating low harmonic content and higher efficiency at fundamental.

(3) RF field across the device is large indicating high impedance.

(4) Operating frequency is determined mainly by the resonant frequency of the external circuit and can be made very stable. Also a device can be used over a much broader bandwidth below the transit time frequency.

This mode is therefore most commonly used in the majority of commercial applications.

1.4. Other Modes

Three other modes of oscillation are also possible. These are the Limited Space Charge Accumulation (LSA) Mode the Quenched Domain Mode and the Hybrid Mode. The LSA mode is the most important of the three in having the greatest practical application but none are widely used commercially.

2. CONVENTIONAL GUNN DIODES

2.1 D.C. Parameters

The Gunn device is defined basically by five parameters.

- n — Doping concentration in the active region of the gallium arsenide.
- L — Thickness of the active region.
- R_o — Low field resistance of the diode measured at a very low current.
- I_s — Saturation current. This is the maximum current through the device and can exceed the operating current by as much as 50 percent. The power supply must be capable of passing through this point.
- V_s — Saturation voltage. The voltage at the current maximum.

V_s and I_s (Fig.6) are independent of the external circuit and may be measured with the diode in any mount. However since V_s is measured on the flat part of the curve the measuring technique must be specified carefully to avoid error.

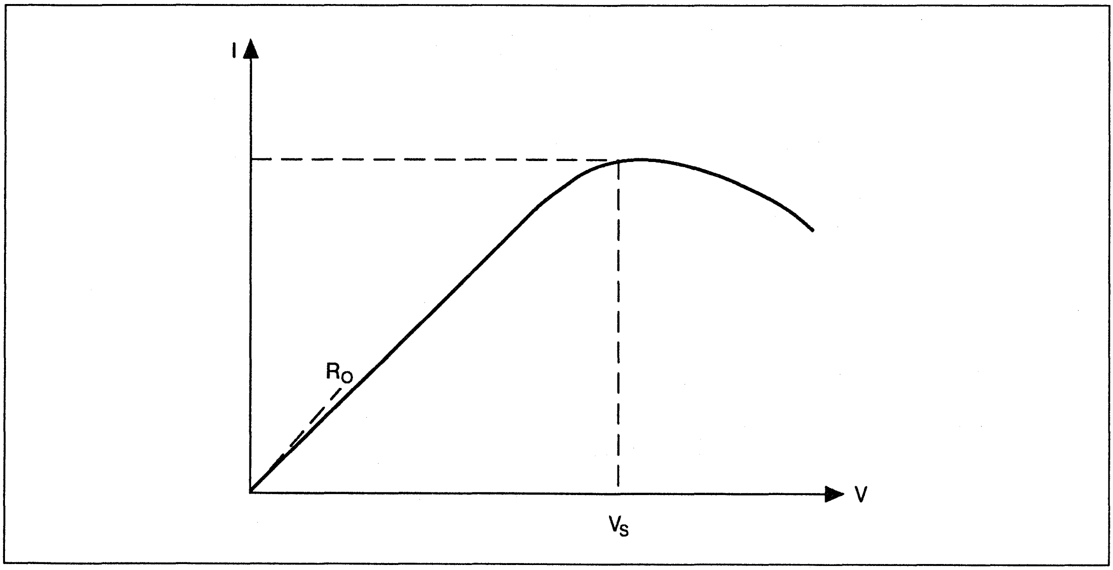


Figure 6. Current-voltage relationship for a Gunn diode

The nL product is also an important parameter in determining the life of the diode for a given stud temperature.

The equivalent circuit of the Gunn diode is given in Fig. 7 in simplified form.

The Gunn device pellet is represented by (-R) and C, L_e and C_e are the encapsulation inductance and capacitance. The ratio R/R_0 is an important design parameter.

The starting, or threshold voltage, must be well below the required operating voltage particularly when low temperature operation is required as the threshold voltage rises with falling temperature. This is controlled by the correct choice of n and L.

2.2 Frequency

The frequency of a Gunn diode is determined primarily by the doping and epitaxial thickness of the gallium arsenide. The carrier concentration and thickness of the epitaxial layer are combined in an empirical equation.

$$n \times L = 1 \text{ to } 2 \times 10^{12}\ \mathrm{cm}^{-2}$$

The thickness is determined by the frequency and hence the carrier concentration is defined.

2.3 Power

The output power is determined primarily by the area and the doping level. Low power diodes are mounted with the substrate on the pillar. Conventional mesa processing is used with an Ohmic metallised contact. The heat sink is positive and the top flange negative. At high powers, the chip is inverted to put the epitaxial layer adjacent to the heat sink giving the flip-chip construction. In this form the whole die area is used and this construction gives a negative heat sink and positive top flange.

The highest power / efficiency is achieved using an integral heat sink (IHS) construction. As with the flip-chip, this construction results in a positive top flange but has the advantage of a thick, gold plated heat sink formed directly onto the epitaxial region and a minimal thickness of remaining substrate, thereby reducing parasitic resistances. Further improvement in output power can be obtained at higher frequencies by the use of graded-gap current injected Gunn diodes (see section 3).

The upper limit on power is mainly determined by the amount of DC power that the encapsulation will take with the available heat sink area and the fact that the diode impedance becomes low and is difficult to match.

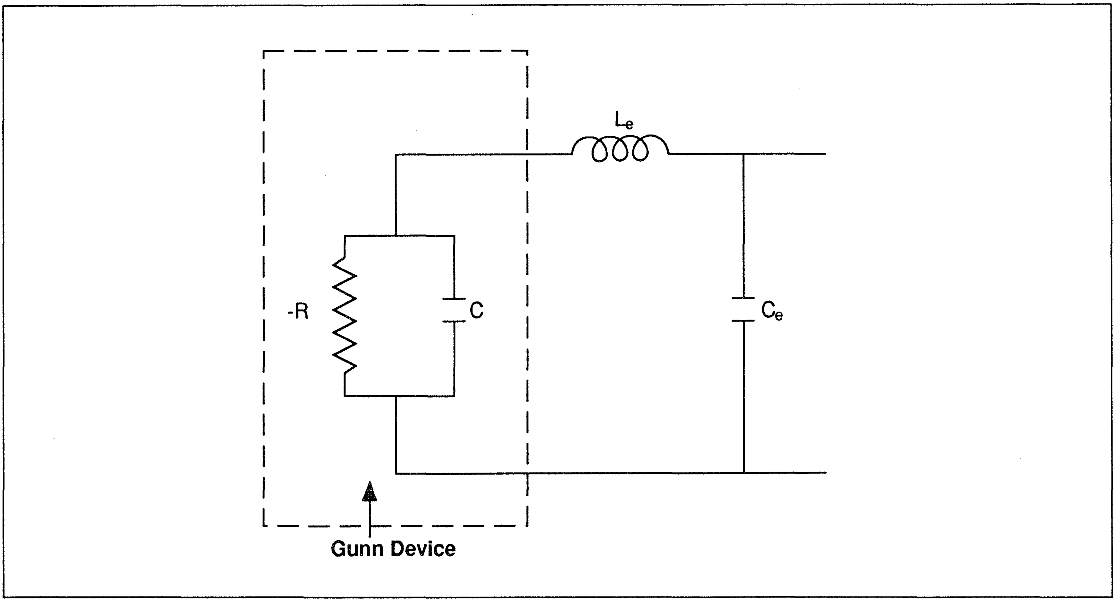


Figure 7. A simple equivalent circuit for a packaged Gunn device

2.4 Starting

The conventional Gunn diode is basically a broad band negative resistance device and random noise is required to start it. Starting thus becomes more difficult at low temperatures and in high Q cavities. This limitation can be overcome at higher frequency by the use of a graded-gap, current injected Gunn diode (see section 3).

2.5 Operating Current

In general, conventionally mounted devices are limited in current by the thermal resistance of the substrate and the copper heat sink in the body. The lower limit of current is more difficult to define because as the area of the contact decreases it becomes more difficult to produce a true ohmic contact and the series resistance caused by non-ohmic alloying increases non-linearly.

At the other extreme, inverted diodes can go up to very high currents with blown heat sinks.

2.6 High Temperature Operation

The standard range of Gunn diodes can be used up to a heat sink stud temperature of +70°C. At higher temperatures it is necessary to reduce the doping level in order to ensure long life. This affects other properties of the diode and may result in modification to other areas of the specification for diodes operating at temperatures greater than 70°C.

2.7 Low Harmonic Diodes

Diodes can be designed to meet low harmonic generation limits (if required by local regulations) by modifying the material specification. The extent to which the harmonics can be reduced, however, is limited by the cavity design and depends on the measurement technique.

2.8 Matching

The matching of the diode to the circuit is critical for output power, noise, smooth tuning and the power-temperature variation. Small differences may exist even between cavities which are nominally identical. Testing in the customer's own cavity design is always the preferred solution.

2.9 Broad-Band Operation

Diodes can be specially designed by modifying the material properties and controlling the encapsulation parasitics to give a broad-band tuning performance in a carefully defined cavlty. This is generally achieved at the expense of output power and efficiency.

2.10 Pulse Diodes

These diodes are even more cavity dependent than CW diodes.

Whereas in CW diodes as low a series resistance as possible is required,this is not true in pulse diodes. The constant re-nucleation of domains at the start of each pulse requires closer control of the field at the cathode and some non-ohmic series resistance is desirable. This also affects the noise performance of the diode.

Various methods of control are available including adding series resistance with a disc, partially alloying the contacts or adding Schottky contacts to the anode or cathode and degrading these either by heating or by shunting with a controlled ohmic contact. Each case offers advantages depending on the specification.

Frequency change during the pulse (chirp) is also affected by these measures as is the dF/dT with which it correlates.

Pulse diode noise is normally defined as the degradation in the Fourier sin x/x display of the RF power pulse from the ideal rectangular pulse values. The factors that control pulse noise and chirp are complex and the solution in any particular case is arrived at by modifications both to the diode processing and oscillator design.

2.11 FM Noise and dF/dT

A similar situation exists with CW diodes in that factors controlling FM noise and the frequency-temperature coefficient are complex and are resolved by work involving both the diode and the oscillator design. In both pulse and CW oscillators, the equivalent circuit of both the diode and the cavity form a total circuit concept and there is a trade-off between the parameters in each component. Oscillators and diodes need to be designed together to achieve given second order aspects of the specification.

In both pulse and CW diodes second order effects such as noise, chirp, dF/dT,etc, bear no direct relationship to the primary characteristics of frequency and power. The secondary parameters can show wide variation between diodes which in all other respects are identical in primary parameter performance. Lower sideband noise performance and much improved temperature stability can be achieved at higher frequencies by using graded-gap, current injected Gunn diodes (see section 3).

2.12 Effects of Special Conditions

In all cases where the optimum unique frequency and power material design parameters have to be modified to achieve some special condition of low or high temperature, restricted voltage or current, or broad-band tuning, then some loss of optimum performance results. There is always a trade-off to be made to meet a special operating condition.

2.13 Gunn Diodes for Wide Temperature Range and High Q Cavities

In general the life of a Gunn diode is longer the lower the operating voltage because, although the current decreases, after saturation, with increasing voltage, the total power dissipated and thus the heating in the epitaxial-layer continues to increase. In practice the voltage must not be less than twice the saturation voltage.

For a Gunn diode to work for long periods at elevated temperatures, it is necessary to choose a material with a lower carrier concentration than normal. This means that for the same current flowing through the device a larger chip is used and greater cooling is affected by the increased area of contact with the heat sink and the larger surface area for radiation.

For a Gunn diode to work successfully at low temperatures heating effects are not important, but domain generation becomes "frozen" and a higher starting voltage is required for coherent domain generation. To ensure that the device starts in the correct mode at low temperatures a material is chosen to have a "starting" voltage appreciably lower than the operating voltage. The "starting" voltage is the voltage at which the diode gives coherent power, in the correct mode and at the right frequency. This "starting" voltage is cavity dependant so it is preferable that the diode is measured in the cavity.

Conventional Gunn diodes are started by the residual noise level which is a function of the cavity Q and the degree of coupling between the diode and the noise field. A high Q cavity may not have sufficient residual noise to start the diode at the customers operating voltage. Thus high Q operation also means higher voltage operation for reliable starting (see section 3., Graded-gap Gunn diodes).

The Gunn diode is basically a current generator and needs matching into the circuit for the maximum transfer of energy (ie. efficiency) and for minimum noise. Mismatching a diode tends to put up the noise.

The impedance matching problem becomes increasingly critical as the cavity Q goes up. The impedance of the diode is determined to a first order by the thickness, doping and operating voltage. However, second order trimming can be obtained by varying the voltage to alter the domain width by field control and therefore the domain capacitance. Thus the voltage at which maximum power is obtained is cavity dependent. If the diode is not well matched to the cavity, however, there may be a conflict between the voltage giving the correct match and the voltage at which the diode would want to operate in a low Q cavity. Thus trimming the diode parameters becomes more critical as the Q goes up and the tolerances on material specifications become correspondingly tighter. It follows that it is more difficult to design a diode to work in a high Q cavity without having access to the cavity.

3. GRADED-GAP GUNN DIODES

3.1 Introduction

The design of microwave Gunn diodes has been traditionall based upon epitaxially grown n^+-n-n^+ structures with an n-type drift region sandwiched between two n^+ contact regions to which ohmic contacts are made (Fig 8 a). The operating frequency and efficiency are primarily dictated by the thickness and doping of the drift region.

As the systems requirements have become more stringent with higher frequencies and output powers demanded, these basic designs have reached the limits of their performance.

These are firstly that there is a rapid fall-off in power at frequencies above 60GHz where Gallium Arsenide (GaAs) Gunn diodes require the less efficient second harmonic component of the power to be utilised.

Secondly, and more importantly, the operation of GaAs devices over the temperature range (-45°C to +25°C) is severely restricted by the turn-on characteristics of the device (fig 9a). As the temperature is reduced, the "turn-on" voltage V_{on}, the point above threshold voltage at which coherent RF power is obtained, increases to the point where it equals the peak-power voltage, V_{pk}. This forces the diode to be operated at a higher voltage, with corresponding loss of power, reduced efficiency, poor FM sideband noise performance and the increased possibility of device failure at the excessive voltage.

A third consideration focusses on the method of accelerating the electrons at the cathode to enable transfer to the low mobility state. In n^+ -n-n^+ structures this acceleration is provided by the field in the drift region, resulting in a portion of this region which does not support domain formation. This "dead zone" may be as much as 0.25μm in a drift region of approximately 1.5μm in millimetric diodes and, since it acts as a parasitic resistance, results in reduced efficiency.

3.2 Hot Electron injection

One solution to the above problems is to tailor the electric field at the cathode. This can be achieved by using a hot electron injection technique, whereby very large electric fields are created inside the semiconductor by using built-in potentials. The advantages of this type of engineered structure are that the metal-semiconductor interface can be removed from the region of the high fields at the cathode, making the ohmic contact process less critical, and that the nucleation point for the accumulation layer can be fixed as a function of bias.

There are a variety of possible structures which can be used for hot electron injection, including a Schottky barrier, a planar-doped barrier (PDB) and a graded-gap AlGaAs injector. The Schottky barrier, while feasible in principle, returns us to the problems of metal-semiconductor interfaces and their associated processing difficulties. Modern growth techniques, such as molecular beam epitaxy, allow the design of both PDB's and graded AlGaAs injectors with a large degree of freedom (Figs 8 b and c).

To produce mmW power with as little bias dependance as possible the optimum injector shape has a slowly increasing potential with an abrupt drop back to the potential of GaAs. The statement of the ideal barrier shape for voltage independant electric field after the injector can be seen if a general triangular potential barrier is considered (see Fig 10).

For an arbitary triangular barrier potential of height Ø with arms length L_1 and L_2 the change in the barrier height due to an applied potential V, is $Ø_2 = Ø + L_2\, V/(L_1 + L_2)$. The electric field at the end of the arm L_2 (E_2) is approximately equal to $Ø/L_2 + V/(L_1 + L_2)$. The ideal condition for good 'turn-on' is for E_2 to be independant of V. This in turn requires L_2 to be as short as possible. This is best realised with a graded-gap injector.

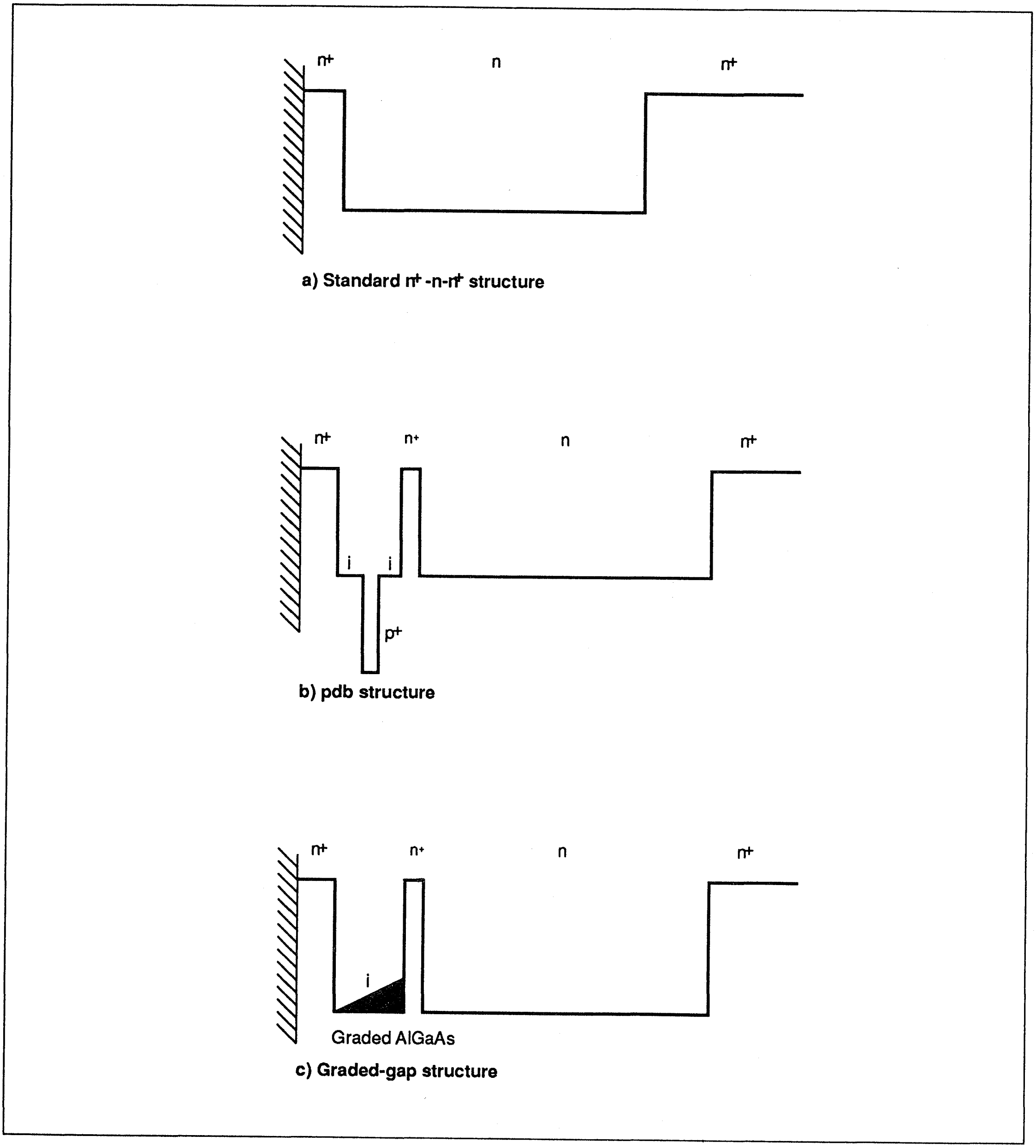
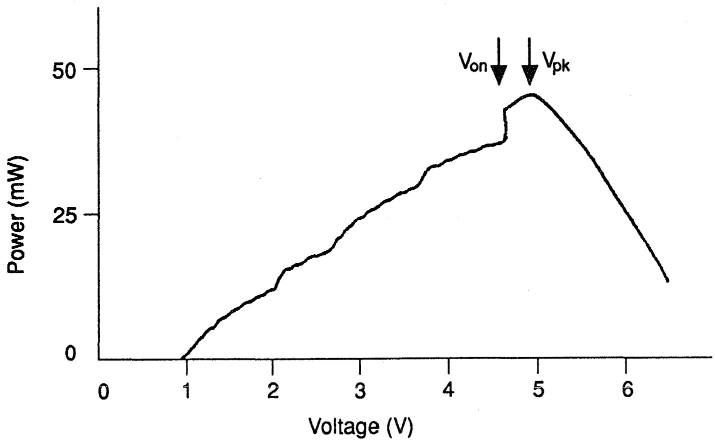
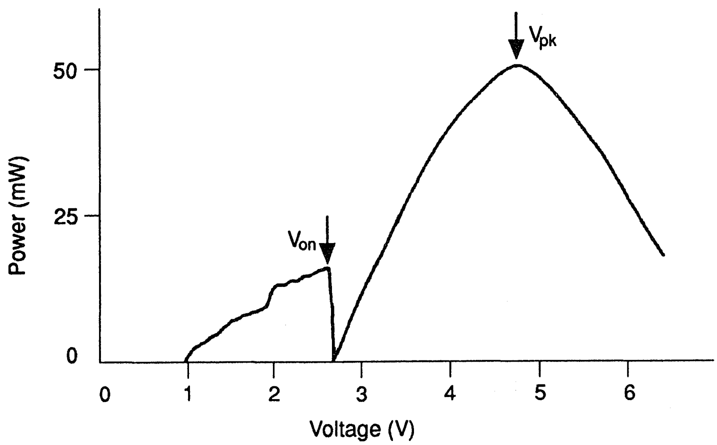


Figure 8

Turn-On characteristics



a) A standard structure



b) A graded-gap structure

Figure 9

Simulations have shown that a thin n^+ layer between the injector and the drift region is critical for controlling the electric field, while retaining the hot electron properties.

An additional benefit from using hot electron injection is the much improved temperature stability. This is due to the temperature of the electrons being set by the injection energy, typically equivalent to 2000K. Changes in the substrate temperature in the 130 degree range required for military specifications are relatively small in comparison.

3.3 Electrical Performance

The first parameters by which the injector performance may be assessed are the DC I-V traces. For a standard n^+-n-n^+ structure the curve exhibits a peak followed by a region of negative gradient; for a graded gap structure under forward bias the I-V trace has no peak, and the maximum current is reduced, Fig.11(a),(b). Injection at too high an energy will produce a curve with no peak but a region of positive gradient following the low-field characteristic, Fig.11(c).

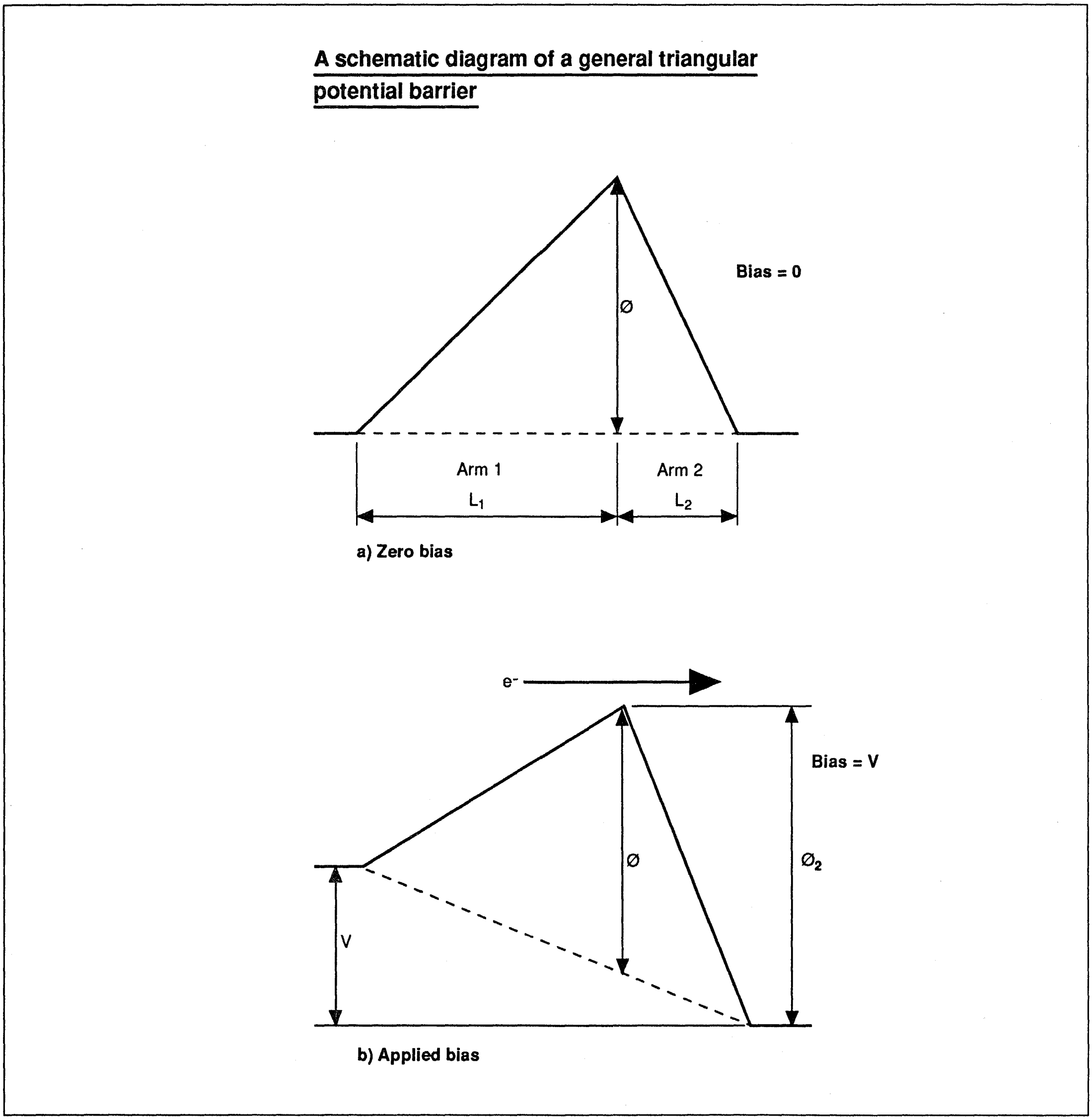


Figure 10

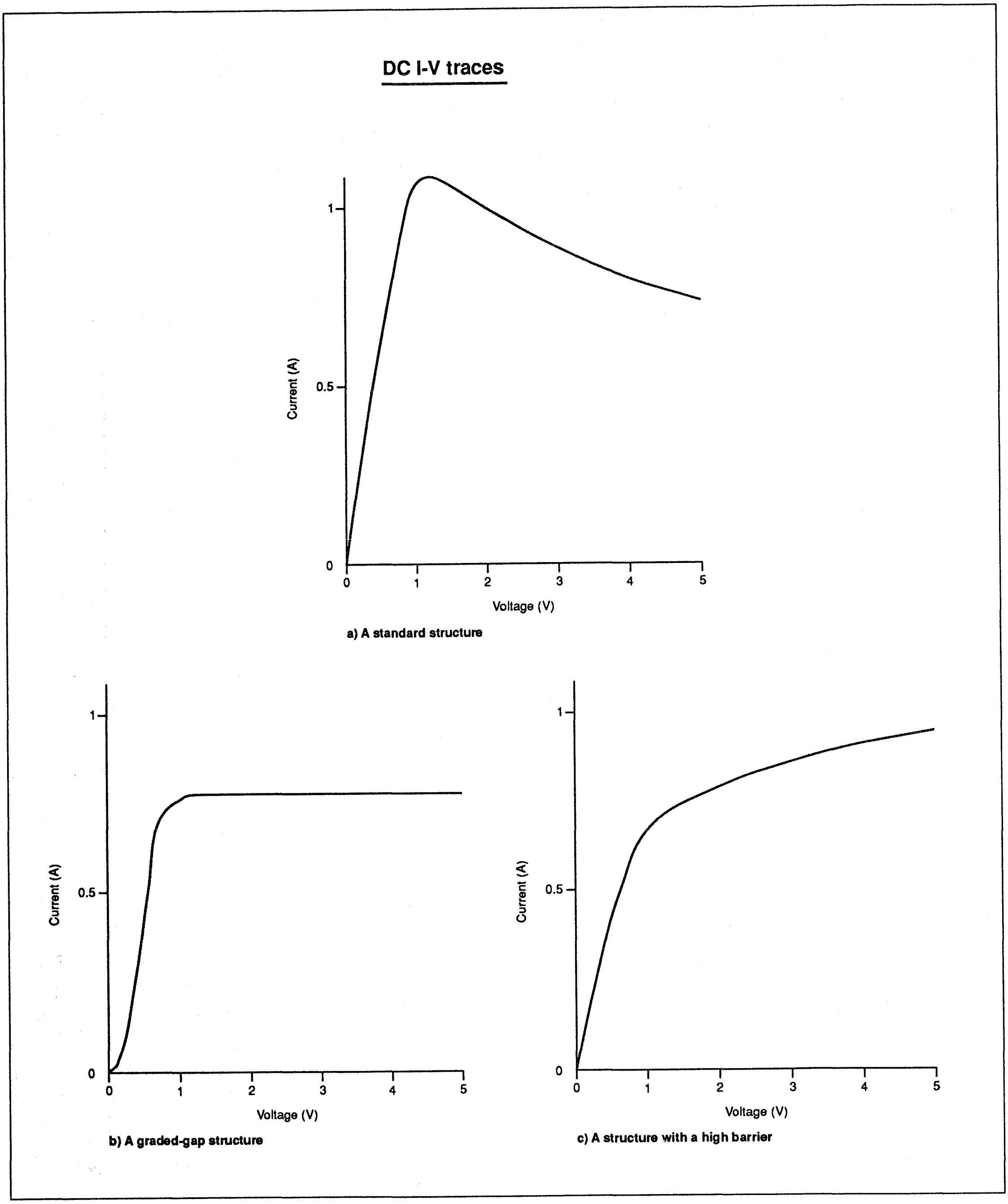

DC I-V traces
Current (A)
1
0.5
0
0
1
2
3
4
5
Voltage (V)
a) A standard structure
Current (A)
1
0.5
0
0
1
2
3
4
5
Voltage (V)
b) A graded-gap structure
Current (A)
1
0.5
0
0
1
2
3
4
5
Voltage (V)
c) A structure with a high barrier

Figure 11

RF performance has demonstrated powers at room temperature of up to 80mW at 90GHz and 2.4% efficiency; the best results achieved for mm-wave GaAs devices at this frequency. 50-60mW at 94GHz with efficiencies of 1.6% is achieved reproducibly (See Table 1). FM sideband noise is better than -80dBc/Hz 1OOkHz from carrier, equal to that obtained from the best standard devices. Significantly, these devices exhibit a turn-on voltage very close to threshold, Fig. 9(b), which allows coherent oscillations around peak power over the full military specification temperature range with none of the disadvantages detailed previously. Further evidence of the improved temperature stability can be seen from the power, frequency and peak-power voltage variation across this temperature range, generally a factor of two or more below that typically exhibited by devices without hot electron injection. This is an added bonus for VC0 designers who can then utilise a larger bandwidth since there is no longer need for compensation for frequency drift with temperature.

Table 1

Typical performance of Graded-gap GaAs Gunn diodes

Freq (GHz)	**Temp (°C)**	**Von (V)**	**Vop (V)**	**Iop (mA)**	**Power (mW)**	**Eff (%)**	**Noise (dBc/Hz)**
90	-40	3.9	4.9	680	58	1.75	
90	+25	3.2	4.7	660	50	1.6	-86
90	+80	3.1	4.8	640	42	1.4	
94	+25	3.0	4.5	600	60	2.0	-88
60	+25	3.0	4.5	600	120	5.0	-90
35	+25	3.0	4.5	1300	350	5.5	-95

GEC PLESSEY
SEMICONDUCTORS

DS3420-1.2 August 1992

DC1270/1220 Series

MILLIMETRE WAVE GUNN DIODES STANDARD AND GRADED GAP

The introduction of the DC1270/DC1220 Series extends the range of high power standard and graded-gap GaAs CW Gunn diodes further into the millimetre wave frequency band.

All diodes are housed in low parasitic outline 106, to ensure good high frequency operation. An integral heatsink (IHS) structure guarantees low thermal impedance to achieve improved power dissipation and effiency. The epitaxial layers are tailored to give the required frequency of operation in either the fundamental or second harmonic mode.

A custom service is available to handle customers' special requirements.

APPLICATIONS

These devices are ideally suited for use as low noise millimetre wave sources. They can be used in local oscillators, phase-locked and locking oscillators for application in FM-CW RADAR transceivers and point to point communication links in low or medium power transmitters. The wideband negative resistance of a Gunn diode enables it to be used in voltage controlled and mechanically tuned oscillator cicuits. They are also used in broadband oscillators as test bench sources.

The devices are available with either polarity heatsink, but generally are supplied with the heatsink as cathode.

FEATURES

- **Low FM and AM noise characteristics**
- **High efficiency**
- **Fixed frequency or wideband applications**
- **Range of power outputs**
- **High reliability**
- **Custom designs**
- **MIL-STD temperature operation**

LIMITING CONDITIONS OF USE

V_O Operating Voltage DC1276, DC1277 DC1278, DC1279	 8V Max. 8V Max.	 see Note 1 -
V_R Reverse Voltage (V_R)	1V Max.	-
T_O Operating Temperature Range (stud)	-40° to +85°C	see Note 6
T_{stg} Storage Temperature Range	-55° to +150°C	-

TYPICAL ELECTRICAL CHARACTERISTICS at T_{amb} = 25°C

Type Number	Outline Note 3	Frequency Band (GHz) Note 5	Minimum Output Power (mW) Notes 5, 6	Typical Operating Voltages (Volts) Note 1	Typical Operating Current (mA) Note 2
DC1276F	106	26-40	50	5.0	700
DC1276G	106	26-40	100	5.0	800
DC1276H-T	106	26-40	200	5.0	900
DC1277D-T	106	40-60	20	3.5	350
DC1277E-T	106	40-60	30	3.5	400
DC1277F-T	106	40-60	50	3.5	500
DC1277G-T	106	40-60	100	3.5	700
DC1278D	106	60-75	20	6.0	600
DC1278E	106	60-75	30	6.0	650
DC1278F	106	60-75	50	6.5	700
DC1279B	106	75-110	10	5.0	550
DC1279C	106	75-110	15	5.0	600
DC1279D	106	75-110	20	5.0	650
DC1279E	106	75-110	30	5.0	700
DC1277F-T	106	75-110	50	5.0	700

NOTE: DC1220 Series diodes are supplied to the same specifications as the DC1270 Series, but with opposite heatsink polarity. This does not apply to the DC1277G-T and DC1279F-T (graded gap) devices, which operate cathode negative only. See Note 8

NOTES:

1. A standard low impedance constant voltage power supply is recommended for driving these devices.
2. The power supply must be capable of supplying the saturation current, as indicated in Figures 1a. and 1b. A value of 1.5 times the operating current as maximum power supply rating should give an adequate margin.
3. The required operating frequency must be specified when ordering.
4. The package parasitics are typically 0.18pH and 0.10nH.
5. Diodes are tested for fundamental operation in a reduced height post-coupled activity.

   Diodes are tested for second harmonic operation in a full height radial-disc-coupled cavity.

   Diodes can be supplied to individual customer requirements, including testing in agreed cavities.
6. Typical variations of frequency and power with temperature are shown in Figures 2a. and 2d. An adequate heatsink must be provided so that the rated stud temperature is not exceeded.
7. Typical variations of power, P_{OUT} and effiency against operating frequency are shown in Figures 3a. and 3b.
8. The graded gap version (denoted by T) offers superior stability performance where low $\frac{df}{dt}$, $\frac{df}{dv}$ and cold start turn on are a premium.

   Added features being higher power and efficiency together with low FM/AM noise.
9. For variations of graded gap diodes other than those listed in the electrical specification, custom designs are available.

TYPE NUMBER SELECTION

The minimum 7 digit type number must be quoted to fully define the device. Please note the following selection process.

(a) All type numbers are prefixed DC12.

(b) Digit 5 specifies polarity.

(c) Digit 6 specifies frequency band and mode of operation.

(d) Digit 7 specifies minimum power output (mW)

(e) Digit 8, where applicable, specifies a graded-gap type Gunn diode.

D	C	1	2				

Polarity	Frequency Band Operation Mode (GHz)	Minimum Power Output (mW)	Graded Gap Type Diode
7 = heatsink negative 2 = heatsink positive	6 = fundimental 26-40 7 = fundamental 40-60 8 = 2nd harmonic 60-75 9 = 2nd harmonic 75-110	A = 5 B = 10 C = 15 D = 20 E = 30 F = 50 G = 100 H = 200	Denoted by 'T'

TYPICAL PERFORMANCE

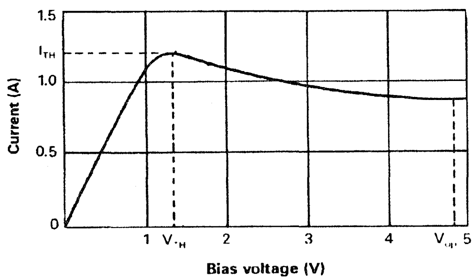


Fig.1a Typical DC Characteristic, Standard Gunn Diode

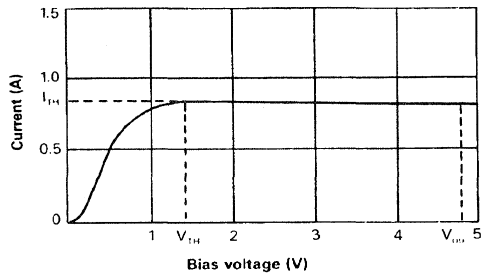


Fig.1b Typical DC Gunn Diode Characteristic, Graded-Gap Gunn Diode

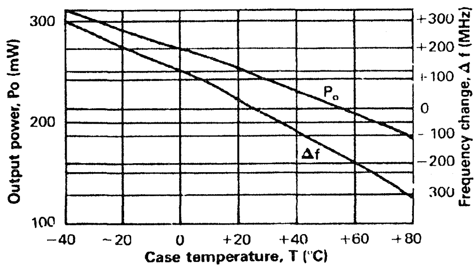


Fig.2a Variation of Power and Frequency with Temperature for a DC1276H Device Operating in the Fundamental Mode.

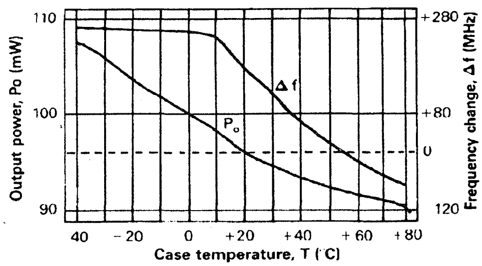


Fig.2b Variation of Power and Frequency with Temperature for a DC1277G-T Device Operating in the Fundamental Mode.

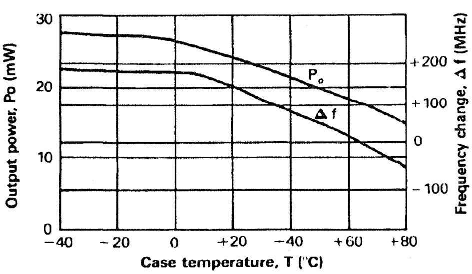


Fig.2c Variation of Power and Frequency with Temperature for a DC1279D Device Operating in the Second Harmonic Mode.

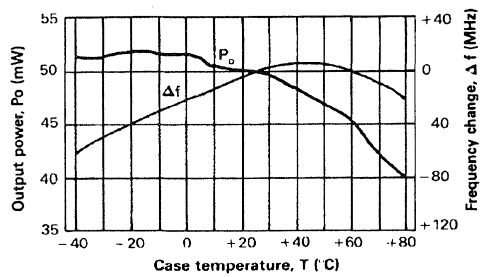


Fig.2c Variation of Power and Frequency with Temperature for a DC1279F-T Device Operating in the Second Harmonic Mode.

TYPICAL PERFORMANCE

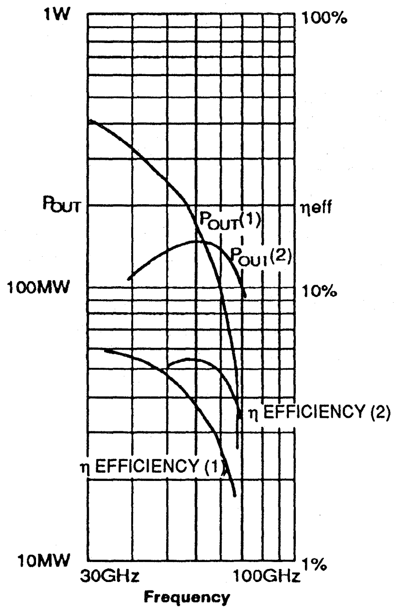


Fig.3a Variation of Power and Frequency for: (1) DC1276T and (2) DC1277 Series.

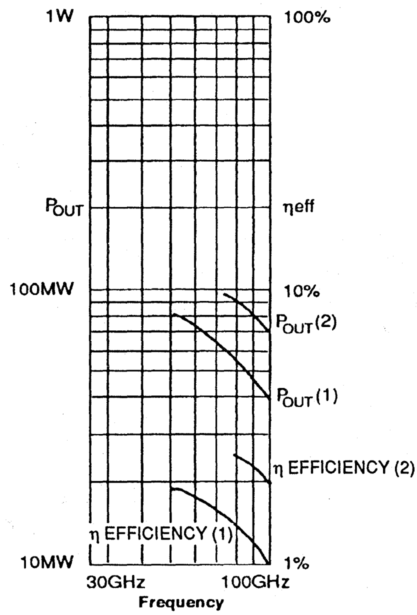
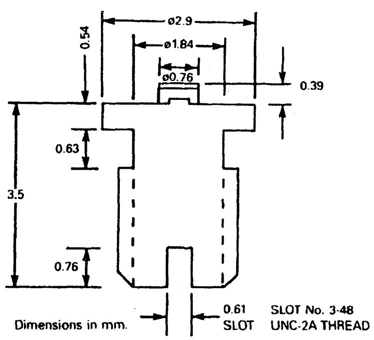
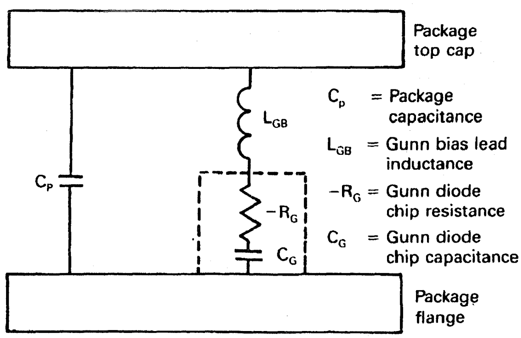


Fig.3b Variation of Power and Efficiency for: (1) DC1278 and DC1279 Series. (2) DC1279F-T Series.

OUTLINES AND DIMENSIONS



ELECTRICAL CONFIGURATION



DS3486-1.2 August 1992

DC1250/70/80 Series

HIGH POWER MICROWAVE GUNN DIODES

The DC1250 Series are gallium arsenide bulk effect devices for the generation of CW microwave power in the range 4GHz to18GHz depending on the cavity and diodes used. A screw base outline is available under the series type DC1280.

Similarly the DC1275 diode housed in low parasitic outline 86, generates CW microwave power in the range 18 to 26GHz.

A seperate data sheet is available for low power diodes and millimetric standard and graded gap diodes.

FEATURES

- **Low cost**
- **High reliability**
- **Output power in excess of 500mW at 12GHz**
- **Output power in excess of 300mW at 18GHz**
- **Output power in excess of 200mW at 26GHz**
- **Custom devices available**

LIMITING CONDITIONS OF USE

V_O	Operating Voltage		
	DC1253, DC1283	16V Max.	see Note 1
	DC1251, DC1281	10V Max.	-
	DC1252, DC1282	8V Max.	-
	DC1275	8V Max.	-
V_R	Reverse Voltage, i.e. top flange negative	1V Max.	-
T_O	Operating Temparature Range (stud)	-20° to +70°C	see Notes 2, 8
T_{stg}	Storage Temperature Range	-55° to +150°C	-

TYPICAL ELECTRICAL CHARACTERISTICS at T_{amb} = 25°C

Type Number	Outline Note 4	Frequency Band (GHz) Note 3	Minimum Output Power (mW) Note 5	Typical Operating Voltages (Volts) Notes 1, 6	Typical Operating Current (mA) Note 7
DC1251F	00	8-12	50	10.0	300
DC1251G	00	8-12	100	10.0	400
DC1251H	00	8-12	200	10.0	800
DC1251J	00	8-12	300	10.0	1200
DC1251K	00	8-12	400	10.0	1600
DC1251L	00	8-12	500	10.0	2000
DC1252F	00	12-18	50	6.5	400
DC1252G	00	12-18	100	6.5	400
DC1252H	00	12-18	200	6.5	900
DC1252J	00	12-18	300	6.5	1300
DC1253F	00	4-8	50	14.0	400
DC1253G	00	4-8	100	14.0	600
DC1253H	00	4-8	200	14.0	900
DC1275F	86	18-26	50	6.0	500
DC1275G	86	18-26	100	6.0	700
DC1275H	86	18-26	200	6.0	1000
DC1281F	40	8-12	50	10.0	200
DC1281G	40	8-12	100	10.0	400
DC1281H	40	8-12	200	10.0	800
DC1281H	40	8-12	300	10.0	1200
DC1282F	40	12-18	50	6.5	400
DC1282G	40	12-18	100	6.5	600
DC1282H	40	12-18	200	6.5	900
DC1288F	40	4-8	50	14.0	400
DC1283G	40	4-8	100	14.0	600
DC1283H	40	4-8	200	14.0	900

NOTES:

1. The recommended drive circuit is indicated in Fig. 1. Most commercial low impedance constant voltage supplies are suitable.
2. Diodes for wider temperature ranges can be supplied to special order.
3. The standard test frequency within the three lower frequency bands are 6.0, 9.5 and 15.0GHz respectively. The required operating frequency within the higher bands must be specified when ordering.
4. The package parasitics are:
   0.2pF and 0.6nH for outline 00, 0.35pF and 0.5nH for outline 40, 0.22pF and 0.16nH for outline 86.
5. Tested in a half wavelength low Q coaxial cavity. The output power will be less for an oscillator with a higher loaded Q and varactor tuning will further reduce the available power.

   Diodes can be tested in other agreed cavities to special order.

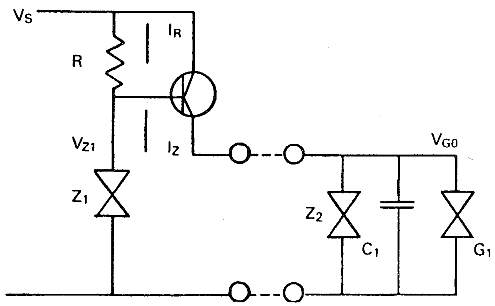
   A seperate data sheet covers low power diodes under the series type numbers DC1200 and DC1230.

NOTES (continued)

6. The variation of output and frequency with operating voltage is shown in Fig. 2 for typical X band diode. The variation of output power with frequency can be reduced by use of voltage tracking as shown in Fig. 3.
7. The power supply must be capable of supplying the saturation current as indicated in Fig. 4. A value of 1.5 times the operating current as a maximum power supply rating should give an adequate margin.
8. Typical variation of frequency and power with temperature is shown in Fig. 5. An adequate heat sink must be provided so that the rated stud temperature is not exceeded.

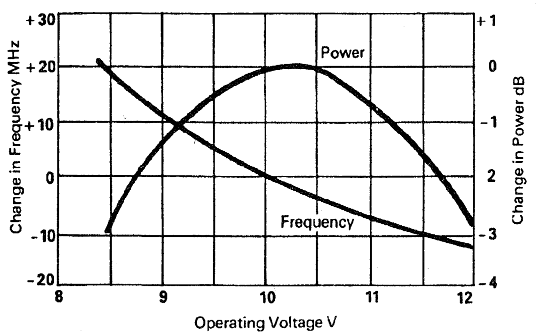
   In a high Q cavity, the temperature coefficient of frequency is almost directly dependent on cavity expansion. In an uncompensated waveguide cavity with a Q of about 200 the temperature will depend initially on the relative change of the match of the diode to the cavity but a reduction of up to 3dB can be expected at +70°C.

   Starting can become a problem in high Q cavities at low temperatures due to lack of system noise and diodes for this duty need to be supplied to special order.



I_R	$= I_B + I_Z$	C_1	$= 0.1\mu F$
I_B	$= \frac{I_{sat}}{h_{fe}}$	G	= Gunn diode
R	$= \frac{V_S - V_{Z1}}{I_R}$	Z_1, Z_2	= Zenner diode
V_{Z1}	$= V_{GO} + 0.7V$	V_{Z2}	$= V_G$ max.

Fig.1 Recommended Gunn Diode Drive Circuit



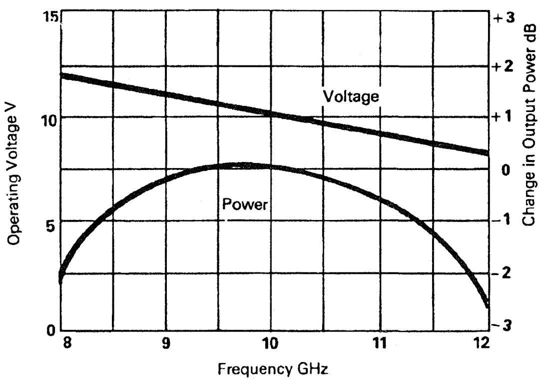


Fig.2 Variation of Output Power and Frequency with Operating Power.

Fig.3 Effect of Voltage Tracking on the Variation of Output Power with Frequency on a Wideband Tunable Waveguide Oscillator.

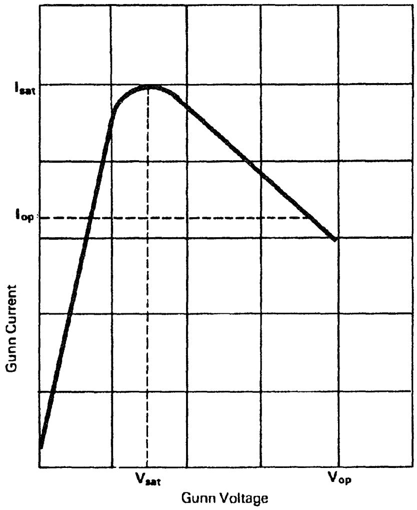


Fig.4 DC Gunn Characteristic

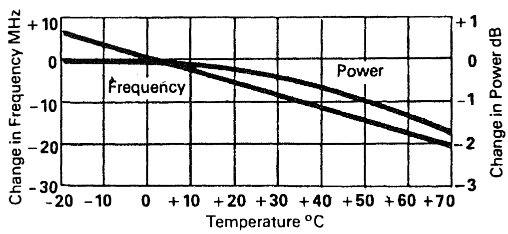
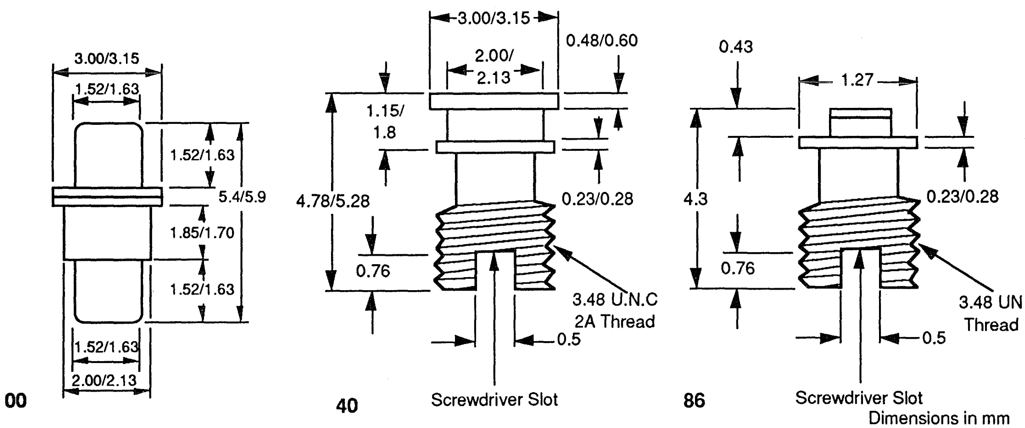


Fig.5 Variation of Frequency with Temperature.

OUTLINES AND DIMENSIONS

POLARITY

The top flange is positive. The diode wil be destroyed if the polarity is reversed. A low impedance constant voltage supply is required.



IMPATT DIODES - INTRODUCTION

Impatt diodes achieve their microwave frequency negative resistance by making use of the phase delay involved in the avalanche generation of electron hole pairs followed by the time taken for them to drift out of the depletion region. Considering the avalanche process first, the density of carriers grows more or less exponentially while the avalanche region voltage is above the breakdown value. In this way the carrier generation lags the applied voltage by around 90°. The bunch of charge carriers then drifts across the depletion region. As the electric field in the depletion region is high, the charge carriers move at their saturated drift velocity giving rise to a constant terminal current that lasts until the carriers get to the end of the drift zone. The current then falls to zero. Figure 1 shows idealised impatt waveforms.

As we see from the diagram, the charge must drift for half the period of the microwave oscillation, so the frequency band is determined by the device dimensions, in particular the depletion region width. The traditional single-drift type of impatt has a junction with one side much more heavily doped than the other e.g. p^+-n-n^+, so all the depletion extends into the more lightly doped material and only one carrier species produces a drift current. In a double-drift impatt p^+-p-n-n^+ the doping levels are not too different, giving rise to a depletion region extending on both sides of the junction. In this structure the holes drift through the depleted p-region and the electrons travel in the n-type.

A double drift diode has higher operating voltage and power because the single avalanche region is used to drive two drift zones.

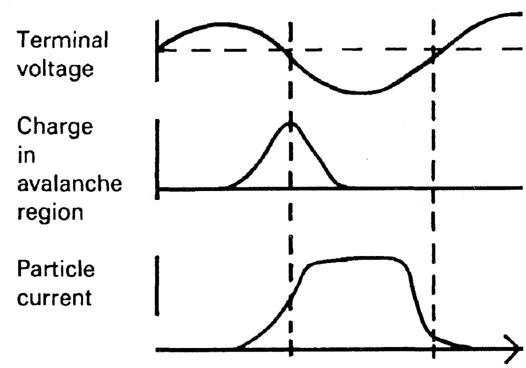


Figure 1

GEC PLESSEY
SEMICONDUCTORS

DS3419-1.2 August 1992

DC1152

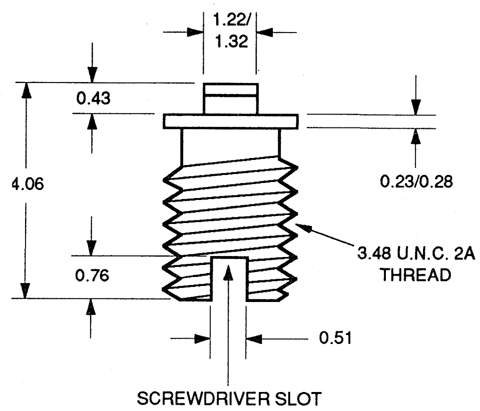
PULSED IMPATT DIODE

This double drift device uses flat profile silicon epi-layers combined with Cr-Pt-Au metalisation for high reliability, and electro-plated Au heatsinks. It is suitable for applications such as amplifiers and high power sources.

ELECTRICAL CHARACTERISTICS

Parameter	Min	Typ	Max	Units
Frequency Range:	31	-	38	GHz
Peak Power Output	15	20	-	W
Pulse Length	-	-	250	nS
Duty Cycle	-	-	1	%
Efficiency	-	4	5	%
Operating Voltage	-	55	-	V
Operating Current	-	14	-	A
Breakdown Voltage	-	40	-	V
Diode Capacitance	-	5.5	-	pF

OUTLINE DETAILS



DS3421-1.2 August 1992

DC1101/91

CW IMPATT DIODES

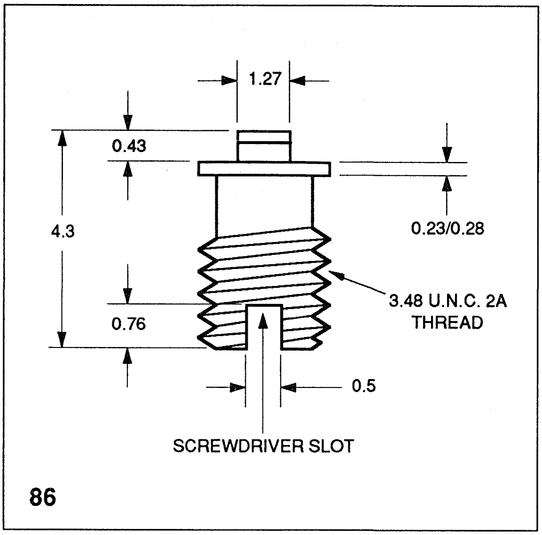
The DC1101and DC1191 are single drift Silicon Impatts for CW operation. The DC1101 optimised for use as an oscillator and the DC1191 as an amplifier. The devices use a flat profiled silicon epitaxial layer and incorporate Cr-Pt-Au metalisation, combined with Au electroplated heat sinks for high reliability.

ELECTRICAL CHARACTERISTICS

Parameter	Min	Typ	Max	Units
Frequency Range: DC1101	30	-	41	GHz
DC1191	34	-	36.5	GHz
Power Output	100	-	300	mW
Efficiency	-	6	8	%
Operating Voltage	-	28	32	V
Operating Current	-	100	120	mA
Breakdown Voltage	-	24	-	V
Diode Capacitance at Breakdown	-	0.4	-	pF
Thermal Resistance	-	-	51	°C/W

Package Parasitics: Lp, nH = 0.1
Cp, pF = 0.2

OUTLINE DETAILS



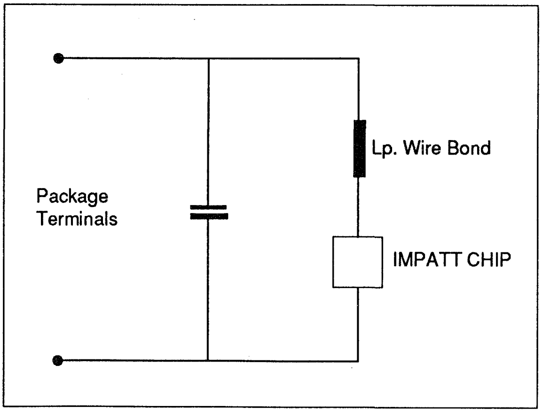


Figure 1

CT3441-2.2 August 1992

MNS CHIP CAPACITORS - INTRODUCTION

GPS Microwave provide a range of M.N.S. (Metal/Silicon-Nitride/Silicon) Chip capacitors for use in thick and thin film hybrid circuits, from VHF to millimetre wave frequencies. Typical applications are coupling/decoupling, DC blocking and as the capacitive tuning element in a filter, oscillator or matching network.

The MNS chips use silicon nitride dielectric upon a highly doped silicon substrate. This substrate acts as a carrier and its low restistivity (2mΩ.cm) minimises series resistance and reduces loss.

The nitride dielectric was chosen in preference to an oxide or a ceramic. The critical design considerations are very high insulation resistance, low dissipation factor and ruggedness. Silicon nitride offers excellent performance in these areas for microwave and millimetre wave applications, with low leakage/high insulation resistance (typically $10^{12}\Omega$) and a low dissipation factor. This low dissipation maximises the Q factor to give minimum losses.

The high dielectric breakdown strength of silicon nitride allows thin dielectric layers to be used. This, combined with the high dielectric constant, enables high capacitance values to be obtained with small chip sizes. The higher dielectric constant of a nitride capacitor enables it to have either a smaller size or a higher working voltage than its oxide counterpart.

The other major benefit of a nitride dielectric is the low temperature coefficient which gives minimum change in capacitance with temperature; a factor of particular importance for filter applications. Here a linear change over 100°C temperature range of 0.05% is offered, which compares favourably with the variation in excess of 20% typically offered by ceramic capacitors.

Custom chips are available for specific applications. One use is for the mounting of FET chips where the device requires to have its gate and drain bond pads on the same level as the alumina circuit, (see figures 1 and 2).

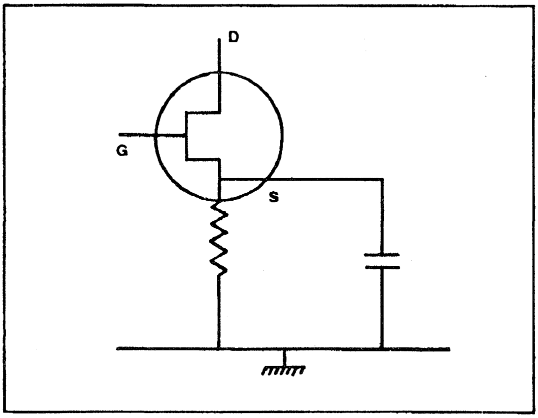


Figure 1. Schematic Layout

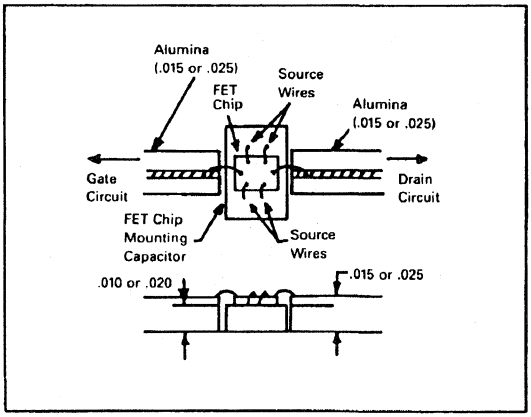


Figure 2. Board Layout

DS3412-1.2 August 1992

DC4400 Series

SILICON NITRIDE CHIP CAPACITORS

A range of Metal/Silicon-Nitride/Silicon (MNS) chip capacitors which compare extremely favourably with their ceramic counterparts.

Nitride dielectric ensures very low loss and excellent temperature stability. The chips are diamond sawn to give tight chip dimensions.

Custom units are available with respect to capacitance value, capacitance tolerance and chip dimensions.

FEATURES

- Extremely low loss, 0.1dB typical
- Excellent temperature stability, 50ppm/°C typical
- For use through 18GHz
- Low cost
- Rugged construction
- Custom units available
- 100% tested

LIMITING CONDITIONS OF USE

Maximum Working Voltage	50V*
Dielectric Withstand Voltage	100V
Operating Temperature Range	-55° to +150°C
Storage Temperature Range	-65° to +200°C

*NOTE These capacitors are tested to a dielectric withstand voltage of 100 volts. They can, therefore, be operated above the listed maximum working voltage. However, to ensure maximum reliability it is recommended that usage be within the stated limits.

APPLICATIONS

These components are suitable for use in thick or thin film cicuits as coupling, decoupling or DC break capacitors in filters, oscillators, amplifiers and matching networks.

HANDLING AND BONDING TECHNIQUES

Both pads are gold metallized. The bottom pad is suitable for attachement by solder preform, gold silicon eutectic or conductive epoxy. The top pad is suitable for lead bonding of gold tapes or wires using thermocompression or ultrasonic methods.

ELECTRICAL CHARACTERISTICS

At T_{amb} = 25°C

Type No.	Outline No.	Capacitance (pF)	Maximum Working Voltage (V)	Nominal Top Contact Size (mm)
DC4402	82B	2.2	50	0.10 square
DC4403	82B	2.7	50	0.11 square
DC4404	82B	3.3	50	0.13 square
DC4405	82B	3.9	50	0.14 square
DC4406	82B	4.7	50	0.15 square
DC4407	82B	5.6	50	0.16 square
DC4408	82B	6.8	50	0.18 square
DC4409	82B	8.2	50	0.20 square
DC4410	82B	10.0	50	0.18 square
DC4411	82B	12.0	50	0.20 square
DC4412	82B	15.0	50	0.22 square
DC4413	82A	18.0	50	0.30 square
DC4414	82A	22.0	50	0.33 square
DC4415	82A	33.0	50	0.40 square
DC4416	82A	47.0	50	0.48 square
DC4417	82A	56.0	50	0.52 square
DC4418	82C	68.0	50	0.57 square
DC4419	82C	82.0	50	0.63 square
DC4420	82C	100.0	50	0.70 square
DC4421	82C	120.0	50	0.62 square
DC4422	82C	150.0	50	0.70 square
DC4423	82D	180.0	50	0.93 square
DC4424	82D	220.0	50	1.03 square
DC4425	82D	330.0	50	1.26 square
DC4426	82D	470.0	50	1.23 square

NOTE:
1. Capacitance measured at 1 MHz.
2. Capacitance tolerance; ±20%.
3. Temperature coefficient; 50ppm/°C typical.
4. Closer tolerances available on request.

A strong in house custom capability is available to service clients' special requirements. The folowwing table details a representative selection of specially commissioned devices which are now available to order. For information on other variations please consult GEC Plessey Semiconductors' Sales Office.

ELECTRICAL CHARACTERISTICS

At $T_{amb} = 25°C$

Type No.	Outline No.	Capacitance (pF)	Maximum Working Voltage* (V)	Nominal Top Contact Size (mm)
DC4439	82E	22.0	50	0.32 square
DC4440	82E	33.0	50	0.32 square
DC4451	82F	4.7	50	0.15 square
DC4463	82B	22.0	20	0.15 square
DC4464	82B	27.0	20	0.16 square
DC4465	82B	33.0	20	0.19 square
DC4466	82B	39.0	20	0.20 square
DC4471	84B	82.0	50	0.86 x 0.30
DC4475**	84A	100.0	25	1.18 x 0.45

NOTE:
1. Capacitance measured at 1 MHz.
2. Capacitance tolerance; ±20%.
3. Temperature coefficient; 50ppm/°C typical.

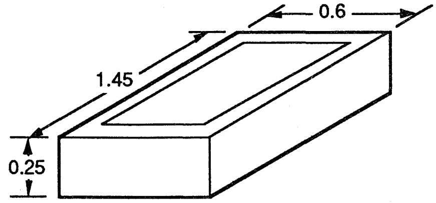
*These capacitors are tested to a dielectric withstand volage of twice the maximum working voltage. They can, therefore, be operated above the maximum working voltage listed. However, to ensure optimum reliability, it is recommended that usage be within the stated limits.

**This capacitor is designed as a FET chip mounting capacitor to suit 0.38mm (15 thou.) thick alumina substrates. Dimensions are 1.45 x 0.6 x 0.25mm thick.

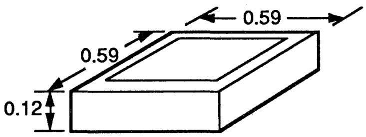
OUTLINES AND DIMENSIONS

OUTLINE	L(mm)	W(mm)	H(mm)
82A	0.59	0.59	0.13±10%
82B	0.26	0.26	0.13±10%
82C	0.72	0.72	0.13±10%
82D	1.45	1.45	0.13±10%
82E	0.38	0.38	0.13±10%
82F	0.50	0.50	0.13±10%
84 A	1.45	0.60	0.25 ±10%
84 B	1.05	0.41	0.13 ±10%

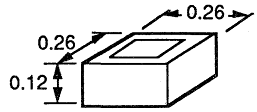
NOTE: dimensional tolerance ± 0.05 mm (L andW)



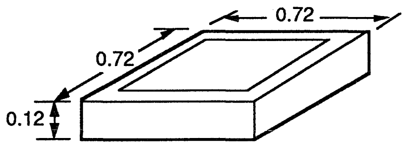
84A



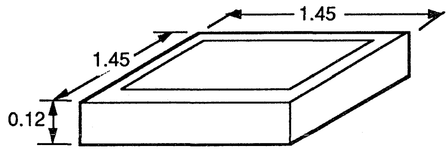
82A



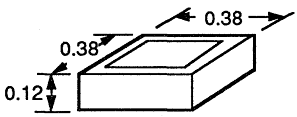
82B



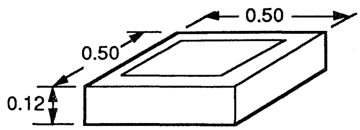
82C



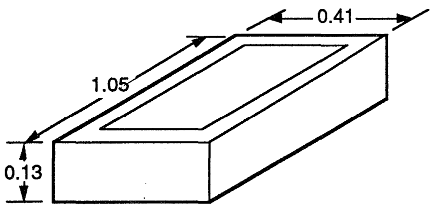
82D



82E

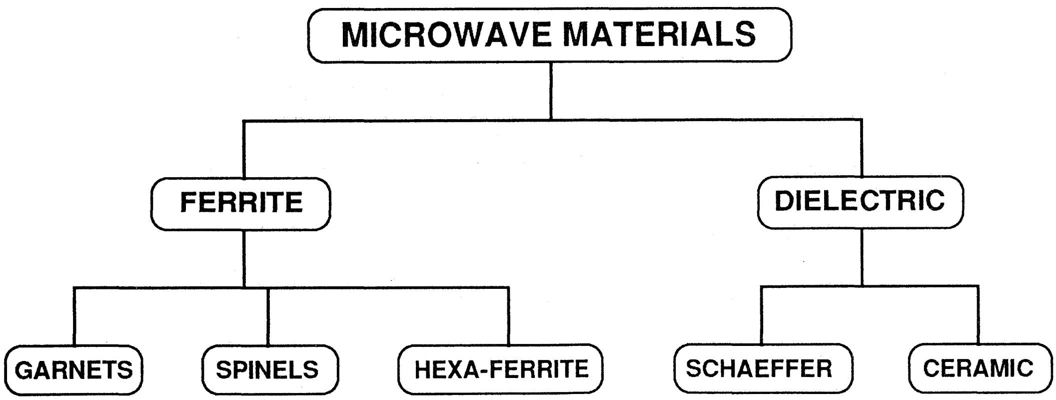


82F



84B

Section 2
Microwave Materials



GEC PLESSEY
SEMICONDUCTORS

Microwave Materials

Garnet Ferrite	• Yttrium Aluminium • Yttrium Gadolinium • Yttrium Gadolinium Aluminium • Yttrium Indium Aluminium • Dysprosium Doped Yttrium Gadolinium Aluminium
Spinel Ferrite	• Magnesium Manganese Aluminium • Nickel Chrome Zinc • Lithium Titanium Manganese Zinc • Nickel Zinc
Hexa Ferrite	• Barium Strontium Calcium
Dielectric Schaefer	• Polystyrene / Titanium Composite
Dielectric Ceramic	• Titanium • Lithium Manganese Titanium • Zirconium Tin Titanates

CT3519-1.4 August 1992

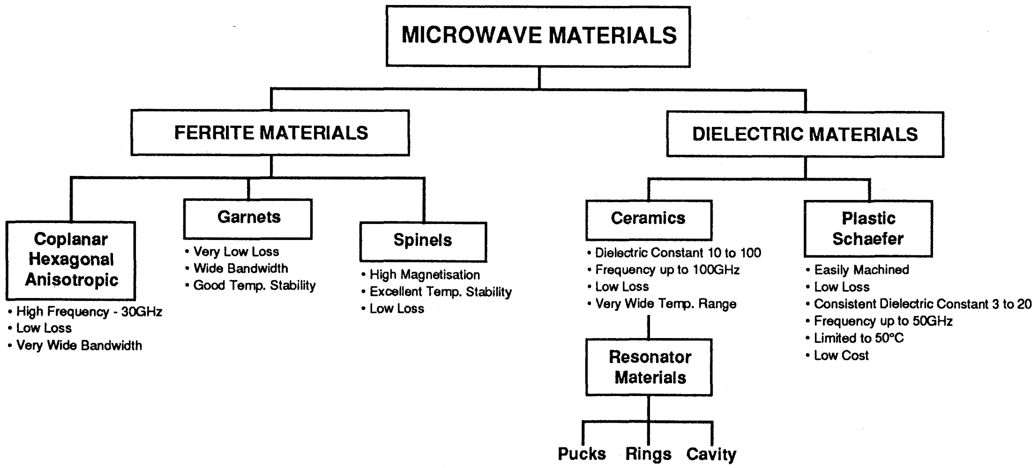
MICROWAVE MATERIALS INTRODUCTION

Specialist high performance materials and components have a fundamental impact on the design and final performance of microwave and millimeter wave circuits. The in- house capability at GPS produces a wide range of magnetic and dielectric ceramic materials principally for use over the frequency range 100MHZ to 100GHz. The facilities available include raw material processing ; pressing; machining; full analytical evaluation and test.

Ferrite materials are manufactured to very close geometric tolerances in a wide variety of shapes and sizes providing low loss, wide bandwidth, excellent temperature stability and high magnetisation. Ferrite substrates in any standard high frequency ferrite material are supplied for thick and thin film circuits; ferrite-in-alumina substrates can include any number of ferrite pucks for thin film circuits.

Microwave dielectric materials offer low loss high dielectric constants with semi-customizable temperature coefficients. Used across the frequency band up to 100GHz as cavity stablised resonator filters, as matching elements and also as substrates.

Schaefer dielectric materials consist of a finely divided ceramic filler uniformly dispersed in a polystyrene matrix. Two types are available; a titanium filled version which offers a wide continuous range of dielectric constants from 3.0 to 20.0 with low loss and good stability; a magnesia filler gives better temperature stability and lower loss, but the dielectric constant range is reduced to 3.0 to 7.0. For both ranges the dielectric constant can be specified to an accuracy of ±2% and the materials are easy to machine and can be readily bonded to suitable substrates using epoxy or similar adhesives.



APPLICATIONS

Garnets: Low Loss, Circulators, Isolators, Loads, Duplexers, Phase Shifters

Spinels: High Power, Pulse Compression, Memory Cores, Transformer Inductors

APPLICATIONS

Ceramics: Temperature Stable Oscillators & Filters, High Frequency Matching Elements, Substrates

Plastics: High Volume Substrates, Low Cost Antennas, Lenses, Matching Elements, Substrates

GEC PLESSEY
SEMICONDUCTORS

CT3193 - 1.4 August 1992

SCHAEFER MICROWAVE DIELECTRIC MATERIALS

GPS offer a range of Microwave Dielectric materials previously manufactured by Schaefer Dielectric Limited of Cambridge. This material is now manufactured at the company's Microwave Division at Lincoln, England.

The material consists of a finely divided ceramic filler uniformaly dispersed in a polystryrene matrix. The dielectric constrant can be specified to an accuracy of ±2%. A number of standard values are normally available but intermediate value materials can be manufactured to special order.

This material may be readily machined with tungsten carbide tools but it is recommended that no lubricant be used to prevent any possible degradation of electrical properties due to surface contamination. It can also easily be bonded using epoxy or similar adhesives. The full range is specified in detail on the following page.

These materials are normally produced in 4½" x 4½" blocks in thicknesses of up to 1". A full machining service is offered and enquires for moulding to special shapes and properties are welcomed.

SOME MICROWAVE APPLICATIONS OF DIELECTRIC MATERIALS

Loading of Waveguides	Small, lightweight waveguides assemblies and delay lines Dielectric coatings or inserts to avoid mode conversion in high - mode guides. Periodic loading for slow - wave structures
Waveguide Components	Dielectric supports and matching posts Sleeves for ferrites Dielectric loaded coupling holes Waveguides filters Phase shifters and tuning elements Dielectric beads for perturbation experiments
Striplines	High dielectric constant substrate for miniture striplines Striplines antennas
Microwave optics	Lenses Prisms Surface blooming (sandwich construction) to minimise reflections Experimental radomes Dielectric shapes for model experiments
Antennas	Dielectric rod antennas Dielectric tube antennas Stripline antennas

PT SERIES

Contains a Titania filler, giving a wide range of dielectric constrant, with low loss and good stability. Standard values of dielectric constrant are (PT-) 3.0, 4.0, 6.0, 8.0, 10.0. 13.0, 16.0.

Intermediate values in the range 3.0 - 20.0 to special order.

PT - SERIES (Titania filled)

Dielectric constant, ε		3 to 20	
Accuracy of ε		±2%	
Frequency variation, 10kHz - 10GHz		<0.5%	
Temperature coefficient, (°C - 1)	ε = 3.0	-2×10^{-4}	
	ε = 16.0	-6×10^{-4}	
Loss tamgent, 10kHz - 10GHz		$<9 \times 10^{-4}$	
Temperature range (°C) storage and operation		- 55 to + 100	
Dielectric strength (kV/cm)		>200	typically
Bulk density (g.cm - 3)	ε = 3.0	1.2	typically
	ε = 16.0	2.8	typically
Thermal conductivity (cal. cm-1.s-1, °C-1)	ε = 3.0	3×10^{-4}	typically
	ε = 16.0	1.5×10^{-3}	typically
Coefficient of linear expansion (°C-1)	ε = 3.0	7×10^{-5}	typically
	ε = 16.0	3×10^{-5}	typically
Young's modulas (dyn. cm-2)	ε = 3.0	2.5×10^{10}	typically
	ε = 16.0	7×10^{10}	typically
Ultimate tensile strength (dyn. cm-2)	ε = 3.0	7×10^{8}	typically
	ε = 16.0	$3.5 \times 10^{\varepsilon}$	typically
Water adsorption (24 hour immersion) by weight		<0.1%	
Machining		Tungsten carbide tools	
Standard sizes (nominal)		$4\frac{1}{2}$" x $4\frac{1}{2}$" x $\frac{1}{2}$" or 1"	

MICROWAVE CERAMIC DIELECTRIC MATERIALS

T3A CERAMIC DIELECTRIC MATERIAL

T3A is a dense, low loss ceramic rutile which was developed for use as a matching medium in microwave ferrite devices, but is suitable generally where a high dielectric constant low loss material is required.

The specification for T3A is given in the table; dielectric properties are measured at 9.4GHz.

Type No	$\rho(g.cm^{-3})$	ε'	$\tan\delta_\varepsilon$
T3A	3.9	80 - 100	<0.0010

P2A CERAMIC DIELECTRIC MATERIAL

P2A is a dense, low loss ceramic dielectric based on lithium ferrite which has no detectable magnetisation at least down to -50°C. It has been developed for use as a matching medium in microwave ferrite devices, but is suitable generally where a fairly high dielectric constant, low loss material is required.

A provisional specification for P2A is given in the table: dielectric properties are measured at 9.4GHz.

Type No	$\rho(g.cm^{-3})$	ε'	$\tan\delta_\varepsilon$
P2A	3.6	20 ±5%	<0.0005

T3A and P2A are available in standard stock as an isostatically pressed block of nominal dimensions 5" x 2" x 1". enquiries for other shapes and sizes including fully machined parts are welcomed.

NOTE

Further ceramic dielectric materials, including Barium Nonatitanate, T4A are at advanced development stage in the laboratory and will be available shortly.

MICROWAVE FERRITE MATERIALS

STANDARD MATERIALS

GPS microwave ferrite materials are designed for applications over the approximate frequency range 100MHz to 100GHz and are available in six families of materials covering both garnet and spinal types and from which a variety of shapes and sizes can be manufactured to very close tolerances.

Most standard materials can be modified for high power requirements, or to give greatly reduced magnetostrictive effects.

APPLICATION GUIDELINES

■ YTTRIUM ALUMINIUM IRON GARNETS including Narrow Linewidth Materials	For very low loss and wide bandwidths
■ YTTRIUM GADOLINIUM ALUMINIUM IRON GARNETS	Where a degree of temperature stability is required
■ YTTRIUM GADOLINIUM IRON GARNETS	Where greater temperature stability is required
■ LITHIUM TITANIUM ZINC IRON SPINELS	For high magnetisation, excellent temperature stability and low loss
■ NICKEL CHROMIUM ZINC IRON SPINELS	Where high magnetisation and extreme temperature stability are required
■ MAGNESIUM MANGANESE ALUMINIUM IRON SPINELS	For low loss application

QUALITY CONTROL

The quality control procedures employed in the manufacture of GPS microwave ferrites are designed to achieve the highest order of reproducibility. Every batch of ferrite material is subjected in the laboratory to a series of physical, electrical and magnetic tests to ensure that it meets the specification in full.

The properties measured and specified for finished material are the saturation magnetisation $4\pi M_S$ (or M_S), Curie temperature T_C, gyromagnetic resonance linewidth ΔH (-3dB), dielectric constant ε' and loss tangent tan δ_ε. Resonance and dielectric properties are measured at 9.4GHz.

The standard working tolerances for the specified properties are given below.

$4\pi M_S$ (M_S):	$\pm$5% garnets with $4\pi M_S > 1000$ G ($M_S > 80$kA/m)
	$\pm$8% other garnets and spinels
T_C:	nominal
ΔH (-3dB):	maximum stated
ε':	$\pm$5% garnets
	$\pm$8% spinels
tan δ_ε:	maximum as stated

SHAPES AND SIZES

Standard materials are available in a variety of shapes and sizes, including bars, discs, cylinders and triangles. Enquiries for more complex shapes will be welcomed. Where a size is not available from stock it can be made to special order.

A comprehensive ceramic machining facility is available on site and precision cutting, grinding and surface polishing to customer's specification can be undertaken.

MATERIALS FOR HIGH POWER APPLICATIONS

Most GPS ferrites are available in a modified form suitable for high power applications. Rare earth doping is employed to increase the spin wave linewidth of Garnet ferrites, and consequently their tolerance to high microwave power levels. Both transition element doping and "porosity broadening" is employed to achieve the same effect in Spinel ferrites. Standard materials modified to improve power handling capabilities can be manufactured upon request.

MAGNETOSTRICTION

Garnet ferrites in their normal form are inherently magnetostrictive and as such their properties are significantly stress dependent. In order to overcome this disadvantage GPS Garnets are also available in a modified form in which magnetostriction is reduced to a low level. Most standard materials can be supplied modified in this way upon request.

MATERIALS FOR LATCHING PHASE SHIFTERS

GPS has extensive experience in the selection of materials for latching phase shifters and a variety of toroidal geometries are available. Enquiries for Garnet, Lithium or Magnesium Manganese Spinel materials for these applications are welcomed.

OTHER MATERIALS

The materials shown are a selection from a wide range currently in production, and enquiries for ferrites with different properties will be welcomed.

In addition to the microwave materials listed GPS also manufactures Nickel Zinc Spinel ferrites for applications at lower frequencies.

MICROWAVE GARNETS

TYPE NO.	$4\pi M_S$ (G)	M_S(kA/m)	T_C (°C)	ΔH (O_E) (Maximum)	ΔH(kA/m) (Maximum)	ε'	10^4 tan δ_ε (Maximum)
YTTRIUM ALUMINIUM IRON GARNETS							
Y13A	1760	140.1	280	60	4.8	14.8	3
Y12A	1450	115.4	255	55	4.4	14.7	2.5
Y16A	1100	87.6	220	50	4.0	14.5	2.5
Y9A	1000	79.6	210	45	3.6	14.4	2.5
Y17A	800	63.7	190	45	3.6	14.3	2.5
Y14A	700	55.7	175	45	3.6	14.2	2.5
Y11A	475	37.8	130	45	3.6	14.0	2.5
Y15A	300	23.9	110	45	3.6	13.8	2.5
YTTRIUM GADOLINIUM IRON GARNETS							
G5A	1220	97.1	280	110	8.8	15.1	3
G4A	1100	87.6	280	140	11.1	15.2	3
G3A	900	71.6	280	175	13.9	15.2	3
G2A	675	53.7	280	250	19.9	15.2	3

MICROWAVE GARNETS

TYPE NO.	$4\pi M_S$ (G)	M_S(kA/m)	T_C (°C)	ΔH (O_E) (Maximum)	ΔH(kA/m) (Maximum)	ε'	10^4. tan δ_ε (Maximum)

YTTRIUM GADOLINIUM ALUMINIUM IRON GARNETS

G9A	1100	87.6	250	75	6.0	14.5	2.5
G6A	1000	79.6	255	120	9.5	14.9	2.5
G8A	1000	87.6	220	50	4.0	14.5	2.5
G11A	800	63.7	230	95	7.6	14.6	2.5
G14A	700	55.7	250	85	6.8	14.5	2.5
G7A	600	47.8	190	70	5.6	14.2	2.5

NARROW LINEWIDTH GARNETS

Y70A	1900	151.2	225	25	2.0	14.5	2
Y71A	1760	140.1	205	25	2.0	14.5	2
Y72A	1500	119.4	185	25	2.0	14.4	2
Y73A	1500	119.4	150	20	1.6	14.3	2
Y74A	1200	95.5	165	20	1.6	14.2	2
Y75A	1000	179.6	150	20	1.6	14.1	2
Y76A	1000	79.6	110	15	1.2	14.0	2
Y77A	800	63.7	130	20	1.6	13.9	2
Y78A	800	63.7	95	10	0.8	13.9	2

MICROWAVE SPINELS

TYPE NO.	$4\pi M_S$ (G)	M_S(kA/m)	T_C (°C)	ΔH (O_E) (Maximum)	ΔH(kA/m) (Maximum)	ε'	10^4. tan δ_ε (Maximum)

LITHIUM TITANIUM ZINC IRON SPINELS

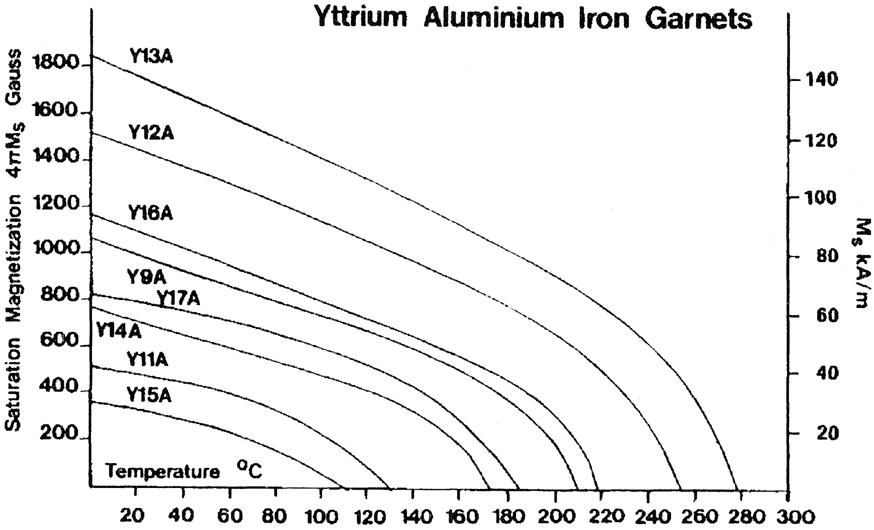
L4A	4800	382.1	450	225	17.9	14.3	20
L3A	4000	318.4	500	325	25.8	14.7	20
L2A	3000	238.8	490	360	28.6	15.2	20
L5A	2500	199.0	430	360	28.6	15.9	20
L1A	2000	159.2	375	360	28.6	16.7	20
L6A	1700	135.3	430	430	34.2	16.3	20

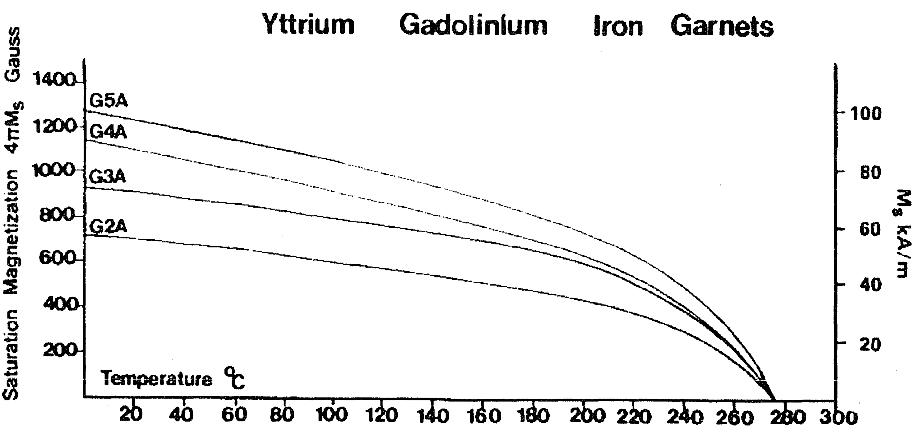
NICKEL CHRONIUM ZINC IRON SPINELS

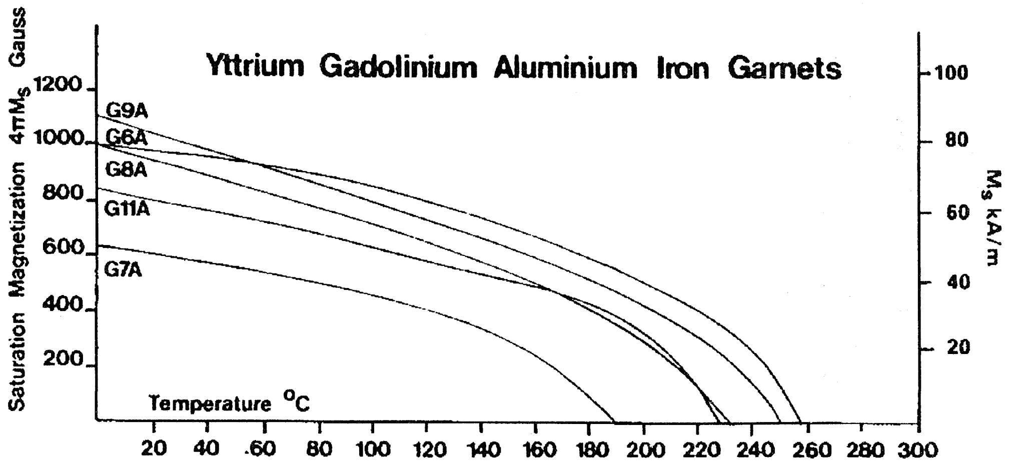
N11A	5000	398.0	375	180	14.3	13.5	20
N10A	4600	366.2	450	200	15.9	13.3	20
N9A	3850	306.5	500	210	16.7	13.1	20
N7A	3000	238.8	590	250	19.9	13.0	20
N2A	2350	187.1	525	300	23.9	12.4	20
N3A	1900	151.2	500	300	23.9	12.0	20
N4A	1775	141.3	473	300	23.9	11.6	20
N5A	1450	115.4	450	350	27.8	11.2	20

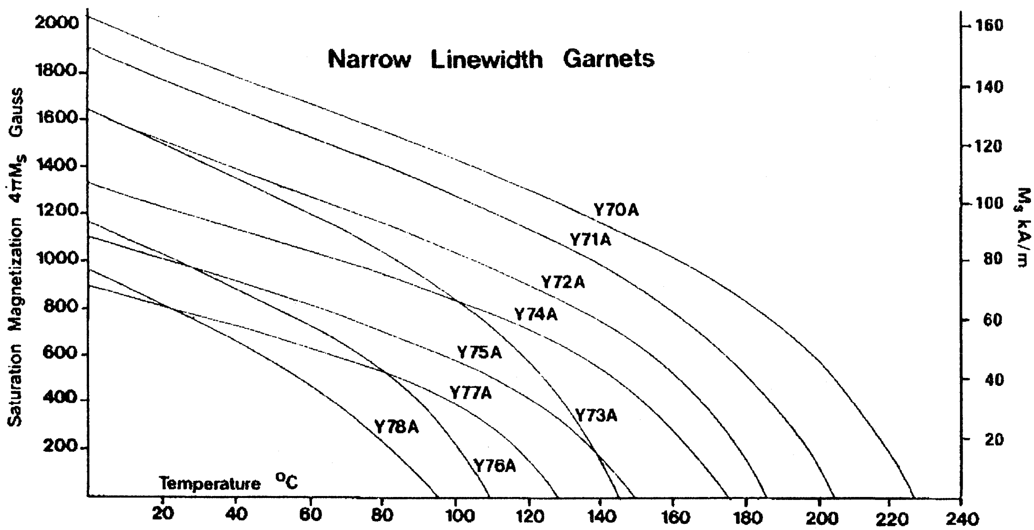
MICROWAVE SPINELS

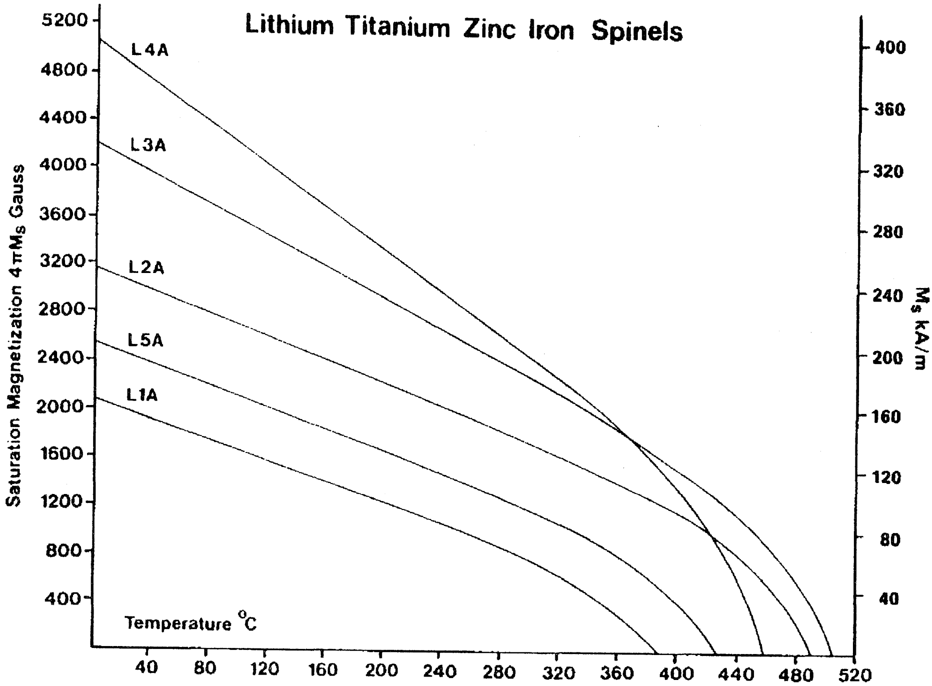
TYPE NO.	$4\pi M_S$ (G)	M_S(kA/m)	T_C (°C)	ΔH (O_E) (Maximum)	ΔH(kA/m) (Maximum)	ε'	$10^4 . \tan \delta_\varepsilon$ (Maximum)
MAGNESIUM MANGANESE ALUMINIUM IRON SPINELS							
M2A	2300	183.1	280	500	39.7	12.5	20
M3A	2150	171.2	265	475	37.7	12.2	20
M4A	1650	131.4	220	300	23.8	11.8	10
M9A	1400	111.5	180	200	19.9	11.7	10
M5A	1200	95.5	160	180	14.3	11.5	10






Yttrium Gadolinium Aluminium Iron Garnets
Saturation Magnetization $4\pi M_S$ Gauss
1200
1000
800
600
400
200
G9A
G6A
G8A
G11A
G7A
Temperature °C
20 40 .60 80 100 120 140 160 180 200 220 240 260 280 300
100
80
60
40
20
M_s kA/m


Narrow Linewidth Garnets
Saturation Magnetization $4\pi M_S$ Gauss
2000
1800
1600
1400
1200
1000
800
600
400
200
Y70A
Y71A
Y72A
Y74A
Y75A
Y77A
Y73A
Y78A
Y76A
Temperature °C
20 40 60 80 100 120 140 160 180 200 220 240
160
140
120
100
80
60
40
20
M_s kA/m


Lithium Titanium Zinc Iron Spinels
L4A
L3A
L2A
L5A
L1A
Saturation Magnetization 4πMs Gauss
Ms kA/m
Temperature °C
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
400
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320
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240
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80
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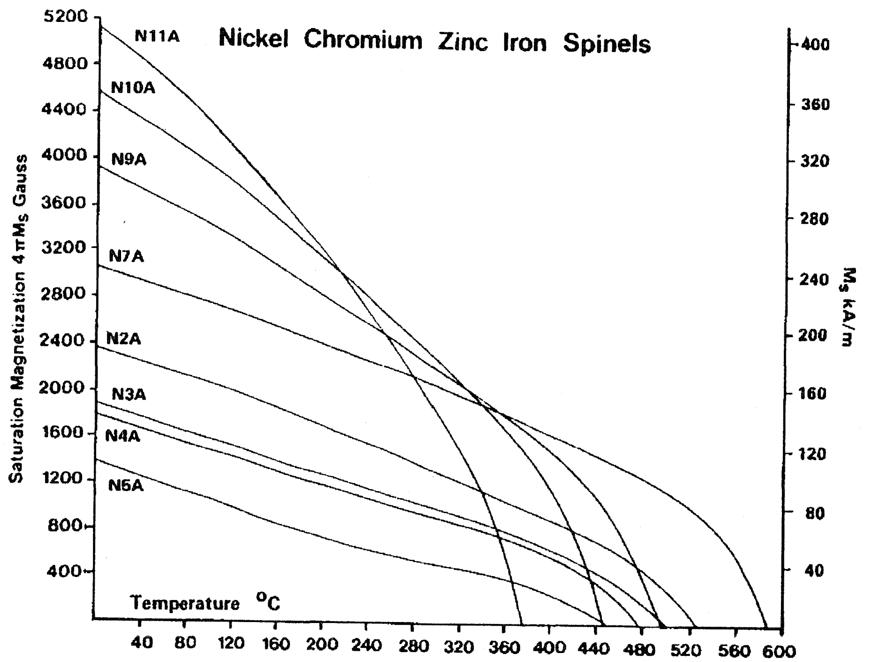
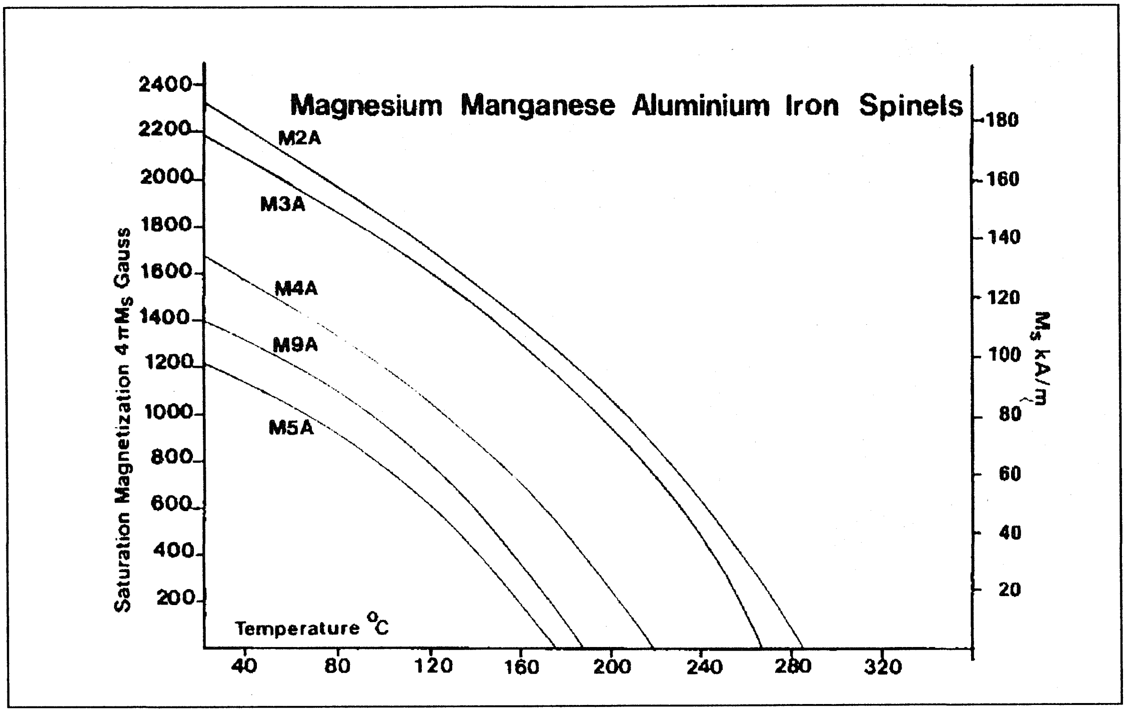
40 80 120 160 200 240 280 320 360 400 440 480 520


Nickel Chromium Zinc Iron Spinels
N11A
N10A
N9A
N7A
N2A
N3A
N4A
N6A
Saturation Magnetization 4πMs Gauss
Ms kA/m
Temperature °C
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
400
360
320
280
240
200
160
120
80
40
40 80 120 160 200 240 280 320 360 400 440 480 520 560 600


Magnesium Manganese Aluminium Iron Spinels
Saturation Magnetization 4πMs Gauss
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
M2A
M3A
M4A
M9A
M5A
Temperature °C
40
80
120
160
200
240
280
320
Ms kA/m
180
160
140
120
100
80
60
40
20

F1101 FERRITE TORRIDUCTOR and F1102 INDUCTIVE CORES

A range of Inductive Cores is available for application as matching and power handling transformers in an extensive variety of circuits. The devices take the form of a rectangular block of ferrite with a pair of circular or square section holes through it. The internal holes contain the windings appropriate to the user's circuit requirement leaving the flat surface of the Torriductor completely unimpeded for secure mounting and maximum heat dissipation through heat sinks.

The advantage of Torriductors over conventional toroidal cores include smaller magnetic reluctance for a given core area and volumne, reduced leakage flux and improved magnetic sheilding of the coil.

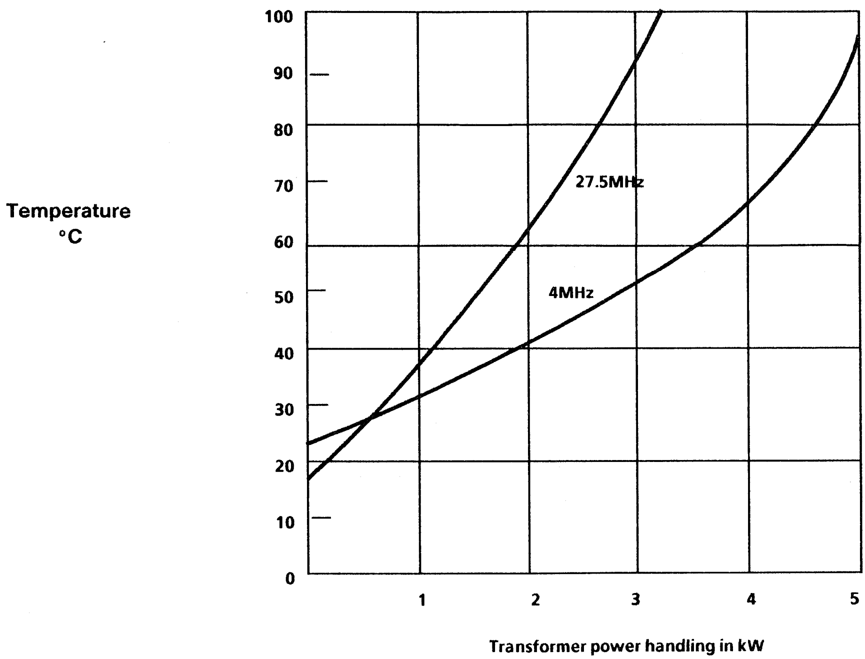
Specification

The following nominal specifications are typical examoles of Toeeiductors developed to specific customer requirements.

Type No.	Material Grade	Inductance	Power Handling	Response - Flat	Dimensions
F1101-02	U1A	-	5kW	2 - 30MHz	88.9 x 88.9 x 38.1mm 3.5 x 3.5 x 1.5 in
F1101 - 06	U8A	3μH / turn	225W	1.5 - 30MHz	22.2 x 15.9 x 12.7mm 0.875 x 0.625 x 0.5 in
F1101 - 07	U8A	4μH / turn	500W	1.5 - 30MHz	34.9 x 25.4 x 19.1mm 1.375 x 1.0 x 0.75 in
F1101-08	U9A	1.0μH / turn	200W	2 - 30MHz	25.4 x 19.0 x 9.1mm 1.0 x 0.75 x 0.36 in
F1102 - 01	U2A	0.55μH / turn	50W	30-300MHz	25.4 x 19.0 x 9.1mm 1.0 x 0.75 x 0.36 in
F1102 - 02	U2A	0.25μH / turn	10W	30-300MHz	12.7 x 12.7 x 9.1mm 0.5 x 0.5 x 0.36 in

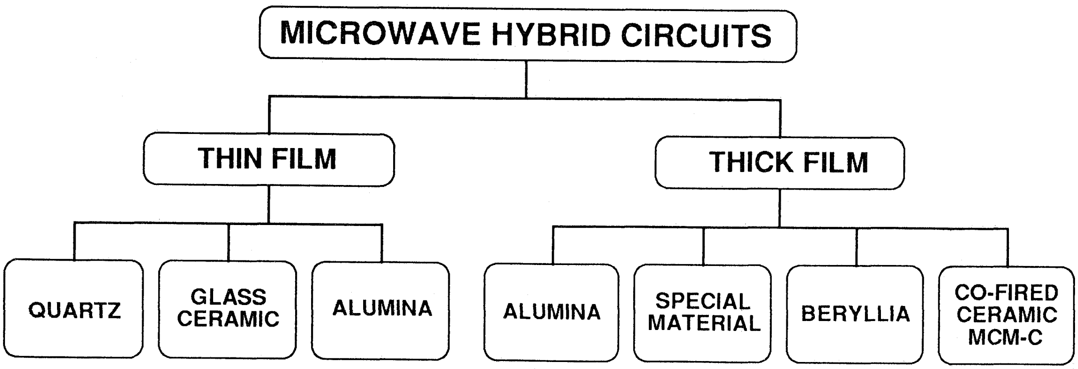
F1101 **TORRIDUCTOR**
F1102 **INDUCTIVE CORES**

The graph shows the results of application tests applied to a 3.5 in x 3.5 in Torriductor wound as an auto - transformer. The Torriductor was allowed to stand free without a heat sink and run at 4MHz and 27.5MHz at powers sufficient to give temperatures of up to 100°C on the hottest point of the Torriductor surface.



Section 3

Microwave Hybrid Circuits



GEC PLESSEY
SEMICONDUCTORS

Microwave Hybrid Circuits

Thin Film Quartz	• Foundry Facility • Inserted Ferrite • Very High Frequency • Low Dielectric • Low Transitional Loss
Thin Film Glass Ceramic	• Foundry Facility • Inserted Ferrite • MIC/MiMAC Process • Laser Machined • High Frequency • Low Dielectric • Low Loss
Thin Film Alumina	• Foundry Facility • Inserted Ferrite • BNSC/ESA Qualification in Progress • MIC/MiMAC Process • Laser Machined
Thick Film Alumina	• Foundry Facility • General Purpose Analog/Digital RF and Microwave • BNSC/ESA Qualification in Progress
Thick Film Special Material	• Steel • Custom
Thick Film Beryllia	• High Power Dissipation
Thick Film Co-Fired Ceramic MCM-C	• Complex High Density Digital

CT3201-1.3 August 1992

THIN AND THICK FILM HYBRID CIRCUITS

Hybrid circuit technology is the basis upon which the final performance of any microwave component depends. The choice of substrate material is critical and can be alumina, glass ceramic, or quartz based. The interconnect technology is either thin or thick film.

Thin Film

GPS has one of the most advanced thin film production foundries in operation today. Leading edge substrate technology allows GPS to manufacture circuits on a variety of substrates at frequencies ranging from d.c. to over 100GHz. The company is currently undergoing ESA qualification for thin film hybrid circuit manufacture and assembly and holds project approval for several space programmes.

GPS has developed the Microwave Monolithic Alumina Circuit (MiMAC) technology which is ideal for high density, high volume, low cost circuitry operating at frequencies up to 40GHz.

Established manufacturing techniques such as circuit patterning, plated through hole interconnects, integrated resistors and solder barriers are readily available supported by in house technical expertise. Evaluation substrates can be supplied on a short timescale basis to facilitate development requirements.

Other technologies can be offered on an individual basis after discussion with GPS.

Thick Film

GPS thick film circuit technology is developed to a high degree. Multi-layer circuits having up to 10 conductor layers with resistors on dielectric are in full production. Auto-printing and trimming capabilities provide for high volume low cost throughput making thick film microwave components ideal for the commercial market place. With more than 20 years experience in the design and manufacture of custom and standard hybrid circuits and modules, many thousands of custom applications have been successfully produced as chip and wire, surface mount, or mixed technology circuits. Qualification to BS9450 was achieved in August 1992. ESA qualification is ongoing with full qualification in 1993.

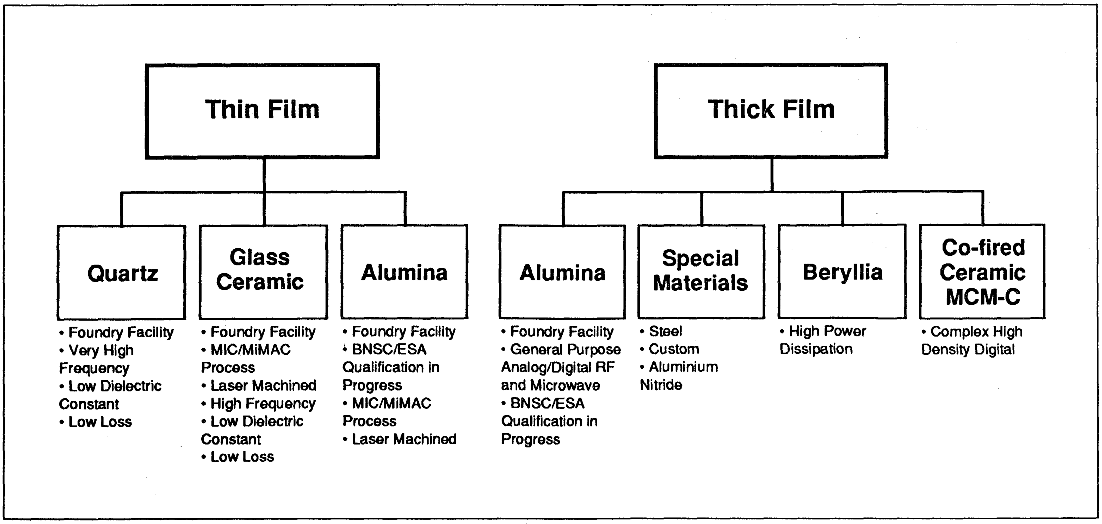


Figure 1

THIN & THICK FILM HYBRID CIRCUITS

QUALITY ASSURANCE STANDARDS HELD

NATO STANDARD AQAP1	EQUIVALENT: MIL-Q-9858A
BRITISH STANDARD 9000	EQUIVALENT: MIL-M-38510
BRITISH STANDARD 9400	EQUIVALENT: MIL-STD-883
BRITISH STANDARD 9450	CAPABILITY APPROVAL FOR THICK FILM PROCESSING
NAMAS	REFERRED STANDARDS FOR CALIBRATION AT MILLIMETRE WAVE FREQUENCIES

CUSTOMER INTERFACE OPTIONS

1. Data can be supplied in drawing format (single cell) to be digitised and arrayed.
2. Data can be supplied in IGES format (single cell) and arrayed on CAD.
3. Data can be supplied in other formats.
   Eg. DXF, HPGL etc. Check with GPS for compatibility before commencing design.

THIN FILM PROCESS DESCRIPTION

The GEC Plessey thin film manufacturing facility can be used to fabricate thin film substrates using and featuring the following:

- A wide range of materials and thicknesses which include alumina, glass ceramic, z-cut quartz and ferrite.
- Laser drilled holes and profiled shapes.
- Defined gold tracks.
- Through hole metallization.
- Integrated resistors which are formed utilizing a thin film of resistive material (nichrome).
- Nickel barriers on top of gold conductors which allows soldering of components to the substrate.
- Air bridge interconnections with a maximum span of 100 microns and a width of 150 microns.
- Diamond sawn edges for a clean square edge.
- All chrome masks utilized for component manufacture.
- Special applications

Examples are ferrite pucks inserted into alumina, glass ceramic and z-cut quartz to form circulators and isolators. Integration of decoupling capacitors.

SPECIFICATION OVERVIEW

1. SUBSTRATE - Maximum Sizes (Unpatterned)

As Fired Alumina
50.8 x 50.8 x 0.254 mm Hi-rel grade
57.2 x 57.2 x 0.381 mm Hi-rel grade
57.2 x 57.2 x 0.508 mm Hi-rel grade
108 x 108 x 0.635 mm
57.2 x 57.2 x 0.635mm Hi-rel grade
Glass Ceramic
57.15 x 57.15 x 0.254 mm Polished finish on one side.
Z - Cut Quartz
In two thicknesses, usually sputtered nichrome to 50 Ohms per square.
0.254 mm Ground finish
0.127 mm Ground finish and sawn to size (max 40 x 40 mm)

1. All the above materials except quartz can be metallized as standard substrates or laser drilled/profiled before metallization.
2. Material can be free issue standard substrate or laser drilled/profiled, a Non Recurrent Engineering (NRE) charge will apply for the evaluation of the nichrome sheet resistivity.
3. Material can be electroplated with gold to a thickness of 3.5 - 9 microns both sides.
4. Z-Cut quartz is fully sputtered gold 3.5 - 5 microns thick.

2. LASER MACHINING

Hole Drilling Constraints	
Minimum hole diameter:	Greater than the thickness of the substrate i.e an aspect ratio of 1:1 or greater.
Tolerance on hole diameter	± 50 microns
Tolerance on hole position	± 20 microns Relative to datum point ± 50 microns Hole centre to hole centre
Minimum distance between holes	100 microns
Minimum distance from elements	100 microns
Profiling Constraints	
Tolerance over the length or width of a profiled shape	±50 microns
Locational tolerance to datum for post definition profiled shape	±50 microns

Radiusing: The strength of an internal corner is considerably improved by radiusing.
(A radius at least equal to the substrate thickness is recommended)
Minimum profiled section is 250 microns i.e. a hole

Proximity of Circuit Elements to Holes
The proximity of profiled elements to circuit components and profiled sections to holes can be defined by utilizing substrate thickness.
1. The edge of a profiled section should be at least 100 microns away form any other circuit component.
2. The distance from the outer edge of the substrate to the profile must not be less than four times the substrate thickness.
3. The distance from a profile to profile within the constraints of 2 (above) must not be less than three and a half times the thickness of the substrate.
4. The distance from a profiled shape to a drilled hole must not be less than two and a half times the thickness of the substrate.

3. METALLISATION

Adhesion Layer	Nickel - Chrome	Sputtered
Resistor Layer	Nickel - Chrome	Sputtered
Conductor Layer	Gold	Sputtered or Sputtered then electroplated
Barrier Layer	Nickel	Electroplated

The nichrome resistor layer is offered in two set values of 50 Ohms per square and 100 Ohms per square with a tolerance ±10%. Other values of Ohms per square are possible but will involve a development programme to attain customer requirements.

Table of Thickness

Nickel Chrome	50 or 100 Ohms per square ±10 %
Sputtered Gold	1500 to 2500 Angstroms
Z- Cut Quartz (Sputtered Gold)	3.5 to 5 microns
Electroplated Gold	Standard 3.5 to 9 microns
Electroplated Nickel Barrier	Standard 5 to 15 microns

4. PATTERNING

Line/Gap Widths - Option 1

Line width minimum	50 microns
Gaps minimum	40 microns
Conductor metallization	3.5 to 9 microns
Nickel barrier layer, oversize only	5 to15 microns thick
Pre and post definition laser drilling and profiling	
Through hole metallization	

Tolerances

±10 microns up to a line width of 100 microns
±100 microns from 1 mm to 10mm
±300 microns over 10 mm

All z-cut quartz substrate manufacturing utilizes this option and it must be stated at this point that no laser drilling or profiling is allowable for z-cut quartz.
This option is also applied to all substrates which have a ferrite puck inserted into them, materials are alumina, glass ceramic and z-cut quartz.

Line/Gap Widths - Option 2

Line width minimum	20 microns
Gaps minimum	15 microns
Pre and post definition laser drilling and profiling	
Conductor metallization	3.5 to 9 microns

Tolerances

±3 microns on a line width of less than 30 microns
±5 microns on a line width greater than 30 microns
±10 microns on all widths up to 10 mm.
±30 microns on all other widths over 10 mm.

This process option cannot be utilized for z-cut quartz or ferrite inserted substrates.

5. RESISTORS

Integrated resistors are formed on the substrate by using nichrome to two standard resistivities:

50 Ohms per square ±10 %
100 Ohms per square ±10 %

Minimum Dimensions

Length	50 microns
Width	100 microns

6. INTEGRATED CAPACITORS

Capacitors can be formed onto the substrate using a dielectric material (silicon nitride), aspects of the design are shown below.

1. Minimum top plate dimensions are 100 microns by 100 microns.
2. The E_r of silicon nitride deposited is equal to 6.25 + 0.25.
3. The dielectric must overlap the gold conductor by 30 microns minimum.

The top plate area governs the capacitance and is calculated using the formulae:

C (in pF) = 350 (in pF mm^{-2}) x Top plate area (in mm^2) or

C (in pF) = 175 (in pF mm^{-2}) x Top plate area (in mm^2) i.e. Capacitance is based on 350 pF mm^{-2} or 175 pF mm^{-2}

4. Tolerance on the capacitance value is ±20%.

The top plate should be recessed with in the bottom plates by the following amounts:

a) If C is less than 20pF the recess should be 15 microns.

b) If C is greater than or equal to 20pF the recess should be 25 microns.

Special Options:

i) Inserted Substrate

Inserted substrates consist of a selected ferrite material mounted into a particular position within the defined area of the substrate. The following materials can be used in this application:

Alumina	Dielectric constant	9.9
Z-cut quartz	Dielectric constant	4.45
Glass ceramic	Dielectric constant	5.9

ii) Other customer requirements can be considered on an individual basis.

7. AIR BRIDGES

Air bridges are integral parts of the circuit and can be used as interconnections to integrated capacitors or from track to track.

Dimensions

width	20 - 150 microns
span	50 - 100 microns
minimum width: span ratio	1:2
plating thickness	4 - 6 microns
bridge height	8 - 11 microns

8. SAWING

Individual circuits are produced oversize, singularly or in an array and usually require cutting to size. This task is usually accomplished using precision diamond saws, the tolerances are as follows:

150 ±10 microns on the saw cut width
±10 microns on positional tolerance
±30 microns on circuit size

Note: The position of the saw cut is usually carried out by the mask manufacturing facility but the designer should be aware of the resulting tolerances on circuit dimensions.

THICK FILM COMPONENT DESCRIPTION

The hybrid consists of an alumina substrate screen printed with up to ten conductor layers, each conductor layer has an insulating layer printed between it and adjoining conductor layers.

Connection between layers of conductor on the upper surface of the substrate are made by printing via holes in the dielectric layer and filling these with conductor material.

Conductors consist of either an alloyed gold material suitable for gold or aluminium wire bonding or silver based conductors for solder mount. Under certain circumstances the underside of the substrate may be fully or partially metallised to form a ground plane. Connection to this ground plane from the upper surface conductor layers is made by through-hole printing of conductor material.

Resistors may be printed on either top surface of the alumina substrate or on the top of the uppermost dielectric layer, in either case no further layers are printed over the resistors (other than a protective coverglaze). Resistors are trimmed to their final value using laser trim techniques.

General

Substrate size	200 x 300	mm [max]
Conductor Layers	Multiple (8 Typical)	Practical Maximum
Through hole metalisation	Available	
Substrate thickness Standard	0.25, 0.625, 1.0	mm
Other Substrate Thicknesses Available	To Customer Requirement	

Ceramic Substrates

Material		Alumina (Al_2O_3)
Purity		96%
Specified impurities		Max 4%
Unspecified impurities		Max 0.1%
Microsurface:	Minimum	0.10um RA (4um inch/CLA)
	Maximum	0.75um RA (30um inch /CLA)
Flatness:	Minimum	0.004 mm/mm (inch/inch)

Pastes

Conductor	Au, PtAu, AgPd, AgPdPt, Ag
Resistors	1 Ohm to 10 Megohm per square

Conductor Tracks (on alumina / on insulating layer)

Track width	0.12	mm [min]
Track thickness fired	7 to 20	um
Distance between tracks:		
from single print operation	0.12	mm [min]
different print operations	0.25	mm [min]
entering a printed insulation layer	0.2	mm [min]
Conductor track resistivity	from 1.7	mΩ/sq
Distance from edge of substrate to track	0.12	mm [min]

Termination Areas

Space between termination pad and edge of substrate	0.1	mm [min]
Overlap of conductor at resistor termination	0.1	mm [min]
Resistor overlap onto conductor	0.2	mm [min]
Termination for passive chips to overlap chip by	0.25	um [min]
Pad for chip mounting clearance around chip	0.25	mm [min]
Landing pad for bond wire	0.25 x 0.25 or 8 x Wire Dia	mm [min]

Resistors

Trim tolerances 2 ohms - 10 ohms 10 ohms - 1 Megohm > 1 Megohm	 1 ± 1% ± 5%	 ohm

Add-on Components

Solder Assembly	Gold wire bonding
Epoxy Assembly	Aluminium bonding
Eutectic Assembly	Surface mount chip assembly
	Surface mount packaged component assembly

CT3193-1.4 August 1992

PLANAR INSERTED FERRITE SUBSTRATES FOR MICROWAVE INTEGRATED CIRCUITS

GPS have the capability to supply a veriety of metalised substrates manufactured using the state-of-the-art pattern plating technique.

* **FILMS:**

ADHESION LAYER	Nickel - Chrome	80 - 20	Sputtered
RESISTOR LAYER	Nickle - Chrome	80 -20	Sputtered
CONDUCTOR LAYER	Gold		Sputtered or Sputered then electroplated
BARRIER LAYER	Nickel		Elecrtoplated

TABLE OF THICKNESS

NICKEL CHROME	50 or 100 OHMs per square ±10%
SPUTTERED GOLD	1500 to 2500 Angstroms
ALUMINA Z-CUT QUARTZ	3.5 to 5 microns
ELECTROPLATED GOLD	Standard 3.5 to 5 microns Optinal 5 to 15 microns

* **ARTWORK**

  * In-house facilites for fabrication of photographic plates in chrome or emulsion from:

    ** Dimensioned drawings

    ** CAD data

    ** Ruby or film enlargement

    ** 1:1 photomask

* FERRITE IN ALUMINA SUBSTRATES

Ferrite pucks may be inserted into alumina substrates and a thin film circuit defined to form integrated non-reciprocal elements.

Ferrite inserted substrates consist of a selected ferrite material mounted into a particular position within the defined area of the substrate.
The following materials can be used in this application:

Alumina	Dielectric constant	9.9
Z-cut quartz	Dielectric constant	4 -4.5
Glass ceramic	Dielectric constant	5.9

LASER MACHINING

Hole drilling constraints

Minimum hole diameter:	Greater than the thickness of the substrate i.e. an aspect ratio of 1.1 or greater.
Tolerance on hole diameter	± 50 microns
Tolerance on hole position	± 25 microns relative to datum point
	± 50 microns hole centre to hole centre
Minimum distance between holes	100 micrometers
Minimum distance from circuit elements	100 micrmeters

Profiling constrants

Tolerance over the length or width of a profiled shape	± 50 microns
Locational tolerance to datum for post definition profiled shape	± 50 microns

Radiusing: the strength of an internal corner is considerably improved by radiusing. (A radius at least equal to the substrate thickness is recommended.)

Minimum profiled section is 250 microns i.e. a hole

* PATTERNING

LIne/Gap Widths

Line width minimum	20 microns
Gaps mimimum	15 microns
Pre and post definition laser drilling and profiling	
Conductor metallisation	3.5 - 5 microns and 5 - 9 microns
Through hole electroplating	
Integrated resistors	
Integrated capacitors, special application	
Air bridges	

TOLERANCES:

± 3 microns on a line width of less than 30 microns

± 5 microns on a line width greater than 30 microns

± 10 microns on all widths up to 10 mm

± 30 microns on all other widths over 10mm

This process option cannot be utilised for z-cut quartz or ferrite inserted substrates.

SAWING

Individual circuits are either produced oversize, singularly or in an array and usually require cutting to size. this task is usually accomplished using precision diamon saws. The tolerances are as follows:

150 ± 10 microns on the saw cut width

± 10 microns on positional tolerance

± 30 microns on circuit size

SUBSTRATES

MRC AS FIRED ALUMINA

57.15 x 57.15 x 0.38 mm Hi-rel grade

57.15 x 57.15 x 0.508 mm Hi-rel grade

57.15 x 57.15 x0.635 mm Hi-rel grade

50.8 x 50.8 x 0.254 mm Hi-rel grade

25.4 x 25.4 x 0.254 mm Hi-rel grade

KYOCERA AS FIRED ALUMINA

57.2 x 57.2 x 0.381 mm

57.2 x 57.2 x 0.508 mm

25.4 x 25.4 x 0.508 mm

108 x 108 x 0.635 mm

50.8 x 50.8 x 0.635 mm

50.8 x25.4 x 0.635 mm

25.4 x 25.4 x 0.635 mm

GLASS CERAMIC

Polished on one side

57.15 X 57.15 X 0.254 mm*

50.8 X 50.8 X 0.254 mm*

31 . 75 X 31.75 X 0.254 mm*

Z-CUT QUARTZ

In two thicknesses:0.254 mm ground finish
0.127 mm Ground finish abd sawn to size)max 40 x 40mm)

Usually sputtered nichrome to 50OHMz per square, no integrated resistors allowable.

All the above materials can be metallised as standard substrates or laser drilled/profiled before metallisation.

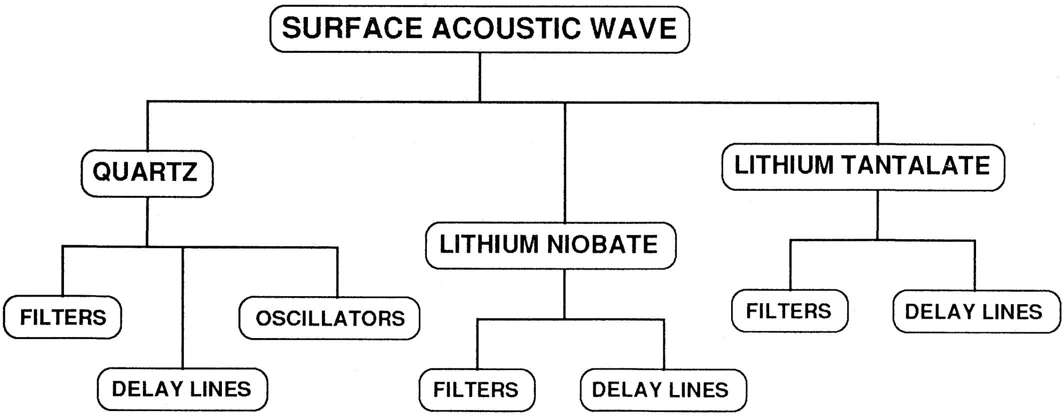
Material can be free issue standard substrate or laser drilled/profiled, a Non Recurrent Engineering (NRE) charge will apply for the evaluation of the nichrome sheet resistivity.

Materials can be electroplated with gold to a thickness of 3.5 - microns, both sides.

Other electroplated thickness can be easily achieved up to a maximum of 9 microns.

Section 4

Surface Acoustic Wave Devices



GEC PLESSEY
SEMICONDUCTORS

Surface Acoustic Wave Devices

Quartz Filters	• Bandpass FIR • Resonator • Transversed Coupled Resonator • Notch • Low Loss • Narrowband • High Q • Low Noise • Hybridised
Quartz Delay Lines	• Linear • Dispersive • Low Loss • Narrowband • High Q • Low Noise • Hybridised
Quartz Oscillators	• Resonator • Delay Line • Multi Frequency • Fixed Frequency • VCO's • Low Loss • Narrowband • High Q • Low Noise • Hybridised
Lithium Niobate Filters	• Bandpass FIR • Vestigial Sideband • Wideband • Low Loss
Lithium Niobate Delay Lines	• Linear • Dispersive • Wideband • Low Loss
Lithium Tantalate Filters	• Bandpass FIR • Wideband • Low Loss • Improved Temperature Stability

DW9230

35.42MHz SAW FILTER FOR GLOBAL POSITIONING SYSTEMS

The DW9230 SAW filter has been specifically developed to be compatible with the GPS1001 Global Positioning Receiver Front End IC also available from GEC Plessey Semiconductors. The device provides 'off-chip' 2nd stage IF filtering for the GPS1001 Front End Receiver used in professional, commercial and consumer Global Positioning Systems.

FEATURES

- Centre Frequency 35.42MHz
- Insertion Loss 17dB ±1dB
- 1dB Bandwidth 1.8MHz Typical
- Passband Ripple 0.5dB Typical
- Phase Ripple 2° Typical
- Operating temperature range: -55°C to +85°C (professional)
  0°C to +70°C (commercial)
- Hermetically Sealed 5 pin TO8 Package
  (alternatives available upon request)

APPLICATION

Military and Civil GPS

ELECTRICAL CHARACTERISTICS

Centre Frequency	35.42MHz (@ 15°C)
Filter Passband	34.62MHz to 36.22MHz
1dB Bandwidth	1.8MHz Typ.
Passband Insertion Loss	17dB ±1dB
Passband Ripple	0.5dB p-p Typ.
Phase Ripple	2° Typ.
Input Voltage	3V Pk Max.
Operating Temperature:	
Professional Grade	-55°C to +85°C
Commercial Grade	0°C to 70°C

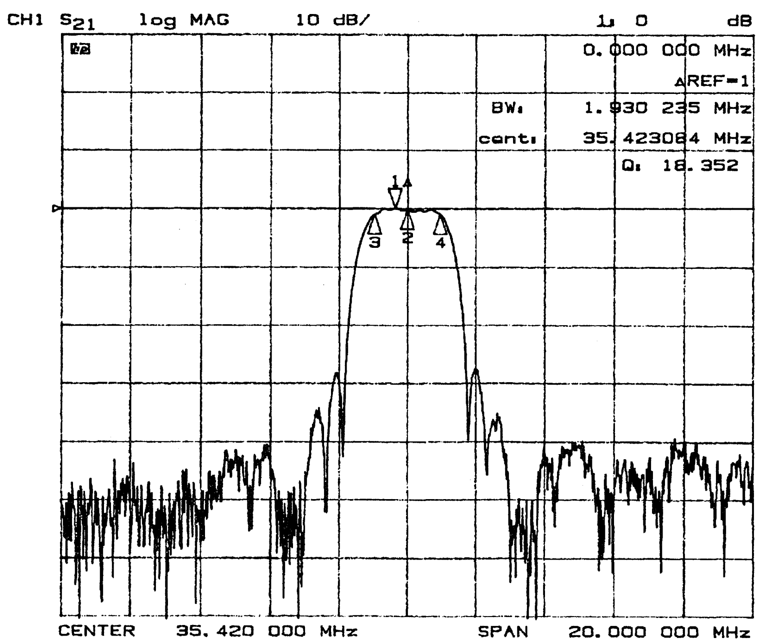
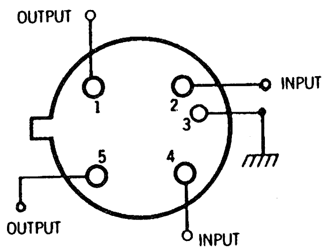
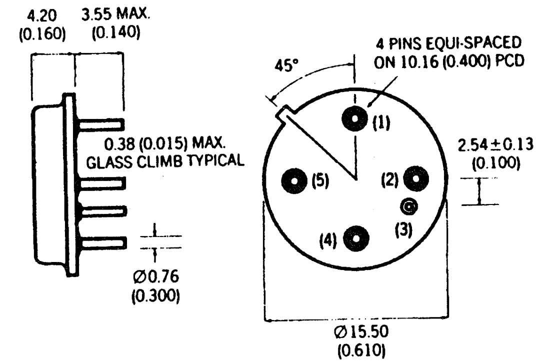


Figure 1: Typical Device Plot

PIN AND PACKAGE DETAILS





GEC PLESSEY
SEMICONDUCTORS

DS3487-1.2 August 1992

DW9240

65.8125MHz LOW LOSS SAW I.F. FILTER FOR PERSONAL COMMUNICATIONS

The DW9240 Low Loss SAW Filter has been developed specifically for the Personal Communications market, where the 1st I.F. Filter Stage is typically in the 60 to 80MHz range. The unique design obviates the need for distinct Roof and Channel Filters usually required to achieve a low shape factor with maximum bandwidth. The filters can be used in single or cascade format, and are available in a low profile, cost effective, surface mountable ceramic package, (alternative packages available upon request).

FEATURES

- Unique Cascade Design Obviates the need for distinct Roof and Channel Filters
- Low Insertion Loss (<7dB Single Filter, <14dB Cascaded Filters)
- Excellent Sidelobe Suppression when used in Cascade
- Low Profile Leadless Surface Mount Package - 40% size reduction against current solutions, (other packages available upon request)
- Hermetically Sealed Package

ELECTRICAL CHARACTERISTICS

Centre Frequency (F_O)	65.8125MHz
Insertion Loss	6.5dB Typ
Passband Characteristics	
1.5dB	F_O ±82.5kHz Min
8.5dB	F_O ±200kHz Max
20dB	F_O ±400kHz Max
25dB	F_O ±600kHz Max
Stop Rejection	
F_O -1.8MHz	38dB Min
F_O ±1MHz to 20MHz	35dB Min
Group Delay Variation	0.5μsec Typ
Maximum Input Level	10dBm
Intermodulation (two tones outside pass band with 800kHz separation)	+19dBm
Impedance In/Out (with external matching)	600R
VSWR In/Out When Matched	1:1.5
Temperature Range	-20° to +85°C

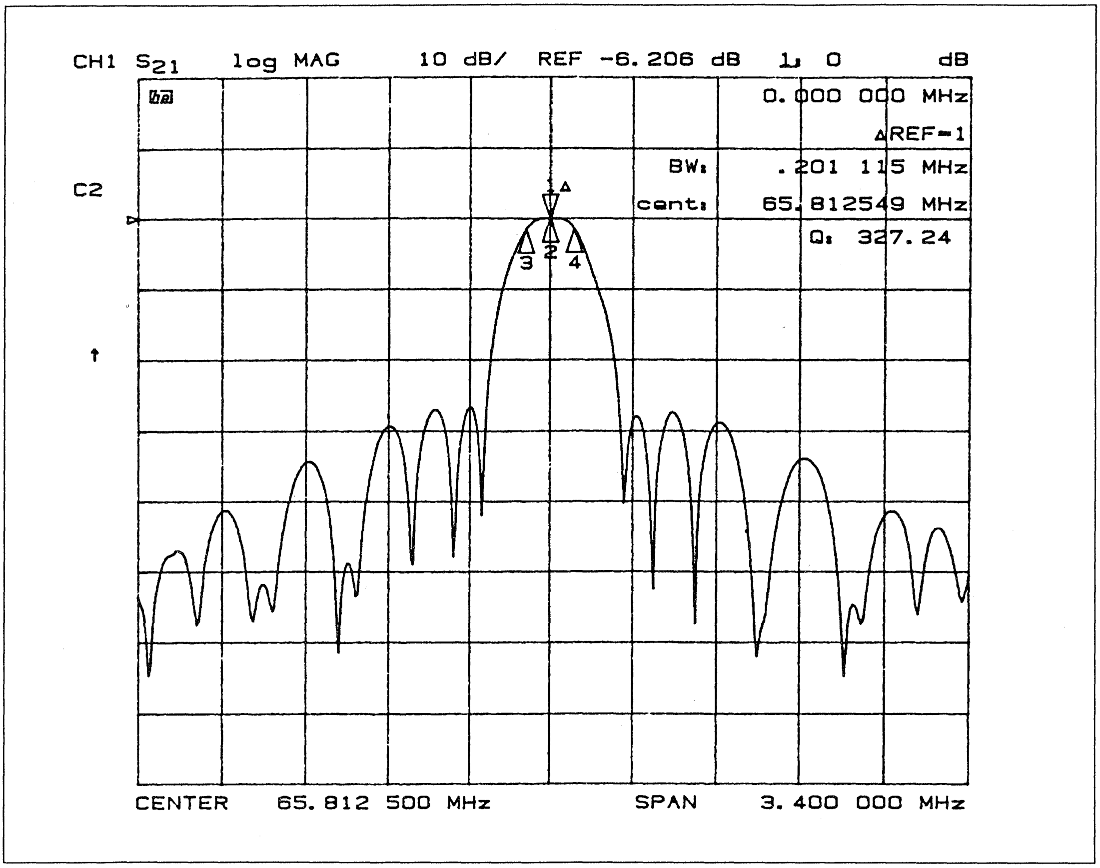
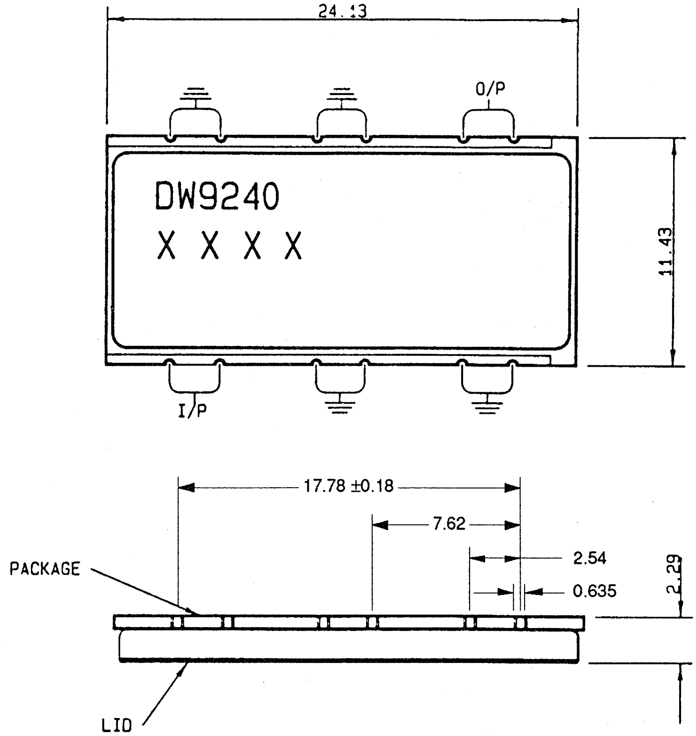


Figure 1: Typical Single Filter Response

PACKAGE DETAILS



DS3532-1.2 August 1992

DW9241

78.8125MHZ LOW LOSS SAW I.F. FILTER FOR PERSONAL COMMUNICATIONS

The DW9241 has been specifically developed for the Personal Communications market, where the 1st I.F. stage filter is typically in the 60 to 80MHz range.

The filter is realised on ST-Quartz, using Single Phase Uni-directional Transducer technology, which provides excellent insertion loss, and temperature stability.

The unique design odviates the need for distinct Roof & Channel filters, usually required to achieve a low shape factor, with maximum bandwidth. The filters can be used in single or cascade format, and are available in a low profile, leadless, surface mount package, which is compatible with most modern manufacturing techniques. Other packages available on request.

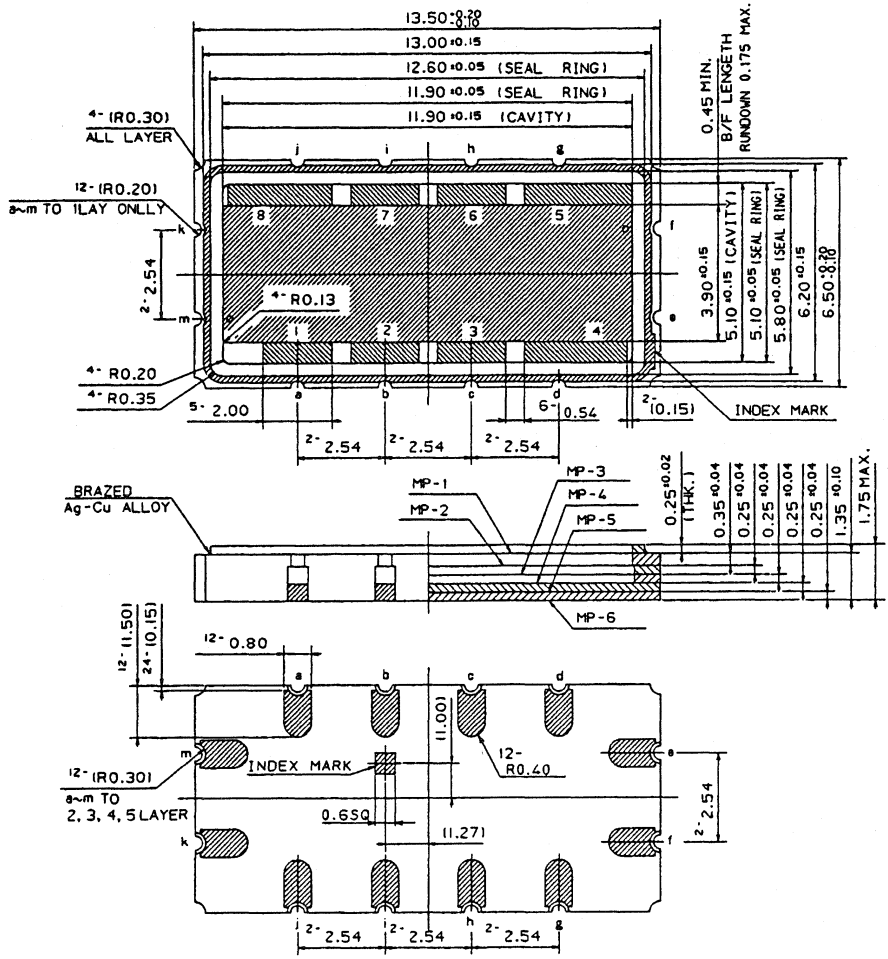
FEATURES

- 78.8125MHz Centre Frequency (f_o)
- Low Insertion Loss (<6dB Single <12dB Cascade)
- Excellent Sidelobe Suppression
- Low Profile, Leadless Surface Mount Package
- Hermetically Sealed Package

ELECTRICAL CHARACTERISTICS

Parameter	Value	Units
Centre Frequency (f_o)	78.8125	MHz
Passband	±85 (Min)	kHz
Insertion Loss	< 6	dB
Passband Ripple	0.5 (Max)	dB
Group Delay	< 0.5	µs
Stopband Rejection: f_o ±200kHz	> 2	dB
f_o ±400kHz	> 12	dB
f_o ±600kHz	> 20	dB
f_o ±800kHz	> 20	dB
-1.625MHz (BW = 200kHz)	> 40	dB
Ultimate Rejection (±1MHz ~ ±25MHz)	> 30	dB
Operating Temperature	-20 to +85	dB

PACKAGE DETAILS



NOTES:

1. PLATING THICKNESS TO BE PER CUSTOMER'S SPECIFICATION.
2. SEAL AREA TO BE METALLIZED.
3. DIE ATTACH AREA TO BE METALLIZED.
4. ELECTRICALLY CONNECTED
   PAD "4" TO PIN NO.e
   PAD "8" TO PIN NO.k
   PADS "1.2.3.5.6.7" TO PIN NO.a.b.c.d.f.g.h.i.j.m AND S/R.D/A.

AN3454-1.2 August 1992

DW9237

433.92MHz SAW RESONATOR APPLICATION NOTE

Surface Acoustic Wave (SAW) resonators are very precise high-Q filters designed for use as the frequency controlling element in oscillators. Compared with other techniques, SAW resonators offer the advantages of quartz stability, fundamental operation at UHF and low microwave frequencies, high-Q (steep phase slope) and low aging rates. These devices are also very compact in size and can operate in rugged environments.

The SAW resonator is essentially a resonator cavity on the surface of a quartz substrate. The cavity consists of many reflectors which reflect the surface acoustic wave onto an interdigital transducer.

The device is packaged in an hermetically sealed metal package (TO-39 style) thus reducing board space requirement to a minimum.

GEC Plessey Semiconductor SAW resonators are available bonded-out for either 0° or 180° insertion phase. Centre frequency setting tolerances of 120ppm and ±200ppm available.

FEATURES

- Quartz Stability of all Electrical Parameters with Very Low Aging Rates - <10ppm/year
- High Q - > 6000 Typical (50Ω Load)
- Excellent Phase Noise Characteristics
- Compact Packaging
- Suitable for Rugged Environments

EQUIVALENT CIRCUITS

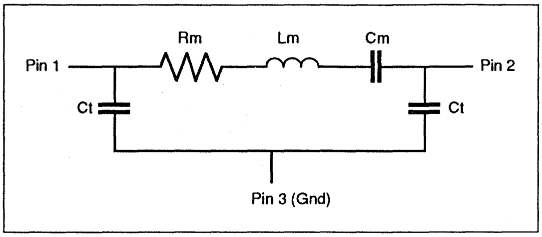


Figure 1: 0° Phase Shift SAW Resonator

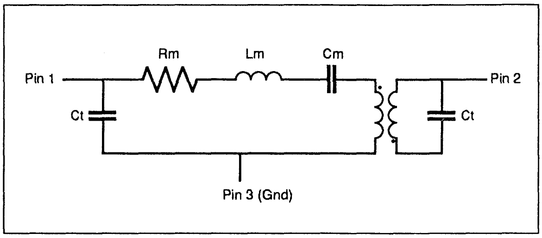


Figure 2: 180° Phase Shift SAW Resonator

ELECTRICAL CHARCTERISTICS

(Chip Temperature = 25°C Unless Otherwise Stated)

Parameter	Min.	Typ.	Max.	Unit
Centre Frequency		433.92		MHz
Setting Tolerance		±100		kHz
Insertion Loss		7.25	9.25	dB
Loaded Q (50Ω load)	5000	6500		
Input / Output Capacitance				pF
Turnover Temperature		0		°C

APPLICATIONS

For oscillator applications the SAW resonator provides the ideal solution for the frequency-controlling element. The following examples illustrate typical applications for SAW resonators.

Figure 3 illustrates a typical circuit for a practical voltage tuned oscillator using discrete transistors and a two-port SAW resonator. The values shown are for use with a 418MHz SAW device and give an R/F output of a few milliwatts.

Simple series inductors are used on either side of the resonator to both tune the Insertion Loss and to create the correct loop phase for the oscillation, together with the varactor tuning inductance. The values of these inductors are interactive in this simple arrangement, but once optimised for a particular layout and specification are repeatable.

The output stage acts as a buffer into the oscillator loop as well as providing a greater output - this may be omitted in some applications.

Suppression of the second harmonic is not fully addressed in this circuit, however there may be some advantage in taking the output from the attenuator side of the resonator where the level of harmonics is lower.

A minimum tuning range of 40kHz between 0v and +5v on the modulation input can be expected.

Figure 4 shows a proposed circuit which utilises a miniature monolithic silicon R/F amplifier as the gain element in the feedback loop. The values shown were used successfully to breadboard a fixed frequency 261MHz oscillator, though a single varactor phase shifter could have been included to provide a frequency modulation capability.

Such integrated amplifiers have the potential to reduce the component count of a SAW oscillator assembly, but there are restrictions imposed by the gain and phase performances available, and the d.c. to R/F efficiencies.

The NEC device chosen for this application has the advantage of requiring no bias components but has higher gain than required, which necessitates the use of attenuators on either side of the SAW resonator. Even so the loop signal level on the breadboard was high thus generating a strong second harmonic which lead to the output being taken after the filtering effect of the resonator.

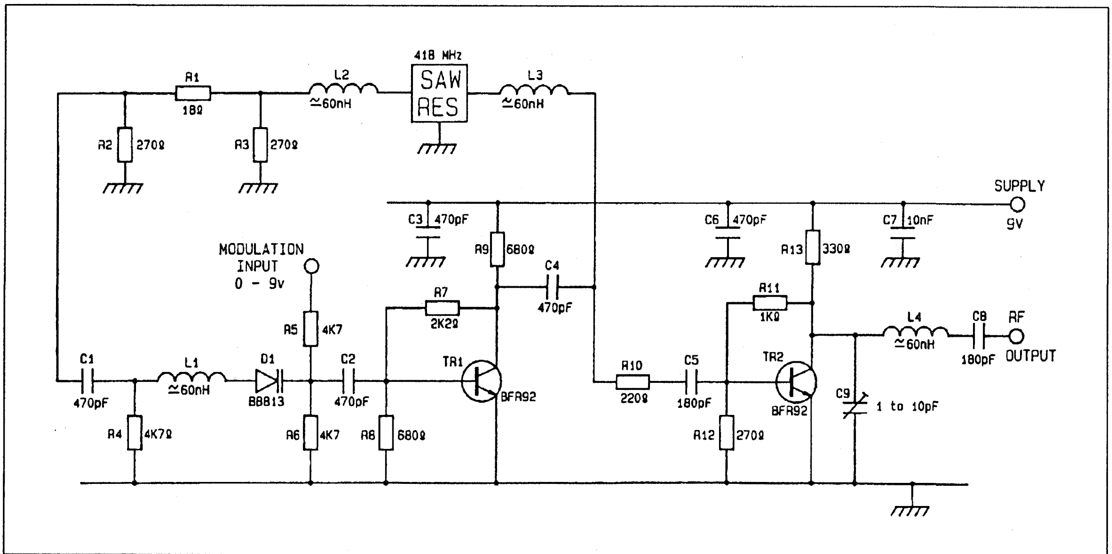


Figure 3: Typical Circuit Using 418MHz SAW Resonator

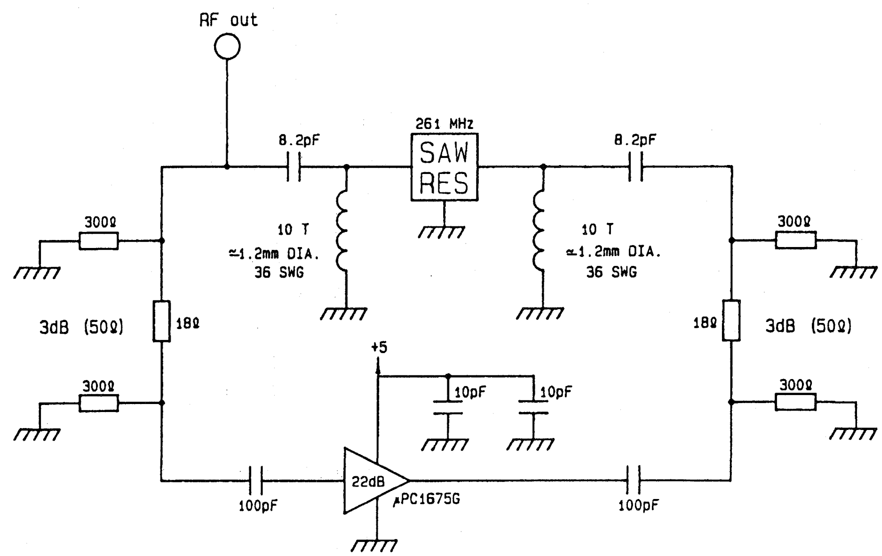
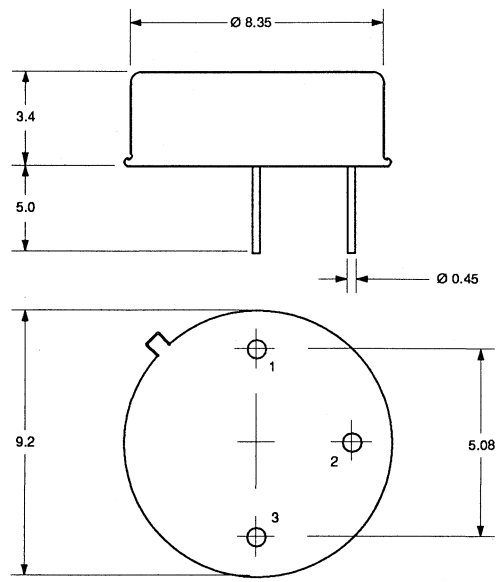


Figure 4: Typical SAW Oscillator Circuit Using 261MHz Resonator plus Monolithic Silicon R/F Amplifier

PACKAGE DETAILS (Dimmensions in mm)

Pin 1 - Input / Output
Pin 2 - Input / Output
Pin 3 - Ground



AN3531-1.2 August 1992

DW9238

418.05MHz SAW RESONATOR APPLICATION NOTE

Surface Acoustic Wave (SAW) resonators are very precise high-Q filters designed for use as the frequency controlling element in oscillators. Compared with other techniques, SAW resonators offer the advantages of quartz stability, fundamental operation at UHF and low microwave frequencies, high-Q (steep phase slope) and low aging rates. These devices are also very compact in size and can operate in rugged environments.

The SAW resonator is essentially a resonator cavity on the surface of a quartz substrate. The cavity consists of many reflectors which reflect the surface acoustic wave onto an interdigital transducer.

The device is packaged in an hermetically sealed metal package (TO-39 style) thus reducing board space requirement to a minimum.

GEC Plessey Semiconductor SAW resonators are available bonded-out for either 0° or 180° insertion phase. Centre frequency setting tolerances of ±120ppm and ±200ppm available.

FEATURES

- Quartz Stability of all Electrical Parameters with Very Low Aging Rates - <10ppm/year
- High Q - > 6000 Typical (50Ω Load)
- Excellent Phase Noise Characteristics
- Compact Packaging (TO-39 Style)
- Suitable for Rugged Environments

EQUIVALENT CIRCUITS

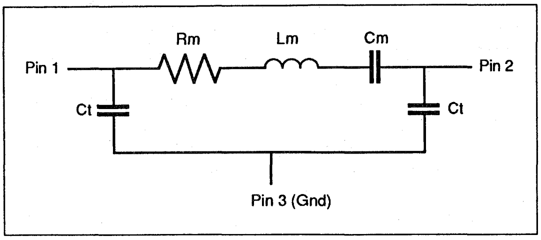


Figure 1: 0° Phase Shift SAW Resonator

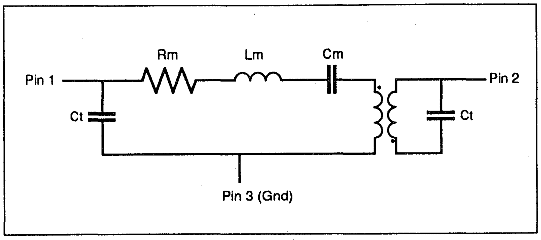


Figure 2: 180° Phase Shift SAW Resonator

ELECTRICAL CHARCTERISTICS

(Chip Temperature = 25°C Unless Otherwise Stated)

Parameter	Min.	Typ.	Max.	Unit
Centre Frequency		418.05		MHz
Setting Tolerance		±75		kHz
Insertion Loss		7.25	9.25	dB
Loaded Q (50Ω load)	5000	7400		
Input / Output Capacitance				pF
Turnover Temperature		0		°C

APPLICATIONS

For oscillator applications the SAW resonator provides the ideal solution for the frequency-controlling element. The following examples illustrate typical applications for SAW resonators.

Figure 3 illustrates a typical circuit for a practical voltage tuned oscillator using discrete transistors and a two-port SAW resonator. The values shown are for use with a 418MHz SAW device and give an R/F output of a few milliwatts.

Simple series inductors are used on either side of the resonator to both tune the Insertion Loss and to create the correct loop phase for the oscillation, together with the varactor tuning inductance. The values of these inductors are interactive in this simple arrangement, but once optimised for a particular layout and specification are repeatable.

The output stage acts as a buffer into the oscillator loop as well as providing a greater output - this may be omitted in some applications.

Suppression of the second harmonic is not fully addressed in this circuit, however there may be some advantage in taking the output from the attenuator side of the resonator where the level of harmonics is lower.

A minimum tuning range of 40kHz between 0v and +5v on the modulation input can be expected.

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Such integrated amplifiers have the potential to reduce the component count of a SAW oscillator assembly, but there are restrictions imposed by the gain and phase performances available, and the d.c. to R/F efficiencies.

The NEC device chosen for this application has the advantage of requiring no bias components but has higher gain than required, which necessitates the use of attenuators on either side of the SAW resonator. Even so the loop signal level on the breadboard was high thus generating a strong second harmonic which lead to the output being taken after the filtering effect of the resonator.

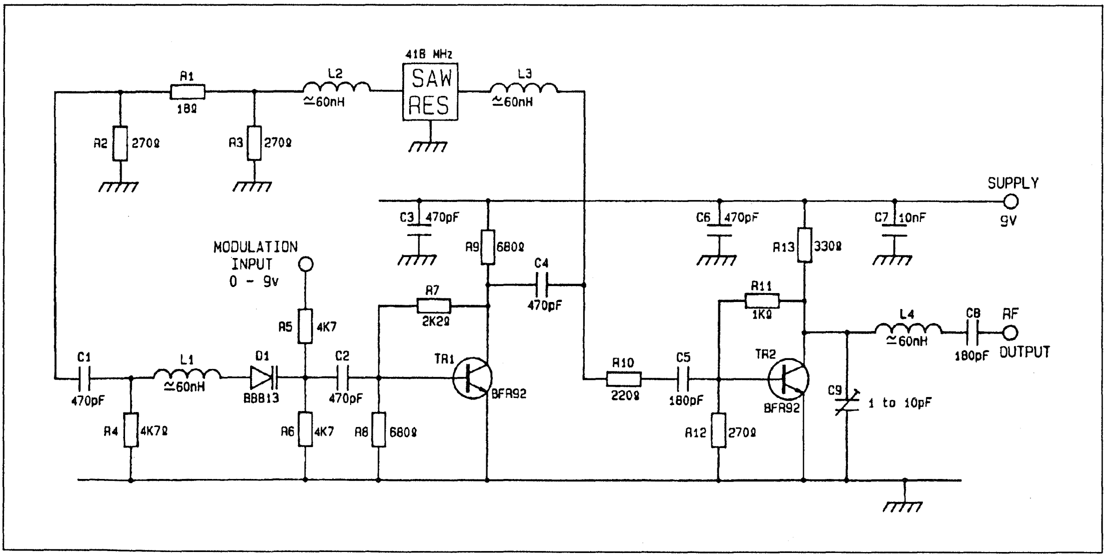


Figure 3: Typical Circuit Using 418MHz SAW Resonator

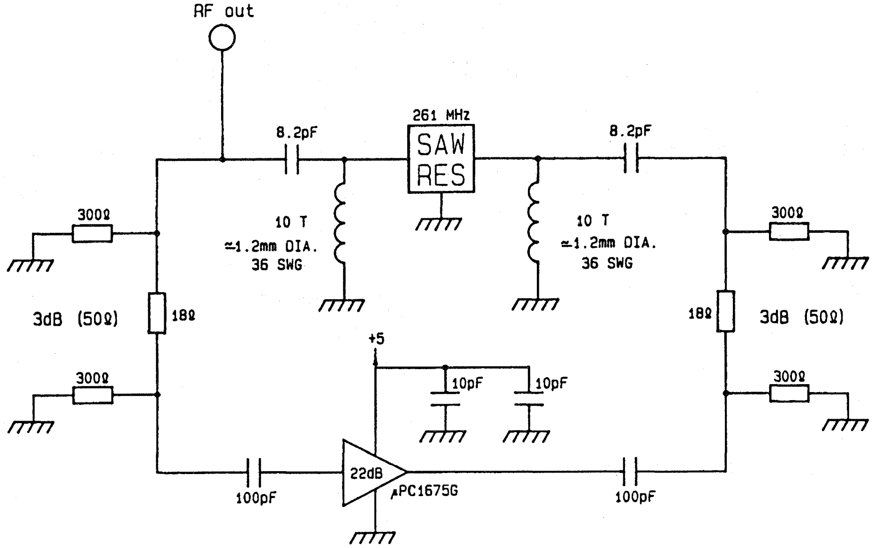
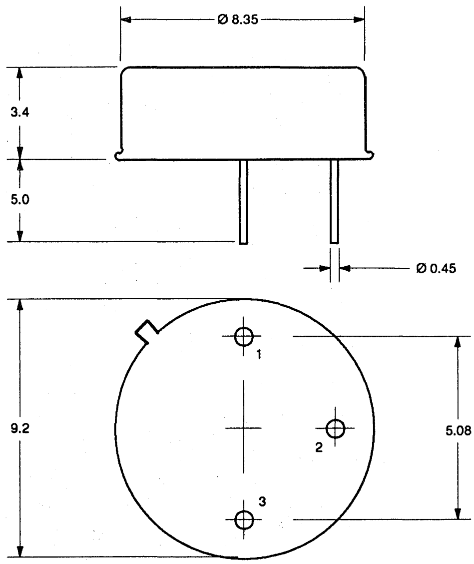


Figure 4: Typical SAW Oscillator Circuit Using 261MHz Resonator plus Monolithic Silicon R/F Amplifier

PACKAGE DETAILS (Dimmensions in mm)

Pin 1 - Input / Output
Pin 2 - Input / Output
Pin 3 - Ground



DS3456-1.2 August 1992

DA9200

200MHz BANDPASS SAW FILTER

The DA9200 is a linear phase SAW bandpass filter designed for use in radar and communication systems. The filter is ideal for I.F. applications due to its low shape factor, high stopband attenuation, compact size and excellent temperature stability.

FEATURES

- 200MHz Centre Frequency
- Narrow Bandwidth (~0.3%)
- Low Shape Factor
- Compact Size
- Excellent Temperature Stability (ST-Quartz)

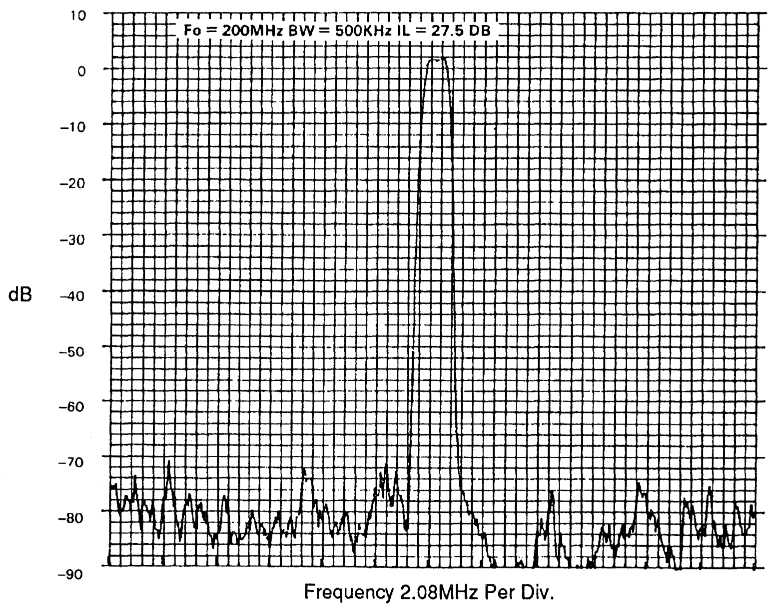
ELECTRICAL CHARACTERISTICS

Parameter	Value	Units
Centre Frequency	200	MHz
Centre Frequency Tolerance	±100	kHz
3dB Bandwidth	700 ±100	kHz
Insertion Loss	26 ±2	dB
Passband Ripple	0.9 (+.6/-.4)	dB
Stopband Attenuation @ ±700kHz	55 (+15/-5)	dB
DC to 700MHz	55 (+15/-5)	dB
Group Delay	5.0	µs
Nominal Impedance	50	Ω

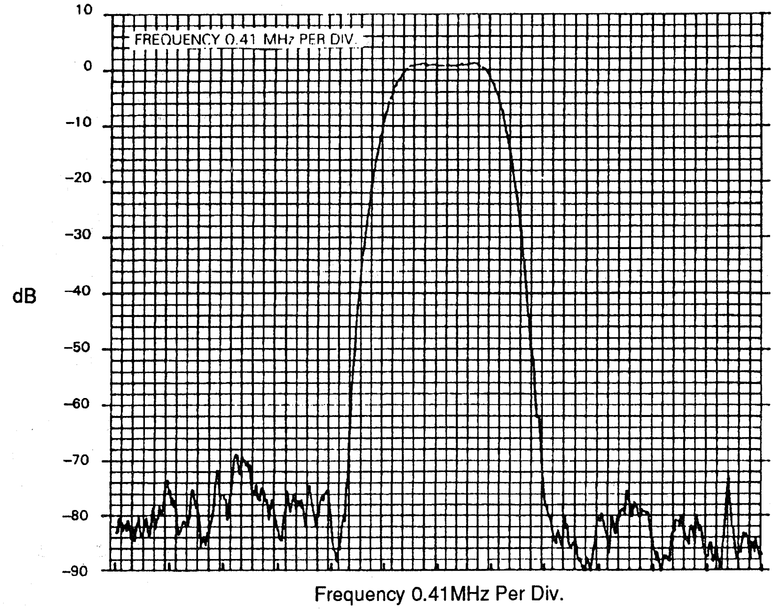
ENVIRONMENTAL / MECHANICAL

Parameter	Value	Units
Operating Temperature	-40 to +85	°C
Storage Temperature	-50 to +90	°C
Weight	< 10	g

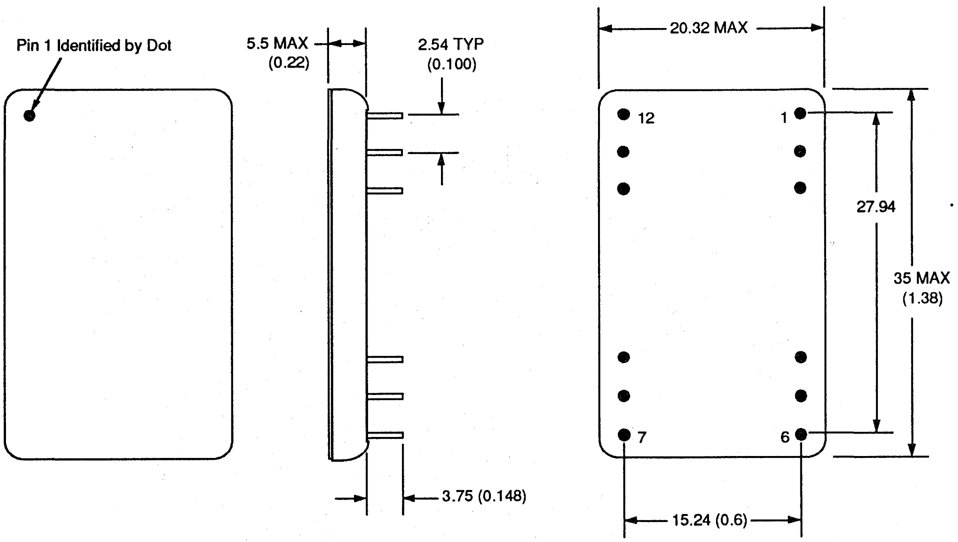
PLOTS



PLOTS (Continued)



OUTLINE



DS3502-1.2 August 1992

DA9201

200MHz BANDPASS SAW FILTER - WIDEBAND

The DA9201 is a linear phase SAW bandpass filter designed for use in radar and communication systems. The filter is ideally suited to I.F. applications due to its wide bandwidth (~8%), high stopband attenuation, compact size and excellent temperature stability (ST-Quartz).

FEATURES

- 200MHz Centre Frequency
- Wide Bandwidth (~8%)
- High Stopband Attenuation
- Compact Size
- Excellent Temperature Stability (ST-Quartz)

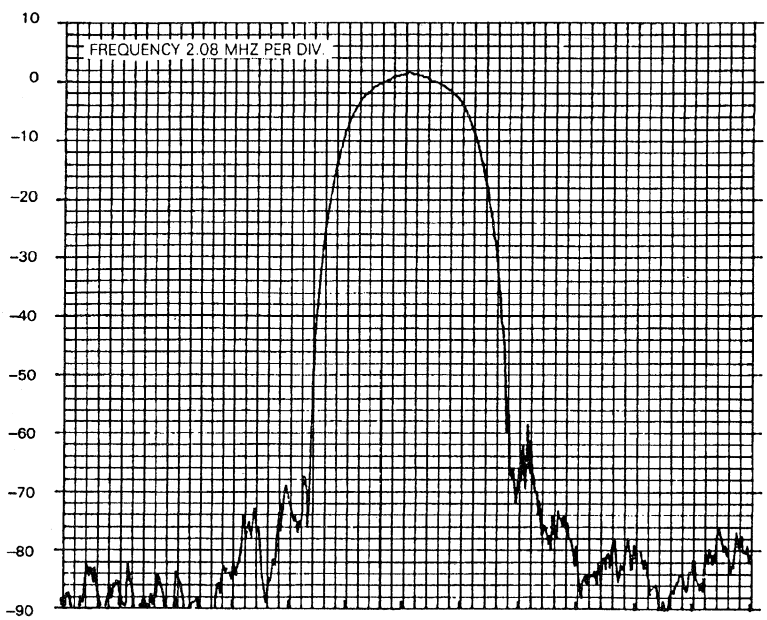
ELECTRICAL CHARACTERISTICS

Parameter	Value	Units
Centre Frequency	200	MHz
Centre Frequency Tolerance	±100	kHz
4dB Bandwidth	16.1 (+.3/-1.1)	MHz
Insertion Loss	34 (+1/-2)	dB
Passband Ripple	0.2 (+.1/-0)	dB
Stopband Attenuation @ ±20MHz	55 ±5	dB
DC to 700MHz	55 ±5	dB
Nominal Impedance	50	Ω

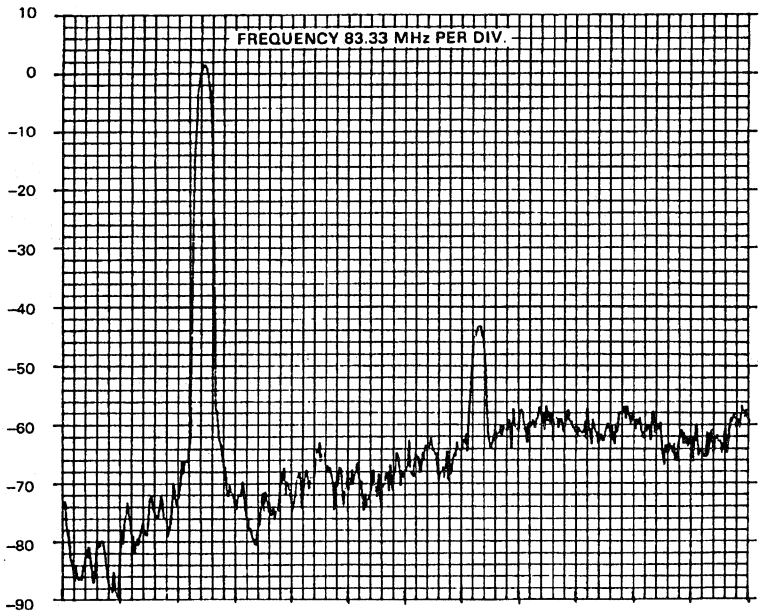
ENVIRONMENTAL / MECHANICAL

Parameter	Value	Units
Operating Temperature	-40 to +85	°C
Storage Temperature	-50 to +90	°C
Weight	< 10	g

PLOTS



PLOTS (Continued)



GEC PLESSEY
SEMICONDUCTORS

DS3457-1.2 August 1992

DA9202

10.7MHz BANDPASS SAW FILTER

The DA9202 is a linear phase bandpass filter operating at 10.7MHz with a 3.0% bandwidth. Its low shape factor, minimum phase diviation, high temperature stability together with its compact size and rugged construction make it ideal for use in I.F. systems.

FEATURES

- 10.7MHz Centre Frequency
- Low Shape Factor
- Minimum Phase Deviation
- High Temperature Stability
- Compact, Rugged Construction

ELECTRICAL CHARACTERISTICS

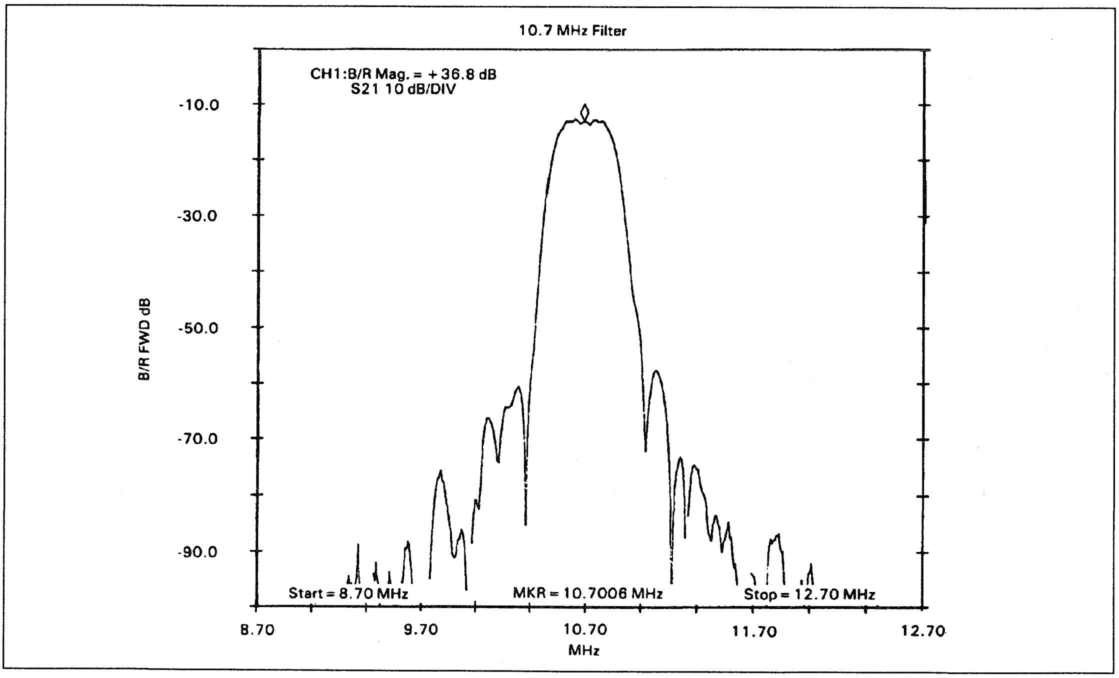
Parameter	Value	Units
Centre Frequency	10.7	MHz
Centre Frequency Tolerance	±12	kHz
3dB Bandwidth	330 (+1/-10)	kHz
Insertion Loss	13.5 (+1/-0)	dB
Passband Ripple	1.0 (+.5/-0)	dB
Stopband Attenuation:		
±187.5kHz	6 (+0/-1)	dB
±375kHz	50 (+0/-5)	dB
to 500MHz	45 (+0/-5)	dB
Group Delay Ripple	1.5 (+1/-0)	µs

ENVIRONMENTAL / MECHANICAL

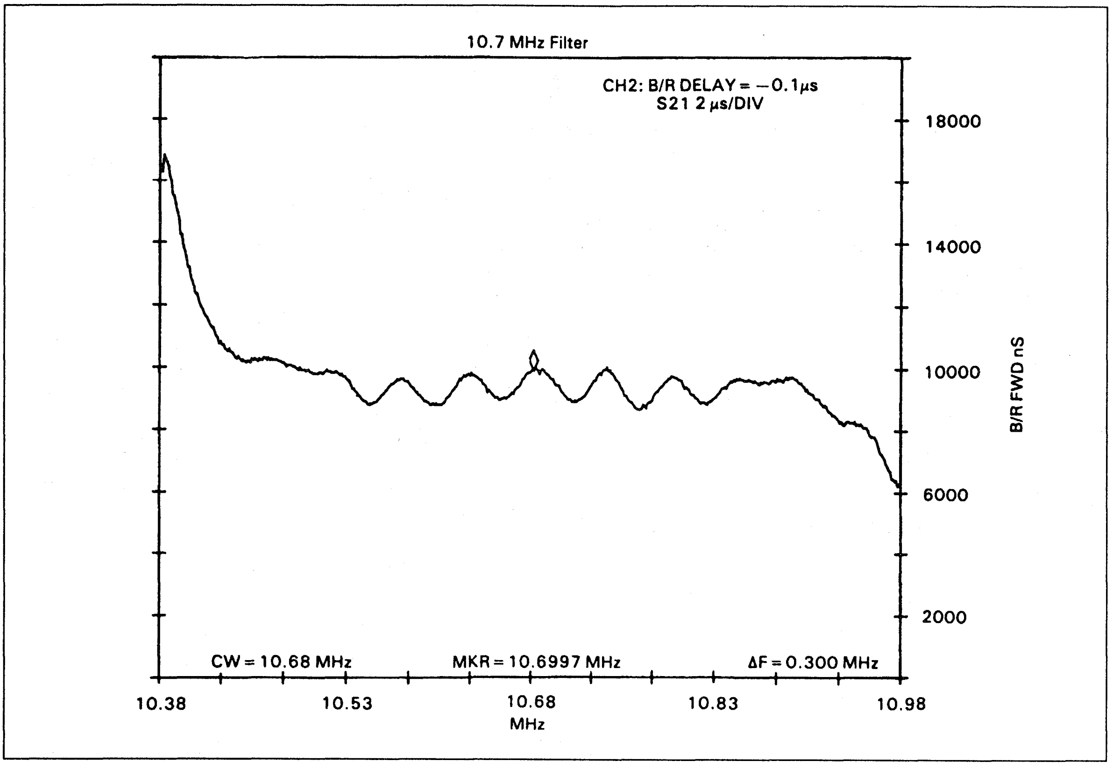
Parameter	Value	Units
Operating Temperature	-26 to +80	°C
Storage Temperature	-40 to +80	°C
Weight	34	g

Finish Nickle Plate

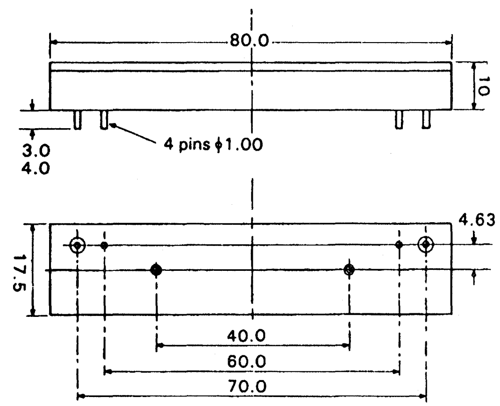
PLOTS



PLOTS (Continued)



PACKAGE DETAILS



DS3458-1.2 August 1992

DA9203

63.5MHz BANDPASS SAW FILTER

The DA9203 is a linear phase bandpass filter operating at 63.5MHz with a 0.4% bandwidth. Its low shape factor, minimum phase deviation, high temperature stability, together with its compact size and rugged construction make it ideal for use in I.F. systems.

FEATURES

- 63.5MHz Centre Frequency
- Low Shape Factor
- Minimum Phase Deviation
- High Temperature Stability
- Compact, Rugged Construction

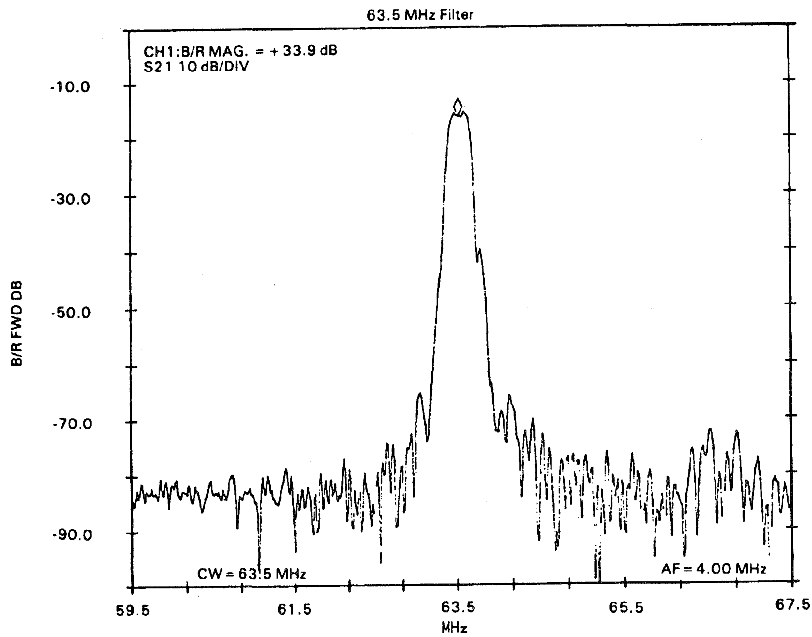
ELECTRICAL CHARACTERISTICS

Parameter	Value	Units
Centre Frequency	63.5	MHz
Centre Frequency Tolerance	±12	kHz
3dB Bandwidth	258 (+16/-9)	kHz
Insertion Loss	14.5 (+1/-0)	dB
Passband Ripple	1.0 (+.5/-0)	dB
Stopband Attenuation:		
±187.5kHz	16 (+0/-1)	dB
±375kHz	45 (+0/-5)	dB
to 500MHz	45 (+0/-5)	dB
Group Delay Ripple	1.5 (+1/-0)	µs

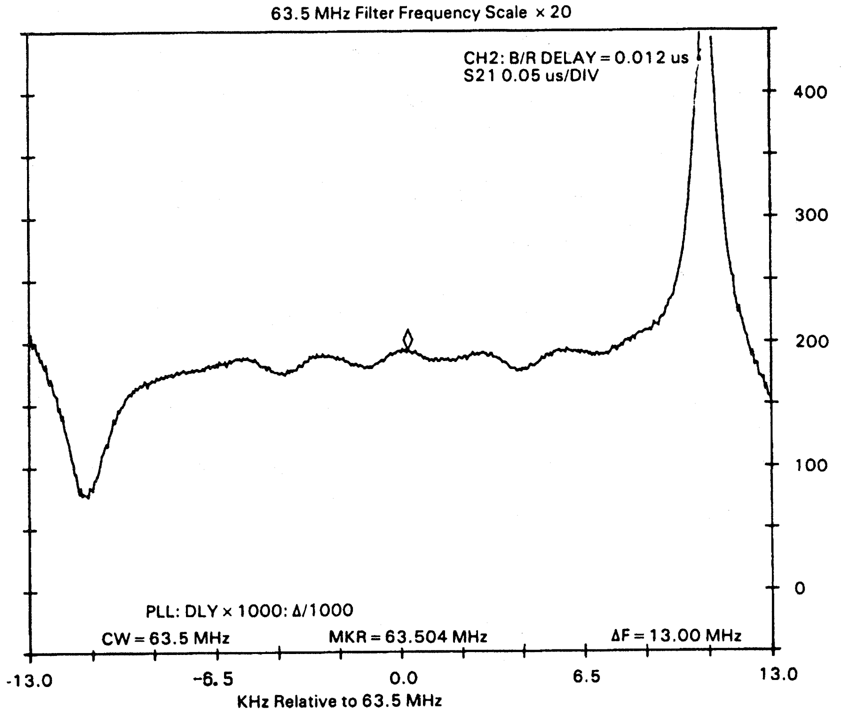
ENVIRONMENTAL / MECHANICAL

Parameter	Value	Units
Operating Temperature	-26 to +80	°C
Storage Temperature	-40 to +80	°C
Weight	24	g
Finish	Nickle Plate	

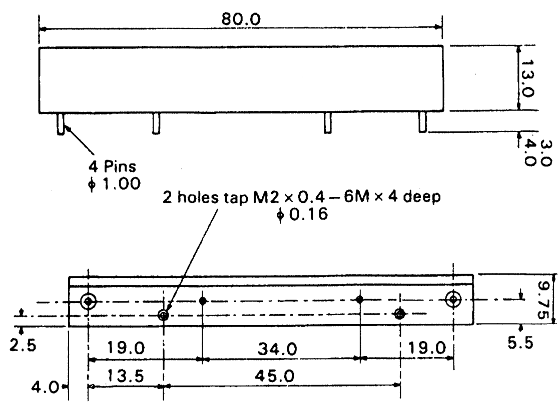
PLOTS



PLOTS (Continued)



OUTLINE DETAILS



DS3461-1.1 July 1992

DW9206

324.315MHz HIGH RELIABILITY SAW FILTER

The DW9206 is a high reliability SAW filter, with a centre frequency of 324.315MHz, which has been designed to operate within the ambient temperature range 0°C to 40°C for periods in excess of 25 years. This is without degradation of performance, and with minimum shift in centre frequency of less than ±1.5ppm.

FEATURES

- Centre Frequency 324.315MHz ±0.01MHz
- 3dB Bandwidth 2.0MHz ±0.1MHz
- Excellent Stability (Centre Frequency Shift < ±1.5ppm Per Annum)
- High Reliability Performance > 25 Years (@ Ambient Temperature 0°C to 40°C)

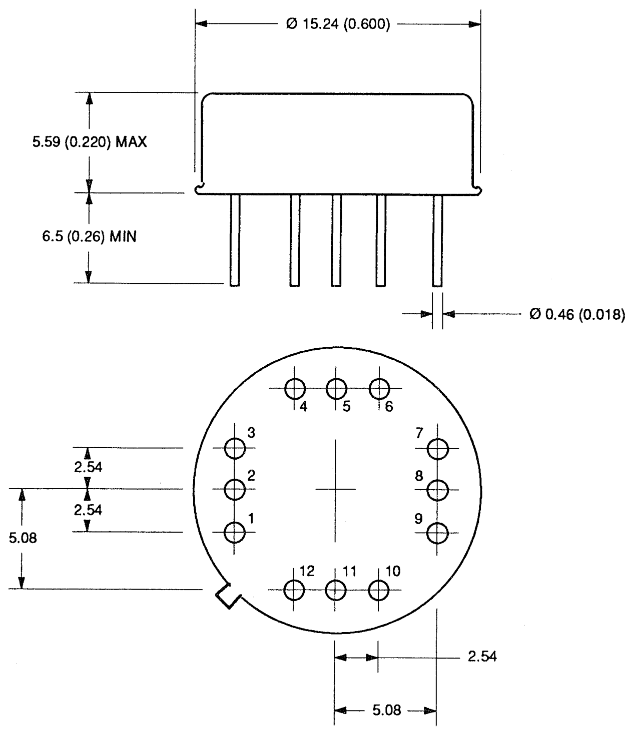
ELECTRICAL CHARACTERISTICS

(@ 25°C unless otherwise stated)

Parameter	Value	Units
Centre Frequency	324.315	MHz
Setting Accuracy	±0.01	MHz
3dB Bandwidth	2.0 ±0.1	MHz
Passband Loss	23.5 ±1.5	dB
Group Delay @ F_O = 324.315MHz	337 ±15	ns
Operating Temperature Range	0 to +40	°C
Storage Temperature Range	-10 to +50	°C

PACKAGE OUTLINE

1	RF INPUT
3	RF INPUT
7	RF OUTPUT
9	RF OUTPUT



DS3462-1.1 July 1992

DW9211

295.6MHz HIGH RELIABILITY SAW FILTER

The DW9211 is a high reliability SAW filter, with a centre frequency of 295.6MHz, which has been designed to operate within the ambient temperature range 0°C to 40°C for periods in excess of 25 years. This is without degradation of performance, and with minimum shift in centre frequency of less than ±1.5ppm.

FEATURES

- Centre Frequency 295.6MHz ±0.03MHz
- 3dB Bandwidth 0.37MHz ±0.03MHz
- Excellent Stability (Centre Frequency Shift < ±1.5ppm Per Annum)
- High Reliability Performance > 25 Years (@ Ambient Temperature 0°C to 40°C)

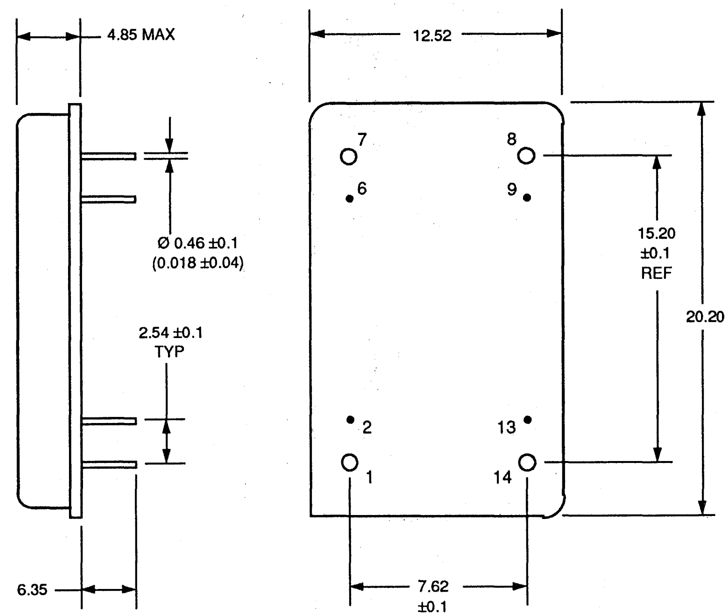
ELECTRICAL CHARACTERISTICS

(@ 25°C unless otherwise stated)

Parameter	Value	Units
Centre Frequency	295.6	MHz
Setting Accuracy	±0.03	MHz
3dB Bandwidth	0.37 ±0.03	MHz
Passband Loss	15.3 ±1.0	dB
Group Delay @ F_O = 295.6MHz	1650 ±50	ns
Operating Temperature Range	0 to +40	°C
Storage Temperature Range	-10 to +50	°C

PACKAGE OUTLINE

1	RF INPUT
7	RF INPUT
8	RF OUTPUT
14	RF OUTPUT



DS3444-1.2 August 1992

DW1101/02/03/04, DW1121 & DW1152

70MHz PROFESSIONAL BANDPASS SAW FILTERS

GPS have developed a range of Surface Acoustic Wave Filters suitable for use in radar, radio communications and ECM systems, which have an I.F. frequency of 70MHz.

Operating Temperature -10°C to +70°C

Test Temperature +25°C ±3°C

FEATURES

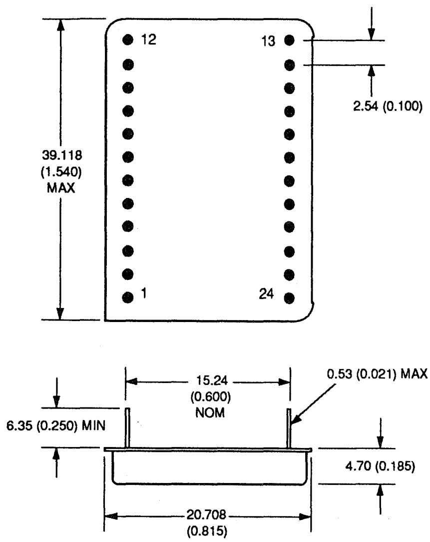
- Excellent Temperature Stability
- Low In-Band Ripple
- Good Out-of-Band Rejection
- Hermetically Sealed Package
- Range of Bandwidths Available

ELECTRICAL SPECIFICATION

Characteristics	DW1101	DW1102	DW1103	DW1104	DW1121	DW1152	Units
Centre Frequency	70	70	70	70	70	70	MHz
1dB Bandwidth (typ)	1.20	2.24	4.65	9.00	0.65	26.0	MHz
3dB Bandwidth (typ)	1.40	2.54	5.40	10.20	0.80	28.0	MHz
Rejection Bandwidth (typ) @ 40dB	2.15	3.60	8.95	16.90	1.30	36.00	MHz
Ultimate Rejection (min)	50	45	50	45	50	50	dB
Insertion Loss (typ)	25	23	23	23	23	22	dB
Group Delay (typ)	4.3	2.0	1.1	1.0	-	Note 1	µs
Package Style (Note 2)	A	A	B	A	A	C	-

Notes: 1. Group Delay Ripple = 60ns p-p.
2. Other packages available upon request.

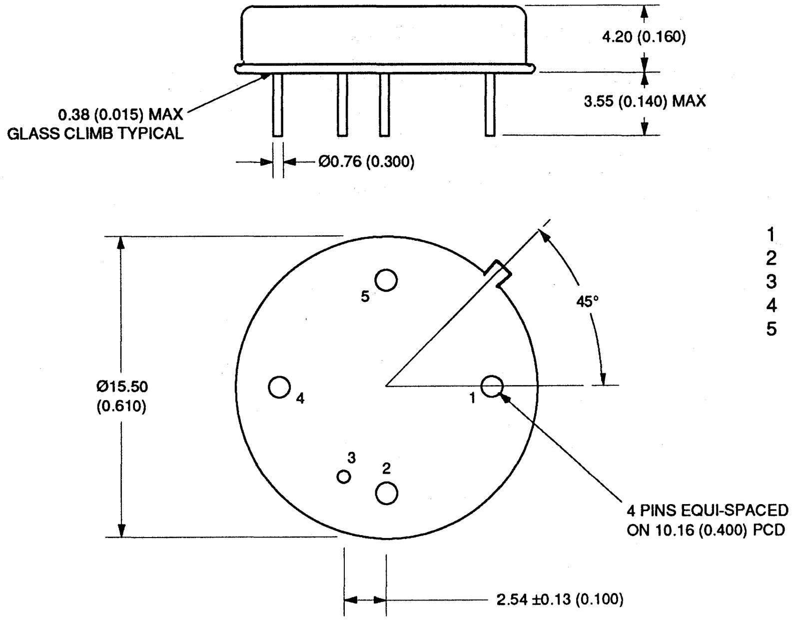
PACKAGE OUTLINES



2	Ground
3	Input
4	Ground
10	Ground
11	Ground
12	Ground
14	Ground
15	Output
16	Ground
22	Ground
23	Ground
24	Ground

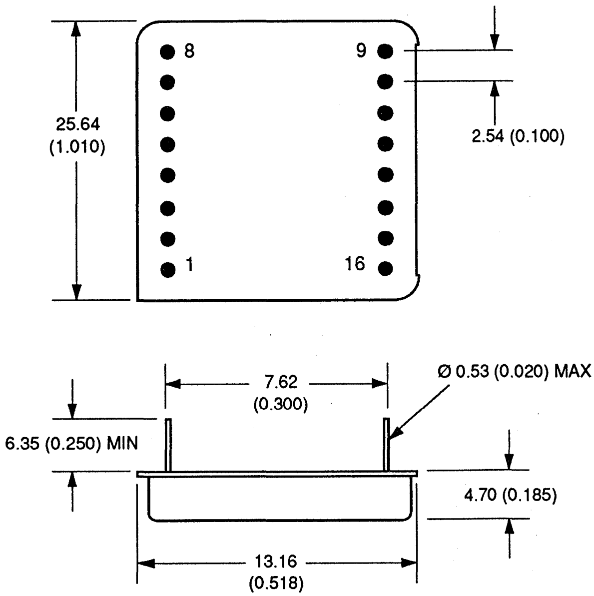
Package Type A

PACKAGE OUTLINES (Continued)



1 Output
2 Ground
3 Ground
4 Input
5 Ground

Package Type B



1 Ground
2 Input
3 Ground
4 NC
5 NC
6 NC
7 Ground
8 Ground
9 Ground
10 Output
11 Ground
12 NC
13 NC
14 NC
15 Ground
16 Ground

Package Type C

DS3445-1.2 August 1992

DW1105/06/08

160MHz PROFESSIONAL BANDPASS SAW FILTERS

GPS have developed a range of Surface Acoustic Wave Filters suitable for use in radar, radio communications and ECM systems, which have a frequency of 160MHz.

Operating Temperature -10°C to +70°C

Test Temperature +25°C ±3°C

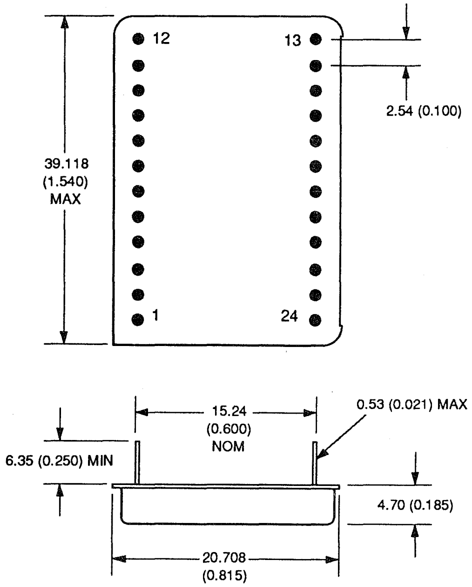
FEATURES

- Excellent Temperature Stability
- Low In-Band Ripple
- Good Out-of-Band Rejection
- Hermetically Sealed Package
- Range of Bandwidths Available

ELECTRICAL SPECIFICATION

Characteristics	DW1105	DW1106	DW1108	Units
Centre Frequency	160	160	160	MHz
1dB Bandwidth (typ)	1.10	2.10	9.50	MHz
3dB Bandwidth (typ)	1.40	2.60	10.90	MHz
Rejection Bandwidth (typ) @ 40dB	2.10	4.10	18.00	MHz
Ultimate Rejection (min)	50	50	50	dB
Insertion Loss (typ)	25	25	23	dB
Group Delay (typ)	3.5	4.5	0.7	µs
Package Style	A	A	B	-

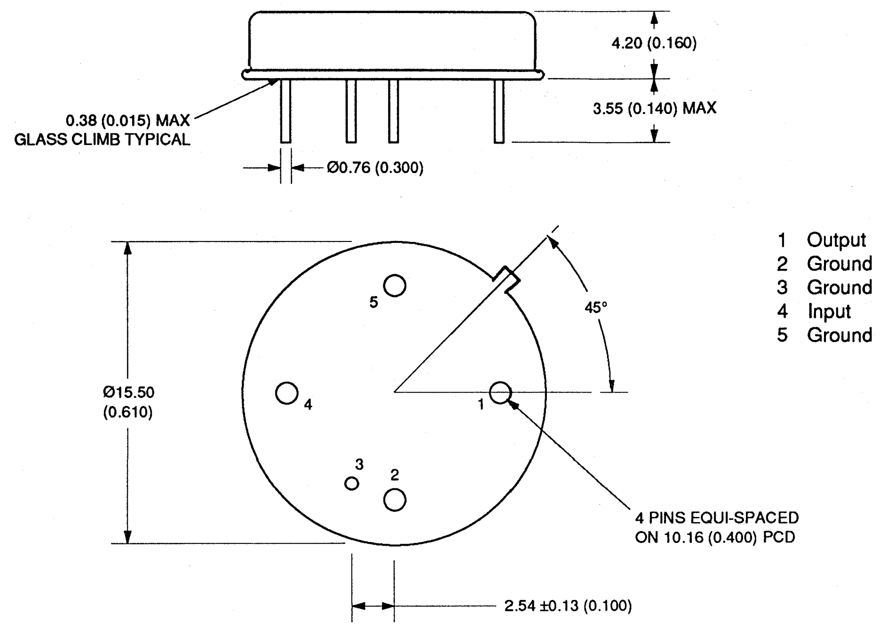
PACKAGE OUTLINES



2	Ground
3	Input
4	Ground
10	Ground
11	Ground
12	Ground
14	Ground
15	Output
16	Ground
22	Ground
23	Ground
24	Ground

Package Type A

PACKAGE OUTLINES (Continued)



Package Type B

DS3443-1.2 August 1992

DW1147 & DW1155

21.4MHz PROFESSIONAL BANDPASS SAW FILTERS

GPS have developed a range of Surface Acoustic Wave Filters suitable for use in radar, radio link and ECM systems, which have an I.F. frequency of 21.4MHz.

FEATURES

- Excellent Temperature Stability
- Low In-Band Ripple
- Good Out-of-Band Rejection
- Hermetically Sealed Package
- Range of Bandwidths Available

1 - Input
2 - Ground
3 - Ground
4 - Ground
5 - Output
6 - Ground
7 - Ground
8 - Ground

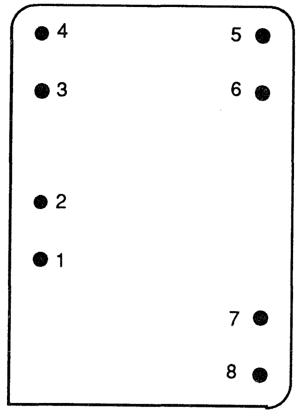


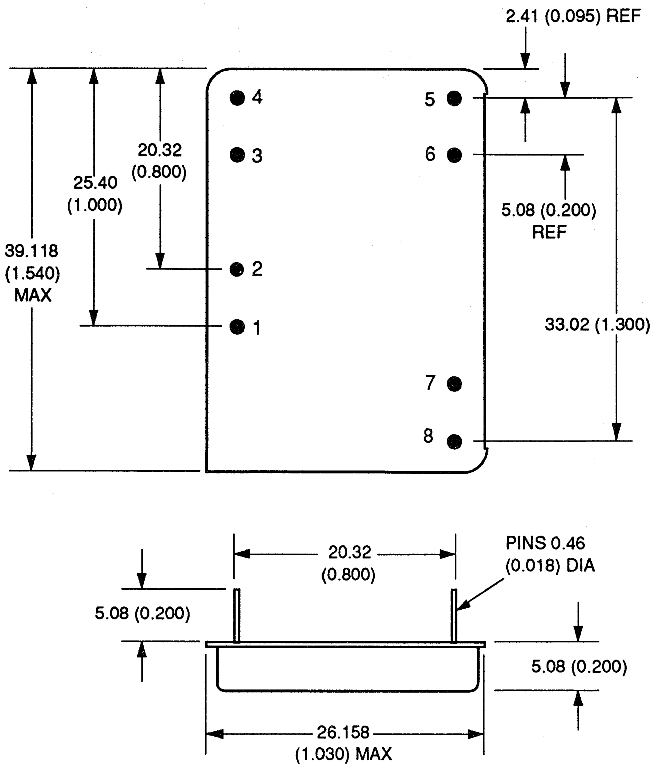
Figure 1: Pin Connections - Bottom View

ELECTRICAL SPECIFICATION

Characteristics	DW1147	DW1155	Units
Centre Frequency	21.4	21.4	MHz
1dB Bandwidth (typ)	220	750	kHz
3dB Bandwidth (typ)	350	800	kHz
Rejection Bandwidth (typ) @ 45dB	900	1450	kHz
Ultimate Rejection (min)	50	45	dB
Insertion Loss (typ)	17	20	dB
Group Delay Ripple (p-p over -3dB b/w)	250	-	ns

Operating Temperature -10°C to +70°C
Test Temperature +25°C ±3°C
Insertion quoted through tuned ports.
Further information available upon request.

PACKAGE OUTLINE



GEC PLESSEY
SEMICONDUCTORS

CT3447-1.2 August 1992

VESTIGIAL SIDEBAND FILTERS FOR PROFESSIONAL APPLICATIONS

GPS's range of Surface Acoustic Wave filters provide IF filtering for most current TV systems. The filters are designed for use in TV modulators and transposers, and are available without sound, with one sound channel, or with stereo sound.

FEATURES

- Filters for System B/G, I, M & K TV Standards
- Linear Phase Characteristics
- Low Amplitude and Group Delay Ripple
- Sidelobe Levels Better Than 50dB
- Hermetically Sealed Package

FILTER	SYSTEM	SOUND	REMARKS	PACKAGE STYLE
DW1401-G	B/G	None		A
DW1404-G	B/G	1		A
DW1406-G	B/G	None		A
DW1408-G	B/G	Stereo		A
DW1409-G	B/G	Stereo		D
DW1411-G	B/G			A
DW2501-G	B/G	None		A
DW1502-I	I	1		A
DW1503-I	I	1		A
DW1505-I	I	1		A
DW9231-I	I	1	NICAM Sound Filter	D
DW9232-I	I	None	NICAM Vision Filter	D
DW1603-M	M	None		D
DW1605-M	M	1		D
DW1701-K	K	None		A
DW1702-K	K	1		A

ELECTRICAL CHARACTERISTICS

Test Conditions (unless otherwise stated):
Temperature = +23°C ±2°C
Load and source impedances = 50Ω

SYSTEM B/G FILTERS	DW1401-G		DW1404-G		DW1406-G		DW1408-G		DW1409-G		DW1411-G		DW2501-G		Units
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	
Passband	34.4 to 39.4		33.65 to 38.9		34.4 to 39.4		33.15 to 38.9		33.65 to 39.15		33.15 to 39.65				MHz
Insertion Loss	29	32	29	32	30	32	29	32	29	32	24	33	28		dB
Passband Ripple	±0.3	±0.5	±0.4	±0.5	±0.15	±0.2		±0.2		±0.5		±0.4		±0.5	dB
Group Delay Ripple	45	60	50	60	40	50		40		40		48		50	ns p-p
Sound	None		1 Channel		None		Stereo		Stereo						-

SYSTEM I FILTERS	DW1502-I		DW1503-I		DW1505-I		DW9231-I		DW9232-I		Units
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	
Passband	34.25 to 41.25		33.4 to 40.9				33.55 to 38.9		32.1 to 33.0		MHz
Insertion Loss	29	30	29	30	29	30		30		30	dB
Passband Ripple	±0.15	±0.25	±0.15	±0.2		±0.5		±0.3		±0.3	dB
Group Delay Ripple	30	40	30	40		60		40		40	ns p-p
Sound	1 Channel		None		1 Channel		1 Channel		None		-

SYSTEM M FILTERS	DW1603-M		DW1605-M		Units
	Typ	Max	Typ	Max	
Passband	42.17 to 46.25		40.75 to 46.5		MHz
Insertion Loss	30	32	26	29	dB
Passband Ripple		±0.5		±0.5	dB
Group Delay Ripple		50		40	ns p-p
Sound	None		1 Channel		-

SYSTEM K FILTERS	DW1701-K		DW1702-K		Units
	Typ	Max	Typ	Max	
Passband	30.5 to 38.25		29.0 to 38.5		MHz
Insertion Loss	25	26	32	26	dB
Passband Ripple	±0.5		±0.5		dB
Group Delay Ripple		40		40	ns p-p
Sound	None		1 Channel		-

ABSOLUTE MAXIMUM RATINGS

Storage and Operating Temperature = -10°C to +70°C
Maximum Voltage = See Operating Note 1
Input Power = +20dBm

OPERATING NOTES

1. Coupling Capacitors

Although there is no DC path within the SAW filter it is advisable to keep any applied DC voltage to <100mV.

Prolonged exposure to voltages in excess of this may adversely affect the life of the filter. Short-term exposure to voltages up to 30 volts should not cause any problems.

2. Temperature Effects

The characteristics of SAW filters of this type behave in a simple predictable manner with temperature. The temperature coefficient of frequency is -90ppm/°C. For example the rejection at 45°C and 40.15MHz will be the same as that at 25°C and 40.22MHz.

3. Mounting Precautions

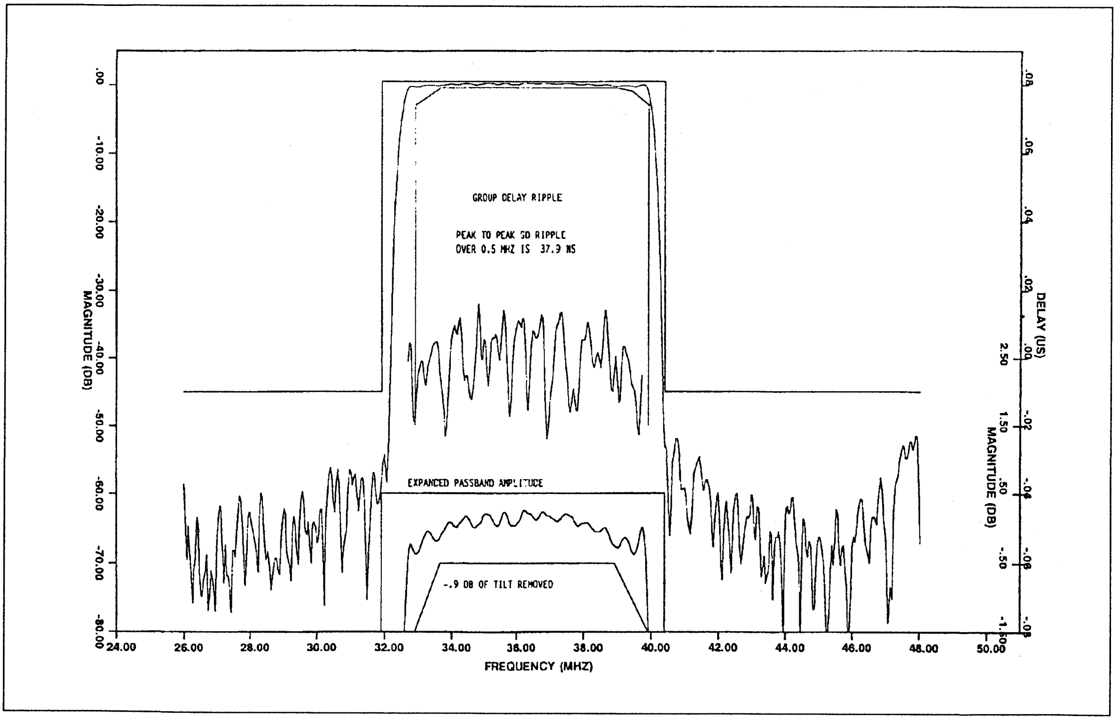
In order to achieve the quoted rejections it is important to prevent excessive direct breakthrough signals. Normal high frequency precautions such as the use of continuous ground plane and short component leads are necessary. It is most important that the SAW filter is well grounded. All the earth leads on the package should be connected to the ground plane by short connections - plated through holes are ideal.

Direct breakthrough signals produce two main effects:

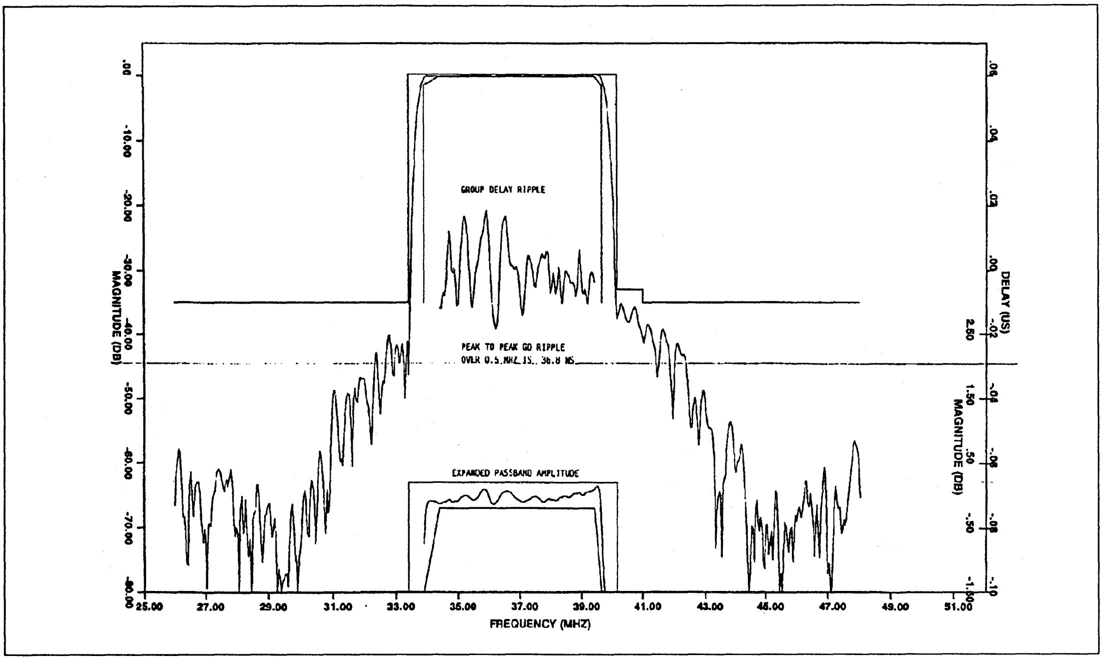
- Specified out of band rejections not achieved
- Passband ripple is excessive

A simple method to check that the grounding is adequate is to connect the package directly to the ground plane temporarily, and check that the frequency response does not change.

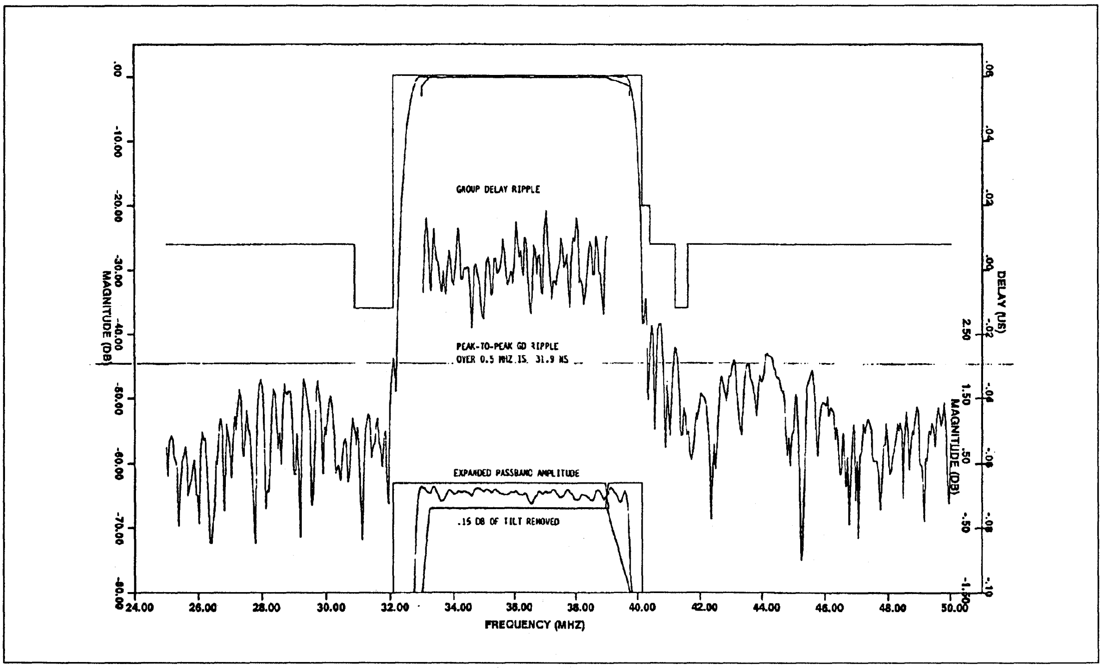
PLOTS



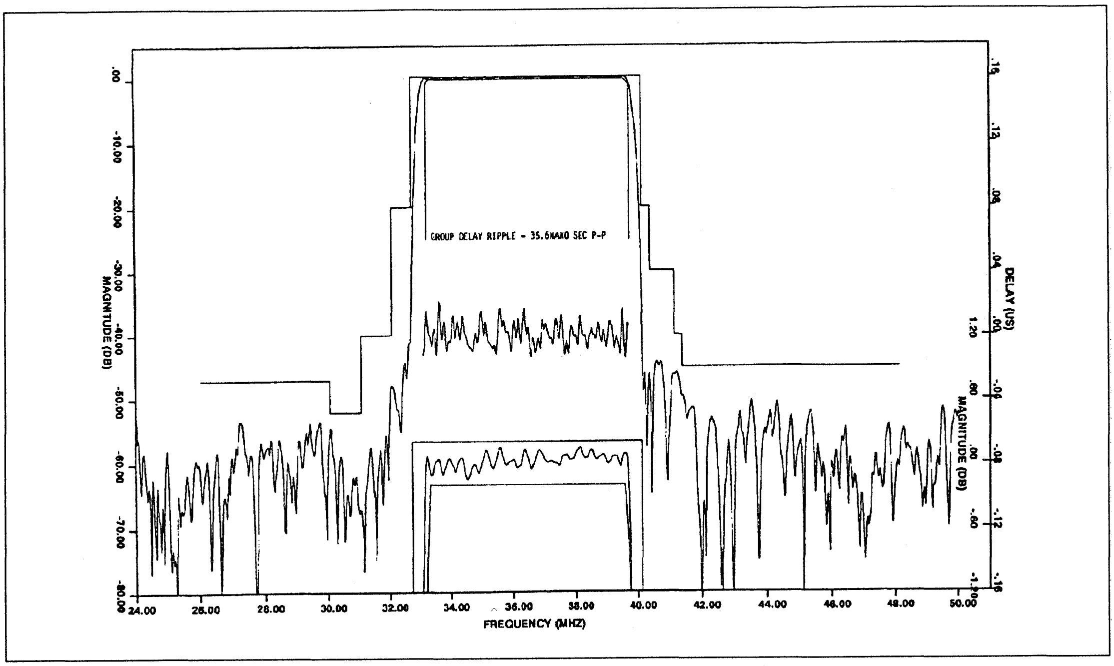
DW1404-G



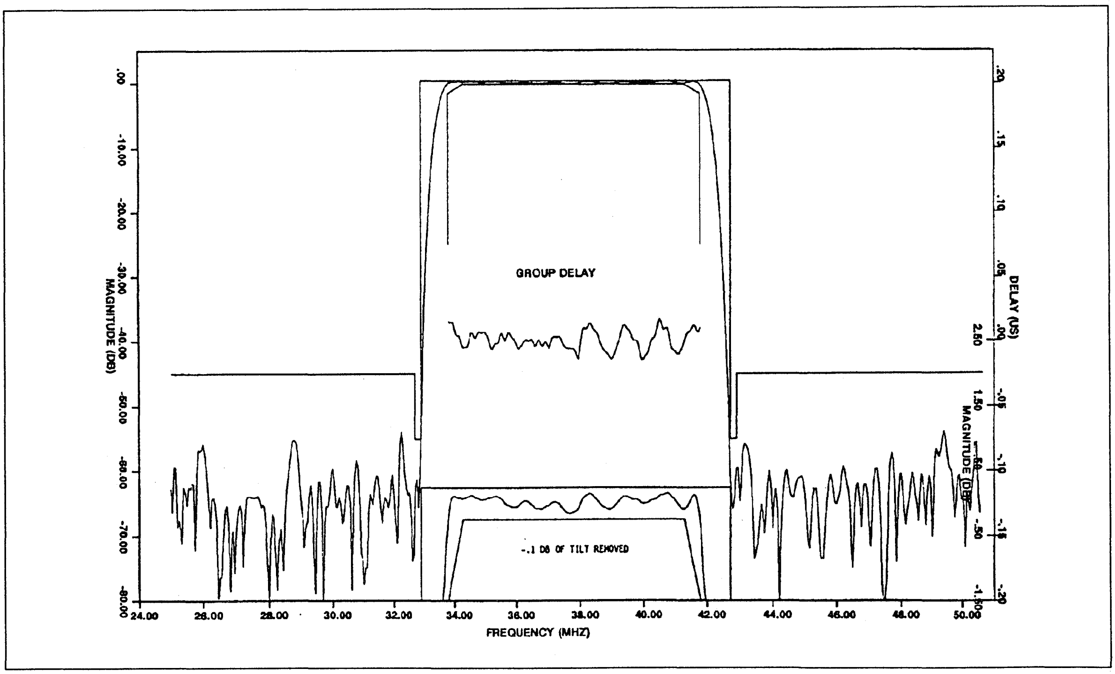
DW1406-G



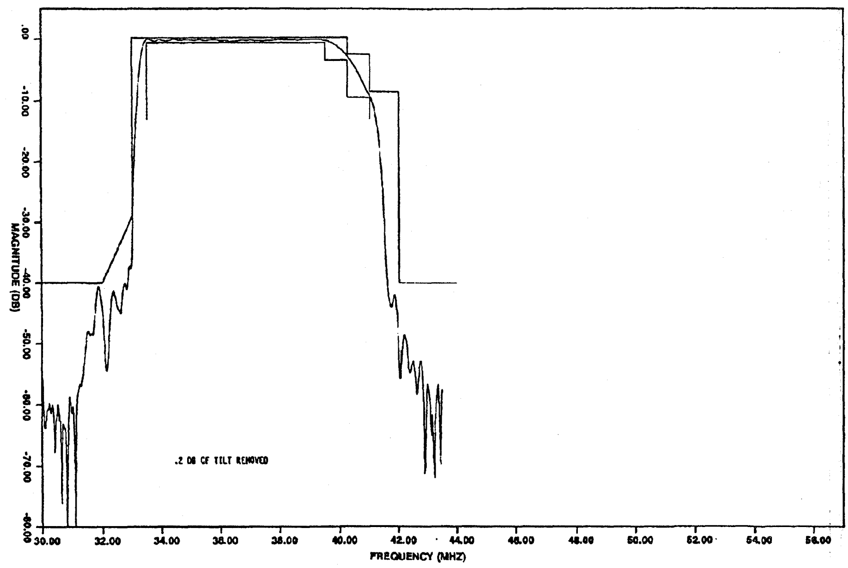
DW1408-G



DW1411-G



DW1502-I

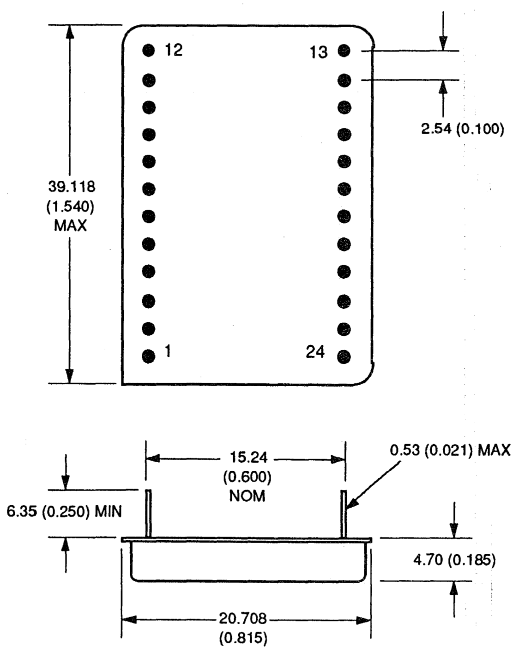


DW1503-I

PACKAGE DETAILS

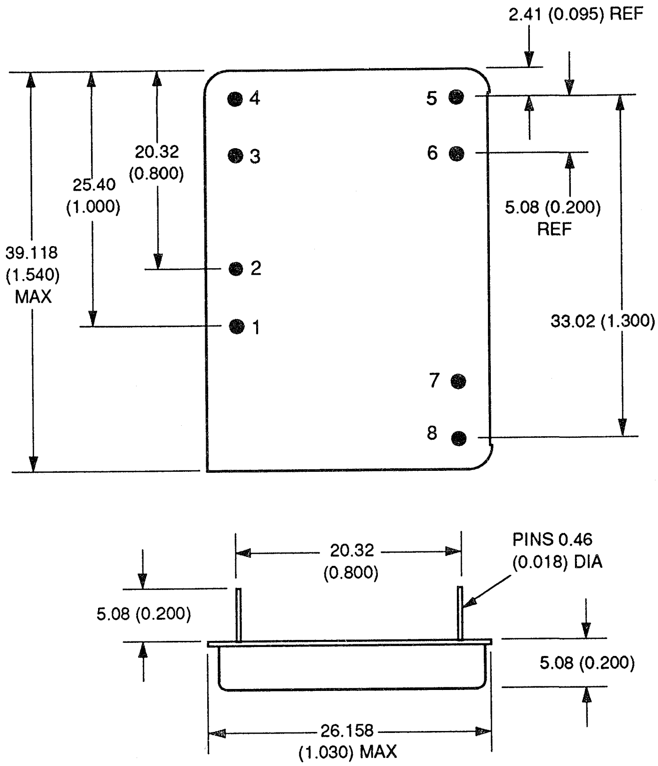
2	Gnd
3	Input
4, 10, 11, 12, 14	Gnd
15	Output
16, 22, 23, 24	Gnd

Note: BP1121 only - Input Pin 1
Output Pin 12



Package Type A

1	Input
2, 3, 4	Gnd
5	Output
6, 7, 8	Gnd



Package Type D

GEC PLESSEY
SEMICONDUCTORS

DS3210-1.3 August 1992

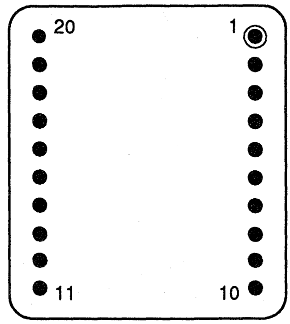
DW9503/04 & DW9511/12/13/14 & DW9517/18/19/20

UHF FIXED FREQUENCY DELAY LINE SAW OSCILLATORS

These oscillators utilise a thick film circuit with SAW delay line technology to realise U.H.F. sources. Of compact design and rugged construction these units are ideal for use in adverse environments. Specific frequencies are for applications in IFF (Identification Friend Foe) NATO systems.

FEATURES

- Compact Design
- High Fundemental Frequencies
- Low Phase Noise
- Mil-Std Screening



2	RF Output
4	Vs = +12V
18	0V
19	0V
Case	RF Ground and 0V

Figure 1: Pin Connections - Pin Side

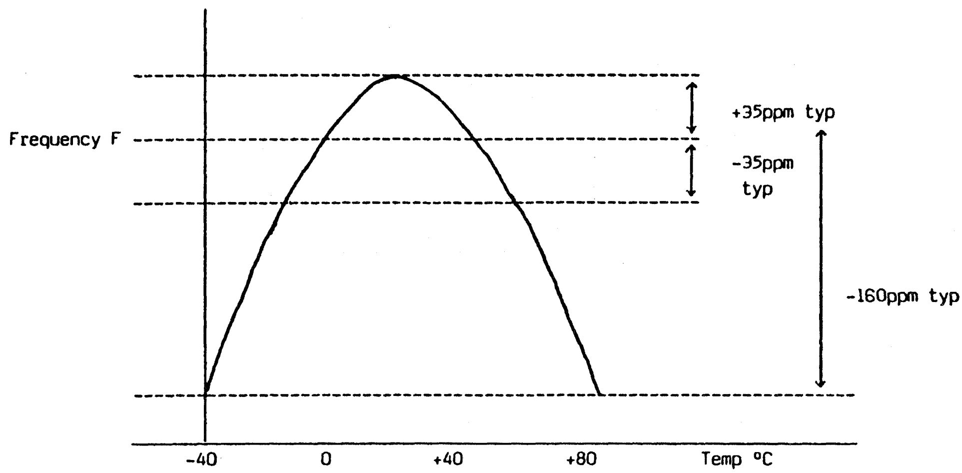


Figure 2: Frequency vs Temperature

ELECTRICAL SPECIFICATION

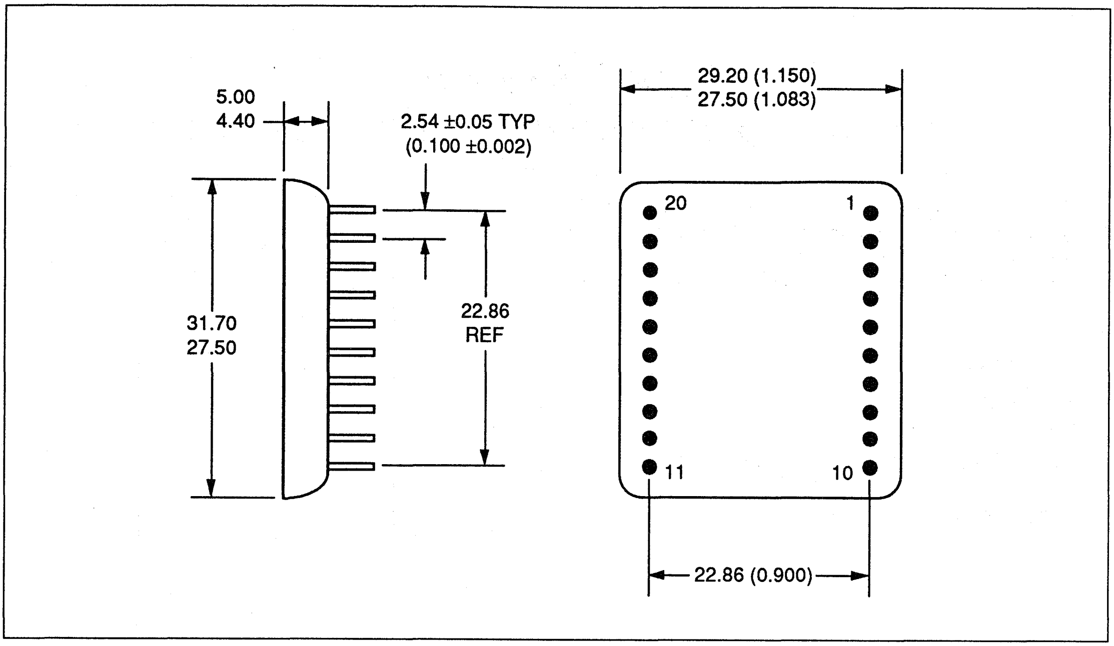
Limiting Conditions of Use:

Maximum Input Voltage	+15V Max
Tamb Ambient Operating Temp Range	-40°C to +85°C
Tstg Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +85°C unless otherwise stated

Characteristics		Value	Unit
Centre Frequency:	DW9503	1030	MHz
	DW9504	1090	MHz
	DW9511	741	MHz
	DW9512	841.5	MHz
	DW9513	945	MHz
	DW9514	1031	MHz
	DW9517	1035	MHz
	DW9518	1052	MHz
	DW9519	1069	MHz
	DW9520	1086	MHz
Frequency Tolerance:	DW950X	±750	ppm
	DW950X-1	±125	ppm
	DW950X-2	±250	ppm
	DW950X-3	±500	ppm
Output Power:	Min	6	dBm
	Max	10	dBm
Supply Voltage		12	V
Supply Current		65	mA
Frequency Drift			
(i) Ageing		10	ppm p.a. Nom
(ii) Temp:	-10 to +60°C	±45	ppm
	-40 to +85°C	+45, -175	ppm
Turn On Time		10	m sec
Spectral Purity:	Excluding Harmonics	< -80	dBc
	Harmonics	-15	dBc
Spectral Noise (Vibration Excluded) @ 1kHz		-80	dBc/Hz
Output Impedance		2:1	Max
Load Impedance		50	Ω Nom

PACKAGE DETAILS All dimensions in mm (inches)



Custom Frequencies in the range 700MHz to 1100MHz can be supplied in this style.

DS3211-1.3 August 1992

DW9539/40

IFF FIXED FREQUENCY DELAY LINE SAW OSCILLATORS

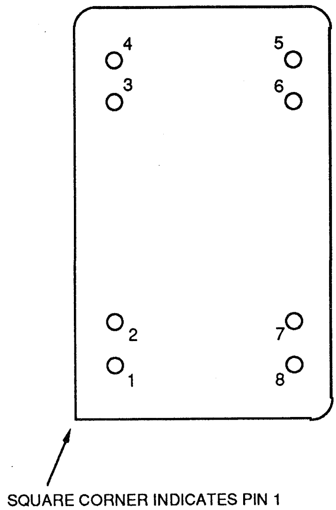
These oscillators utilise SAW delay line technology with thin film hybrid circuitary to realise low current r.f. sources for NATO STANAG IFF applications. Of very small size these oscillators can be characterised for switched supply operation.

FEATURES

- Low Current
- Small Size
- Switch Supply Operation
- Custom Frequencies Available 700-1100MHz

APPLICATIONS

- NATO STANAG IFF



1	GND
2	GND
3	GND
4	R.F. OUTPUT
5	GND
6	GND
7	GND
8	+12V

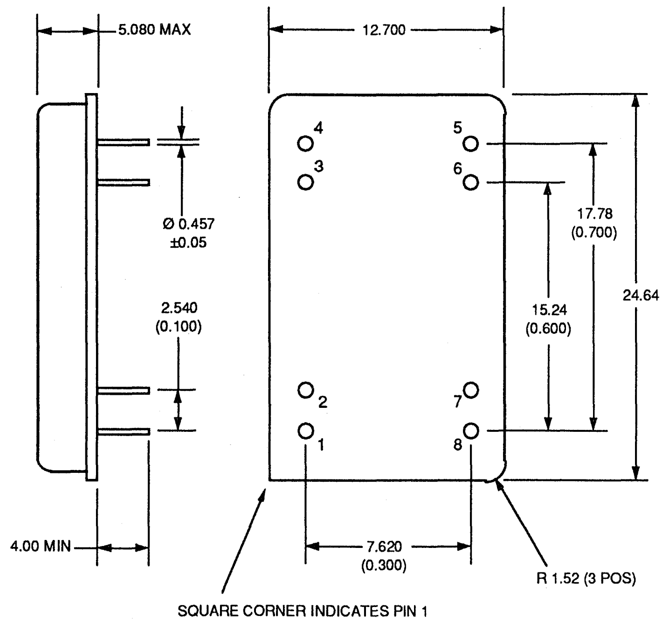
Figure 1: Pin Connections - Pin Side

ELECTRICAL SPECIFICATION

Characteristics @ -54°C to +100°C unless otherwise stated

Characteristics		Value	Unit
Frequency c.w. @ 25°C:	DW9539	1030.01	MHz Min
		1030.15	MHz Max
	DW9540	1090.01	MHz Min
		1090.15	MHz Max
@ -54°C to +110°C:	DW9539	1029.825	MHz Min
		1030.175	MHz Max
	DW9540	1089.825	MHz Min
		1090.175	MHz Max
Output Power:		10	dBm Min
		13	dBm Max
Harmonics: (fo x 2)		-20	dBc Max
(fo x 3)		-30	dBc Max
(>fo x 4)		-30	dBc Max
Spurious Signals		-80	dBc Max
Phase Noise (Static): @ 1kHz		-80	dBc/Hz Max
@ 10kHz		-110	dBc/Hz Max
Supply Current @ Vs = 12V		45	mA Max

PACKAGE DETAILS All dimensions in mm (inches)



A range of other standard frequencies are available between 700MHz and 1100MHz. Custom frequencies in this range are available on application.

GEC PLESSEY
SEMICONDUCTORS

DS3214-1.3 August 1992

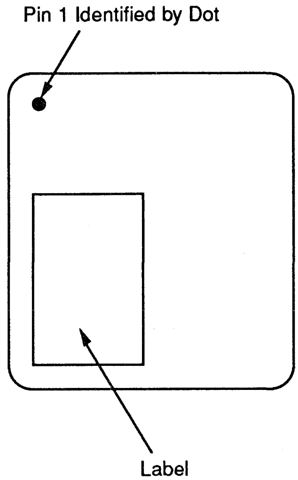
DW9543/44

IFF RECEIVER TEST OSCILLATORS

These SAW oscillators are designed to provide built-in test sources for IFF receivers working to the STANAG specification. The rise and fall times simulate the worst case conditions allowed in such a system.

FEATURES

- Standard NATO STANAG IFF Frequencies
- Compact Design
- Pulse Outputs Simulate Received Signals



2	MOD. R.F. O/P
15	+15V Vs
19	MOD. LOGIC INPUT
1 3 4 6 7 9 10 12 14 16 17 18 20	CONNECTED TO CASE (0V)

Figure 1: Pin Connections - Top View

ELECTRICAL SPECIFICATION

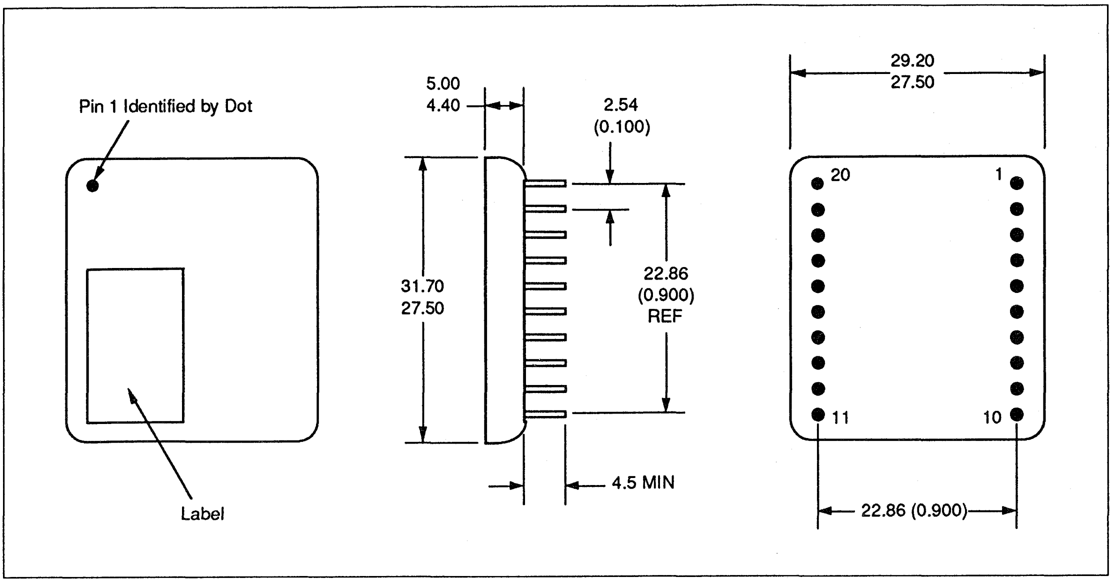
Limiting Conditions of Use:

Power Supply (Requires internal voltage regulator)	+14V to +16V DC
Operational Temperature Range	-40°C to +90°C
Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +90°C unless otherwise stated

Characteristics	Value	Unit
Centre Frequency: DW9543 DW9544	1030 1090	MHz MHz
Frequency Stability (All Cases)	±500	kHz
Power Output at Room Temperature	-20 (±2)	dBm
Rise Time Fall Time	50 to 100 50 to 200	ns ns
Modulation Depth (RF on = Mod. Low)	20	dB Min
Turn On Time	1	ms Max
Spectral Purity: Excluding Harmonics Harmonics	-80 -20	dBc Max dBc Max
Spectral Noise (Inc. Vibration) @ 1kHz @ 10kHz	-20 -98	dBc/Hz Max dBc/Hz Max
Spectral Noise (Exc. Vibration) @ 1kHz @ 10kHz @ 50/70kHz off.	-80 -110 -120	dBc/Hz dBc/Hz dBc/Hz
Modulation Input Port	CMOS	Compatible
Supply Voltage	15	V
DC Current	100	mA Max

PACKAGE DETAILS All dimensions in mm (inches)



SPECIFIC TYPES FOR I.F.F. APPLICATIONS INCLUDE:

■ DW9533, DW9534	High Output Power, Transmitter Drive Oscillator
■ DW9539, DW9540	Small Size, Low Current, Fixed Frequency
■ DW9848, DW9849	General Purpose VCO
■ DW9852, DW9853	Linear Tuning VCO

DS3223-1.2 August 1992

DW9508 Series

SAW RESONATOR OSCILLATORS

These oscillators are based on SAW resonator technology with thick film surface mount circuitry to realise a very low phase noise oscillator. These units are intended for use as high frequency reference oscillators. The high output power simplifies the use of low orders of multiplication to achieve microwave frequencies.

FEATURES

- Very Low Phase Noise
- Excellent Noise Floor
- High Fundamental Frequency
- Output Suitable To Drive Frequency Multiplies

ELECTRICAL SPECIFICATION

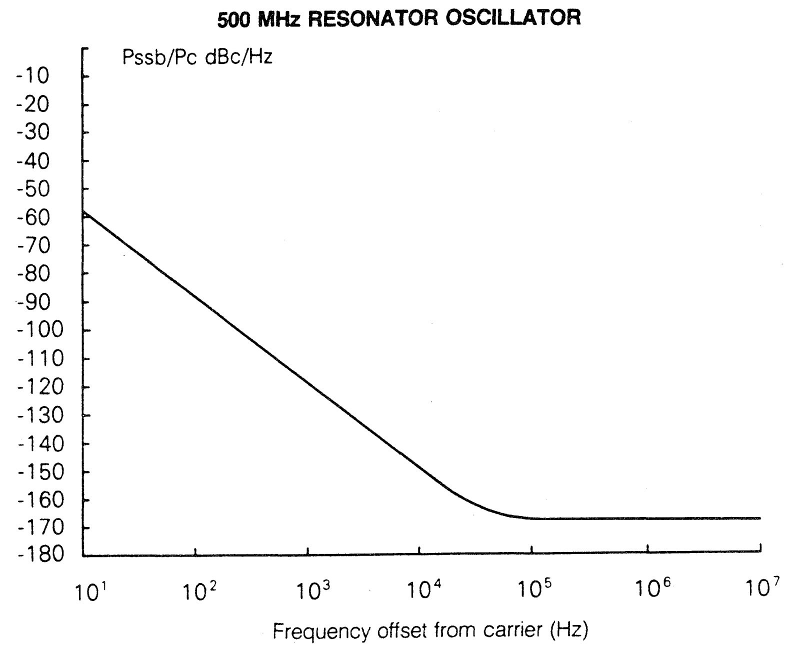
Limiting Conditions of Use:

Power Supply	+15V
Operational Temperature Range	-40°C to +90°C
Storage Temperature Range	-55°C to +100°C

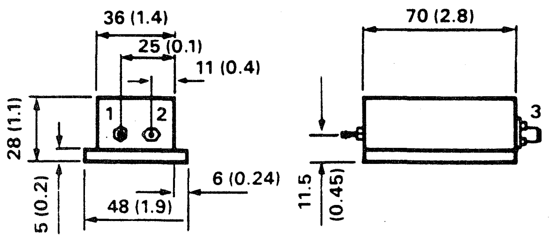
Characteristics @ -40°C to +90°C unless otherwise stated

Characteristics	Values		Units
	Typical	Limits	
Frequency	500	-	MHz
Setting Accuracy	-	±30	kHz
Temperature Stability	-	±60	kHz
Spectral Noise (Static) @ 1kHz	-125	-120 Max	dBc/Hz
Harmonics	-20	-15 Max	dBc
Output Power	17	15 Min	dBm
Output Impedance	50 Nom	-	Ω
Supply Voltage	15	-	V
Supply Current	-	65 Max	mA

NOTE: Oscillators in this series are available at other standard and custom frequencies in the range 300MHz to 750MHz.



PACKAGE DETAILS All dimensions in mm (inches)



1	GROUND
2	Vs = +15V
3	RF OUTPUT

CONNECTIONS

R.F. OUTPUT - SMA
SUPPLY +15V - FILTER CON
SUPPLY 0V - EARTH POST / BOX

GEC PLESSEY
SEMICONDUCTORS

DS3215-1.3 August 1992

DW9509/10 & DW9515/16 & DW9528 & DW9558

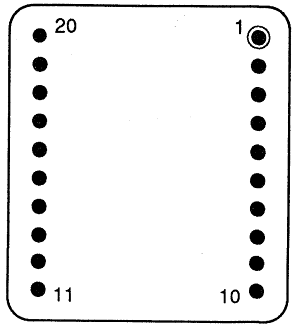
FIXED FREQUENCY SAW RESONATOR OSCILLATORS

These oscillators utilise SAW resonator technology to realise UHF sources with excellent phase noise close to carries. The use of thick film circuitary results in a compact design of rugged construction.

This series can be provided to a range of setting accuracies, depending on the option selected.

FEATURES

- Compact Design
- VHF Sources
- Excellent Phase Noise
- Custom Frequencies Available



2	RF OUTPUT
4	Vs = +12V
18	0V
19	0V

Figure 1: Pin Connections - Pin Side

ELECTRICAL SPECIFICATION

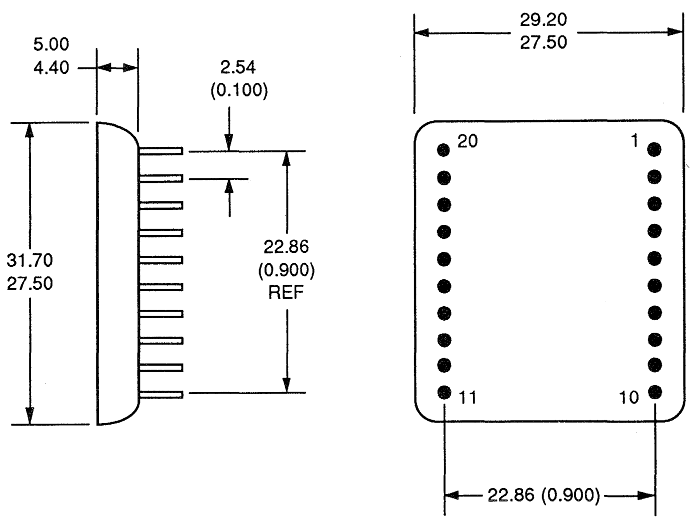
Limiting Conditions of Use:

Maximum Input Voltage	+15V Max
Tamb Ambient Operating Temp Range	-40°C to +85°C
Tstg Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +85°C unless otherwise stated

Characteristics		Value	Unit
Centre Frequency:	DW9558	500	MHz
	DW9509	555.5	MHz
	DW9510	695	MHz
	DW9515	609.2	MHz
	DW9516	650.6	MHz
	DW9528	725	MHz
Setting Accuracy:	Option 1	±125	ppm
	Option 2	±250	ppm
	Option 3	±500	ppm
Output Power:	Min	6	dBm
	Max	10	dBm
Supply Voltage		12	V
Supply Current		65	mA Max
Output Impedance		50	Ω Nom
Harmonics		<-15	dBc
Spurii		<-100	dBc

PACKAGE DETAILS All dimensions in mm (inches)



DS3216-1.3 August 1992

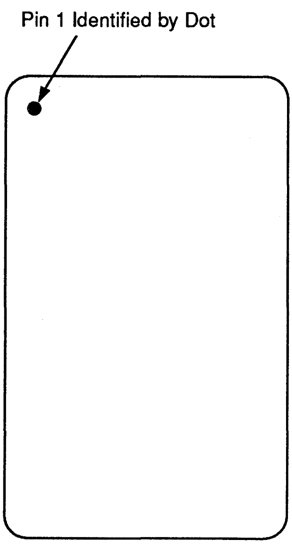
DW9533/34

IFF TRANSMITTER DRIVE OSCILLATORS

These oscillators utilise SAW delay line technology with thin film hybrid circuitary to realise compact drive sources for IFF transmitters. The output can be pulse modulated allowing a solid state power amplifier chain to be driven within STANAG IFF specification. A low power output is provided for use as the LO of the receiver section.

FEATURES

- High Output Power
- Pulse Modulation
- Fast Rise and Fall Times
- Meets STANAG Requirements
- LO Output Available
- Compact Design



Pin	Function
3	Mod. RF Output
9	CW RF Output
19	+15V Vs
22	Mod. Logic Input
1, 2, 5, 6, 7, 8, 10, 11, 13, 15, 18, 20, 21, 23, 25, 26, 27, 29, 30	Connected to Case (0V)
4, 12, 14, 16, 17, 24, 28	Not Connected

Figure 1: Pin Connections - Top View

ELECTRICAL SPECIFICATION

Limiting Conditions of Use:

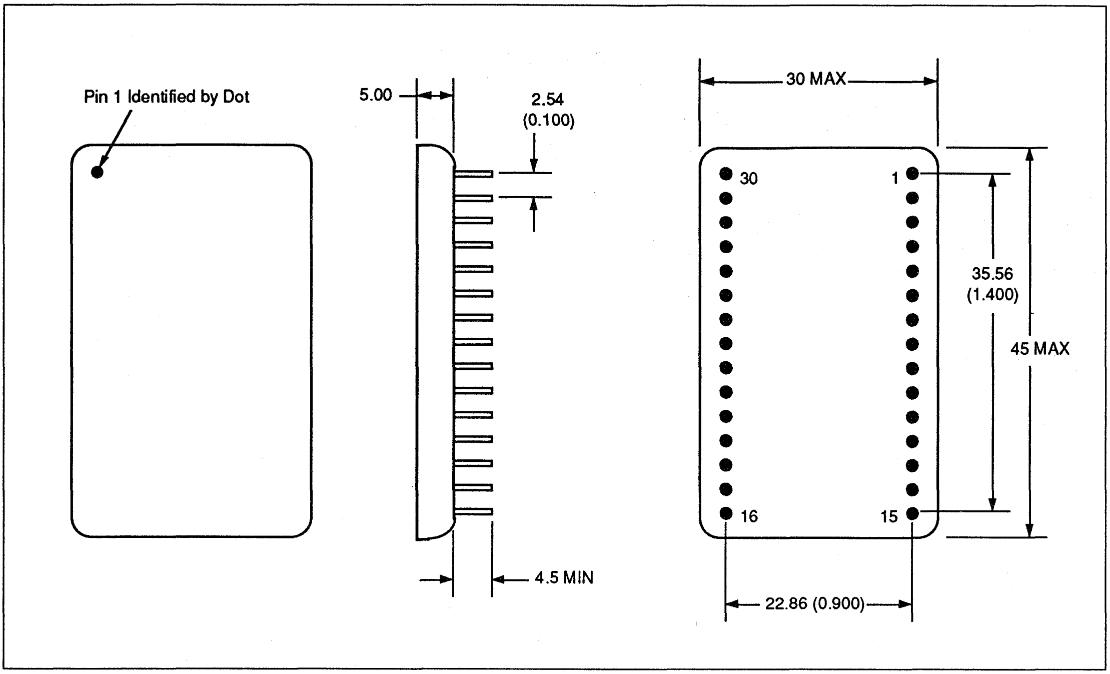
Power Supply	+16V Max
Operational Temperature Range	-40°C to +90°C
Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +90°C unless otherwise stated

Characteristics		Value	Unit
Centre Frequency:	DW9533	1030	MHz
	DW9534	1090	MHz
Frequency Stability (All Cases)		±200	kHz
Power Output	L.O. Output	3 to 10	dBm
	Mod. Drive	23 to 26	dBm
Rise/Fall Times		20	ns Max
VSWR into 50Ω		1.5:1	Max
Modulation Depth (RF on = Mod. Low)		20	dB Min
Spectral Purity	Excluding Harmonics	-70	dBc Max
(at L.O. port):	Harmonics	-30	dBc Max
Spectral Noise (Inc. Vibration)	@ 1kHz	-20	dBc/Hz Max
(at L.O. port):	@ 10kHz	-98	dBc/Hz Max
Spectral Noise (Exc. Vibration)	@ 1kHz	-80	dBc/Hz Max
(at L.O. port):	@ 10kHz	-110	dBc/Hz Max
	@ 50/70kHz off.	-140	dBc/Hz Max
Modulation Input Port		CMOS	Compatible
Propagation Deley	tp	160	ns Max
DC Current @ 15V	Modulation Level High	120	mA Max
	Modulation Level Low	175	mA Max

Note: Other frequencies in range 750 to 1100MHz are available in this series.

PACKAGE DETAILS All dimensions in mm (inches)



SPECIFIC TYPES FOR I.F.F. APPLICATIONS INCLUDE:

■ DW9539, DW9540	Small Size, Low Current, Fixed Frequency
■ DW9843, DW9844	Self-Test Oscillator for Receivers
■ DW9848, DW9849	General Purpose VCO
■ DW9852, DW9853	Linear Tuning VCO

DW9537

UHF FIXED FREQUENCY SAW RESONATOR OSCILLATOR

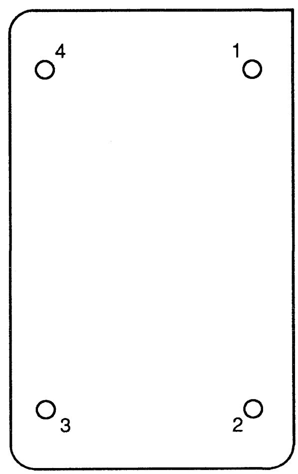
The use of thin film circuitary techniques with chip and wire construction allow small UHF sources to be realised. These oscillators are stabalised by lightly loaded SAW resonators resulting in excellent close to carrier phase noise specifications.

FEATURES

- Excellent Phase Noise
- Small Size
- UHF Range
- Custom Frequencies - 400 to 700MHz
- Mil-Std Screening
- High Vibration Immunity

APPLICATIONS

- Microwave Synthesisers
- High Speed Clock Oscillator
- Fundamental UHF Source
- UHF Local Oscillator



1	GND
2	RF OUTPUT
3	GND
4	Vs = +12V

Figure 1: Pin Connections - Pin View

ELECTRICAL SPECIFICATION

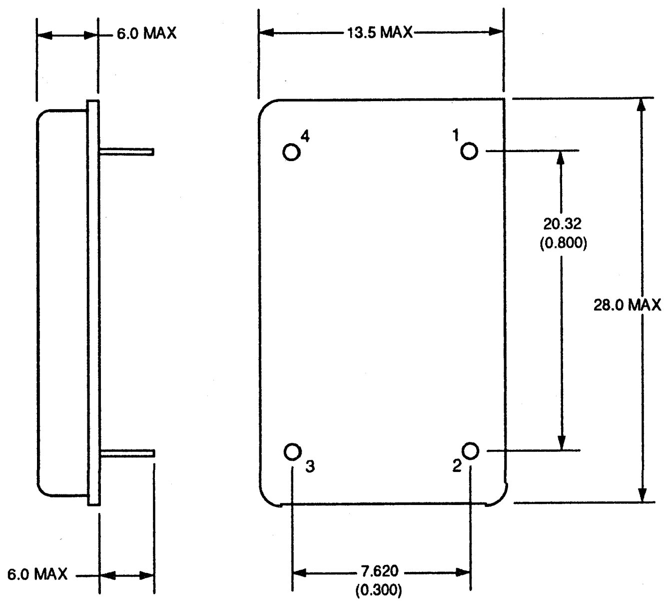
Limiting Conditions of Use:

Power Supply	+15V Max
Operational Temperature Range	-40°C to +90°C
Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +90°C unless otherwise stated

Characteristics		Value	Unit
Frequency:		650.6	MHz
Setting Accuracy:	Option 1	±125	ppm
	Option 2	±250	ppm
	Option 3	±500	ppm
Temperature Stability:	-10°C to +60°C	±110	ppm
	-40°C to +85°C	±220	ppm
Output Power		6	dBm Min
Output Impedance		50	Ω Nom
Harmonics		<-15	dBc
Spurii		<-100	dBc
Supply Voltage		12	V
Supply Current		65	mA

PACKAGE DETAILS All dimensions in mm (inches)



DS3218-1.2 August 1992

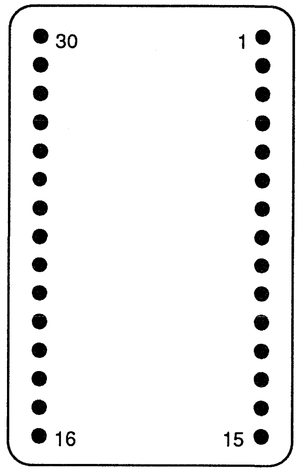
DW9538

TRIPLE OUTPUT FIXED FREQUENCY OSCILLATORS

These oscillators are fabricated using chip and wire construction and use SAW delay technology. These UHF sources offer triple output each buffered by an internal output amplifier.

FEATURES

- Three Buffered Outputs
- UHF Source
- Compact Design
- Can Be Supplied With Varactor Tuning



3	Output 1
6	Gnd
8	Vs
24	Output 2
28	Output 3

Figure 1: Pin Connections - Bottom View

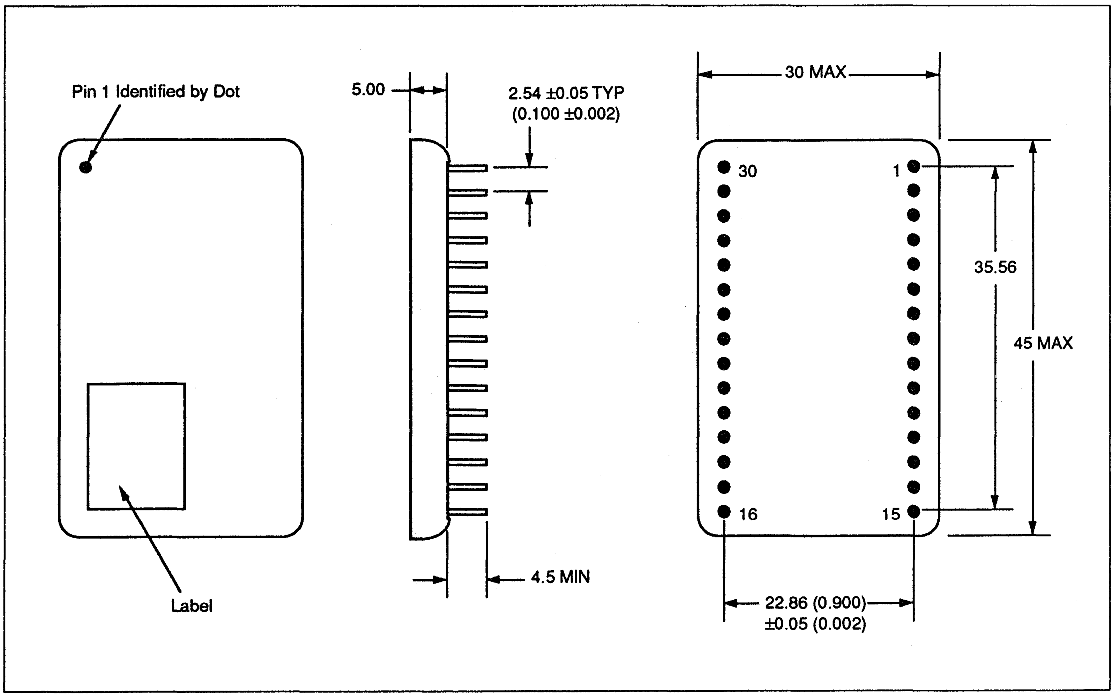
ELECTRICAL SPECIFICATION

Limiting Conditions of Use:

Power Supply	+12V
Operational Temperature Range	-54°C to +100°C
Storage Temperature Range	-54°C to +100°C

Characteristics	Typical	Limits	Unit
Frequency	1030		MHz
Frequency Accuracy (Total)		±0.2	MHz
Output Power	11	+1/-2 dB	dBm
Spectral Noise (Static) Δfo = 1kHz	-95	-85	dBc/Hz
Harmonics	-35	-30	dBc
Spurii (Excluding Harmonics)	-100	-60	dBc
Output Impedance	50		Ω
Supply Voltage	+12	-	V
Supply Current	155	175 Max	mA

PACKAGE OUTLINE



DS3219-1.2 August 1992

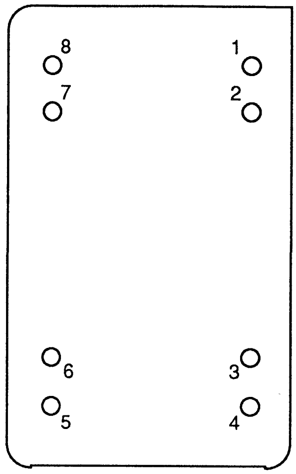
DW9541/78 Series

ECL COMPATIBLE SURFACE ACOUSTIC WAVE OSCILLATORS

These high stability oscillators are based on fundamental frequency quartz SAW resonator techniques and provide ECL compatible clocks in the frequency range 200MHz to 600MHz. The low noise floor of the SAW feedback loop ensures excellent short-term stability in the very short sampling periods typical of modern high data rate systems. These features make SAW-based clock oscillators the optimum choice in many critical applications.

FEATURES

- High Fundamental Frequencies of 200MHz to 600MHz
- 10K or 100K ECL Compatible
- Excellent Short-Term Stability
- Good, Medium and Long-Term Stability
- Small Size



	DW9541	DW9578
1	GND	GND
2	GND	GND
3	GND	GND
4	-5.2V	-4.5V
5	OUTPUT (Q)	OUTPUT (Q)
6	OUTPUT ($\overline{Q}$)	OUTPUT ($\overline{Q}$)
7	GND	GND
8	+15V	+11.5V

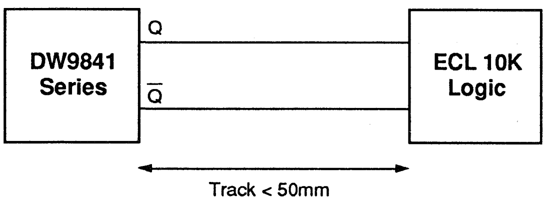
Figure 1: Pin Connections - Top View

ELECTRICAL SPECIFICATION

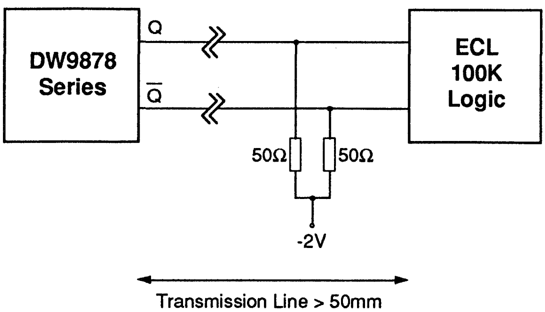
Characteristics @ 25°C except where stated

Characteristics		DW9541	DW9578 *	Unit
Frequency:		500.075	357.181	MHz
Frequency Accuracy (Total):	25°C	±0.1	±0.1	MHz
	-40°C to +110°C	+0.2/-0.3	±0.15	MHz
Output Voltage (Q and $\overline{Q}$):	High	-0.90	-0.90	V
	Low	-1.75	-1.70	V
Output Impedance		100	Open Emitter	Ω
Supply Voltage		+12 / -5.2	+11.5 / -4.5	V
Supply Current:	Typical	20 / 40	25 / 50	mA
	-40°C to +70°C	30 / 70	30 / 70	mA

* All tests performed with ECL outputs (Q and $\overline{Q}$) terminated in 50Ω to -2V.

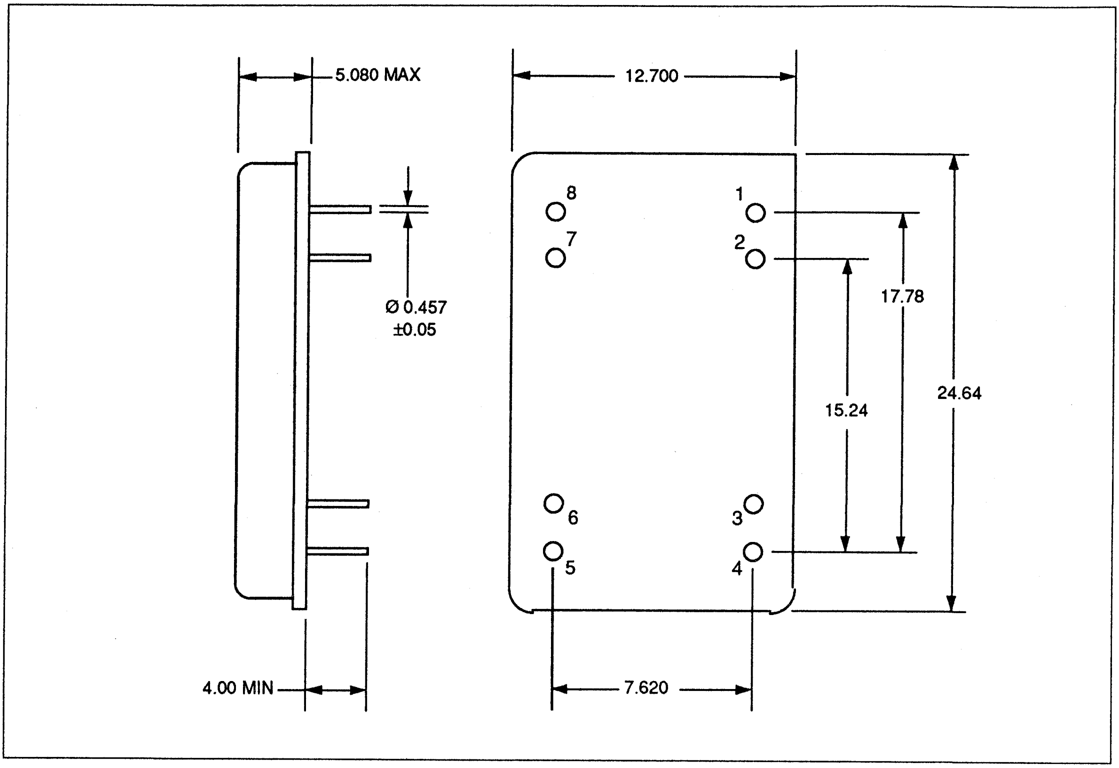


Oscillators from the DW9841 Series are internally terminated and can drive short lengths of track without further components.



Oscillators from the DW9578 Series have open emitter outputs and can drive long tracks. These tracks, however, should be correctly terminated adjacent to the device being driven and should have the correct characteristic impedence.

PACKAGE DETAILS All dimensions in mm (inches)



DW9806/22D/24/25D/27

UHF DELAY LINE SAW VCO

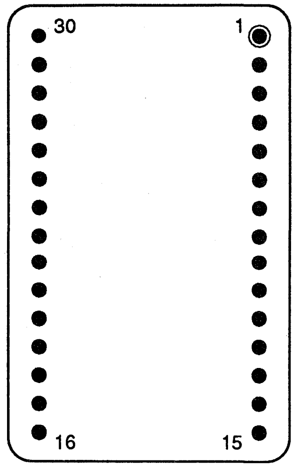
Thick film construction is used in this design to realise a compact oscillator in the low UHF range. Electronic tuning is provided for modulation or phase locking purposes.

FEATURES

- Compact Design
- Electronic Tuning
- Can Be Supplied Fixed Frequency

ELECTRICAL SPECIFICATION -40°C to +85°C

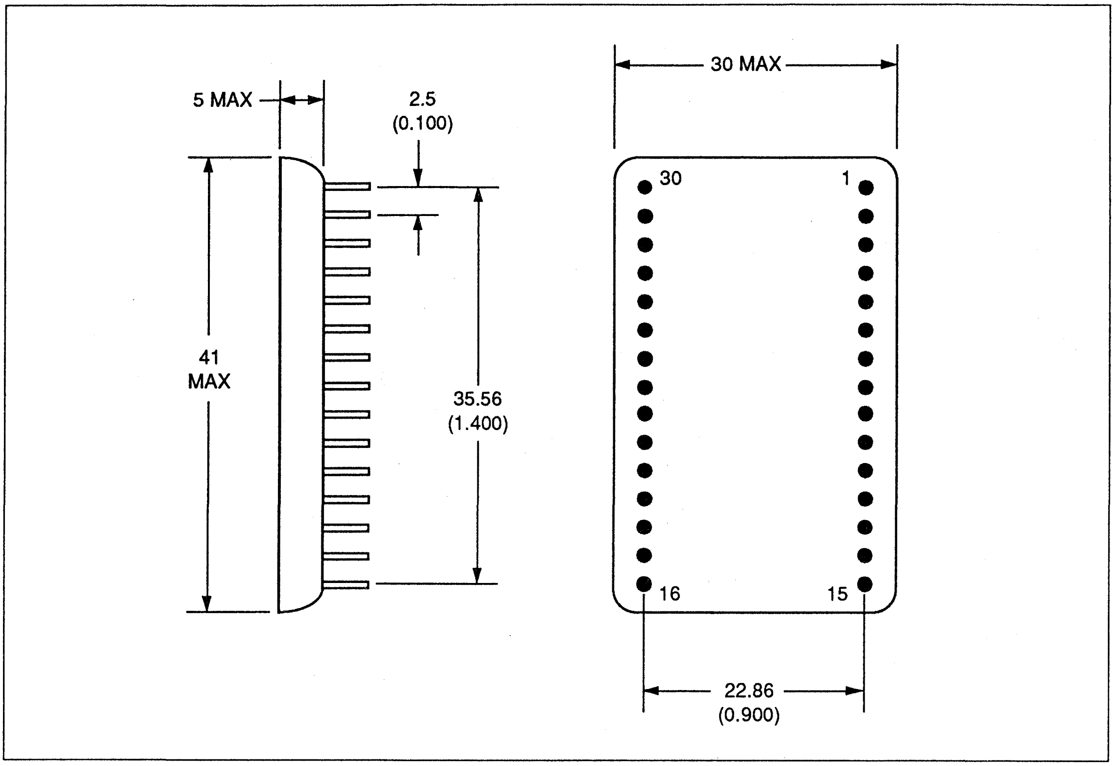
CHARACTERISTIC	VALUE		UNIT
	TYPICAL	LIMITS	
Frequency DW9827	500	-	MHz
DW9806	480	-	MHz
DW9822D	504	-	MHz
DW9824	307.2	-	MHz
DW9825D	420	-	MHz
Setting Accuracy	-	±50	ppm
Temperature Stability	-	±120	ppm
Tuning Range	±200		ppm
Tuning Voltage	-	±8	V
Output Power	12	6 min	dBm
Spectral Noise	-80		dBc
Harmonics	-20	-15 min	dBc
Spur ii	-	-100 max	dBc
Output Impedance	50	-	Ω
Supply Voltage	±12	-	V
Supply Current	60, 2	65, 10	mA



2	RF Output
4	0V
14	Vb
17	Vs = -12V
29	Vs = +12V

Figure 1: Pin Connections - Pin Side

PACKAGE DETAILS All dimensions in mm (inches)



GEC PLESSEY
SEMICONDUCTORS

DS3220-1.3 August 1992

DW9803/04

IFF DELAY LINE SAW VCO

This oscillator utilises SAW delay line technology with thick film hybrid circuitary to realise a compact UHF source. Electronic tuning is provided for modulation purposes.

This device can be provided to a range of setting accuracies.

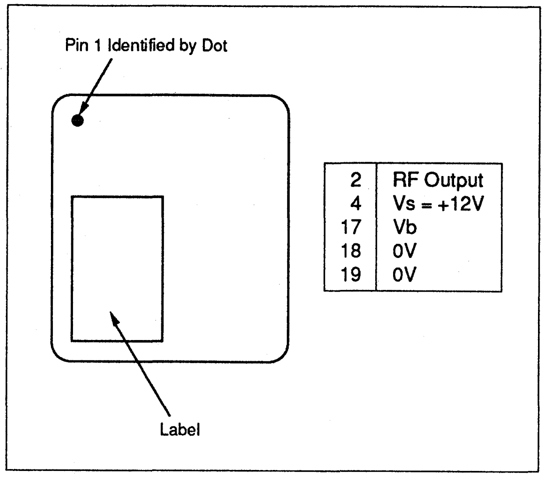


Figure 1: Pin Connections - Top View

FEATURES

- Electronic Tuning
- IFF NATO STANAG Frequencies
- Compact Design

APPLICATIONS

- NATO STANAG IFF Systems

ELECTRICAL SPECIFICATION

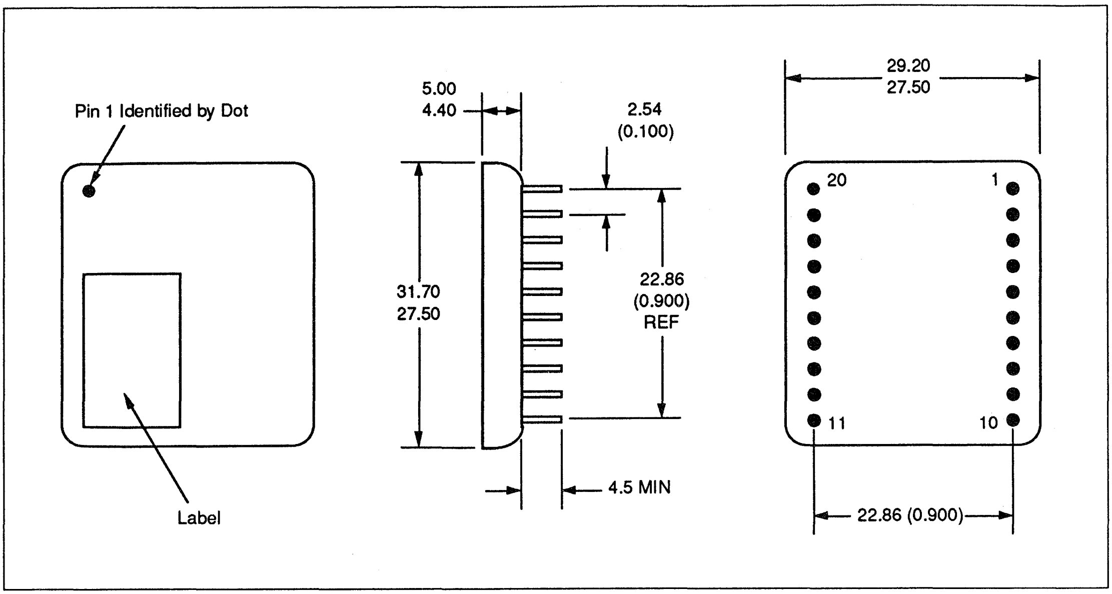
Limiting Conditions of Use:

Power Supply	+15V Max
Operational Temperature Range	-40°C to +90°C
Storage Temperature Range	-55°C to +125°C

Characteristics @ -40°C to +90°C unless otherwise stated

Characteristics		Value	Unit
Frequency:	DW9803	1030	MHz
	DW9804	1090	MHz
Power Output		10	dBm
Spectral Purity		-15	dBc
Spectral Noise (Static) @ 1kHz		-80	dBc/Hz
Supply Voltage		12	V
Supply Current		65	mA
Setting Accuracy	Option 1	±125	ppm
	Option 2	±250	ppm
	Option 3	±500	ppm
Temperature Stability	-10°C to +60°C	±45	ppm
	-40°C to +85°C	±120	ppm
Harmonics		<-15	dBc
Output Impedance		50	Ω Nom

PACKAGE DETAILS All dimensions in mm (inches)



Custom frequencies in the range 700MHz to 1100MHz can be supplied in this style.

DS3221-1.2 August 1992

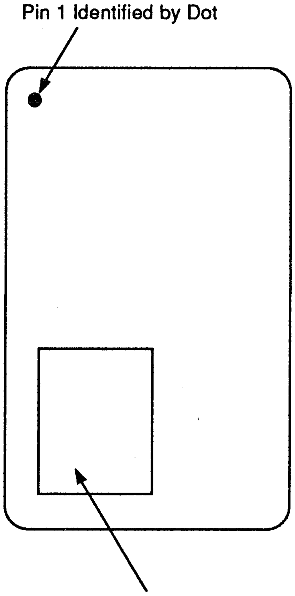
DW9810

MULTIPLIED OUTPUT DELAY LINE OSCILLATOR

This oscillator is constructed using thin film techniques and contains an integral x2 multiplier together with electronic tuning. These features realise a versatile L-Band frequency source that can be used in a phase locked loop.

FEATURES

- L-Band Frequency Source
- Low Phase Noise
- Electronic Timing
- Fixed Frequency Variant Can Be Supplied



Pin	Function
17	Tuning Voltage
27	V_s +15V
29	R.F. Output
1, 3, 5, 6, 8, 10, 11, 13, 15, 16, 18, 20, 21, 23, 25, 26, 28, 30	Connected to Case (0V)
2, 4, 7, 9, 12, 14, 19, 22, 24	Not Connected

Figure 1: Pin Connections - Top View

ELECTRICAL SPECIFICATION

Limiting Conditions of Use:

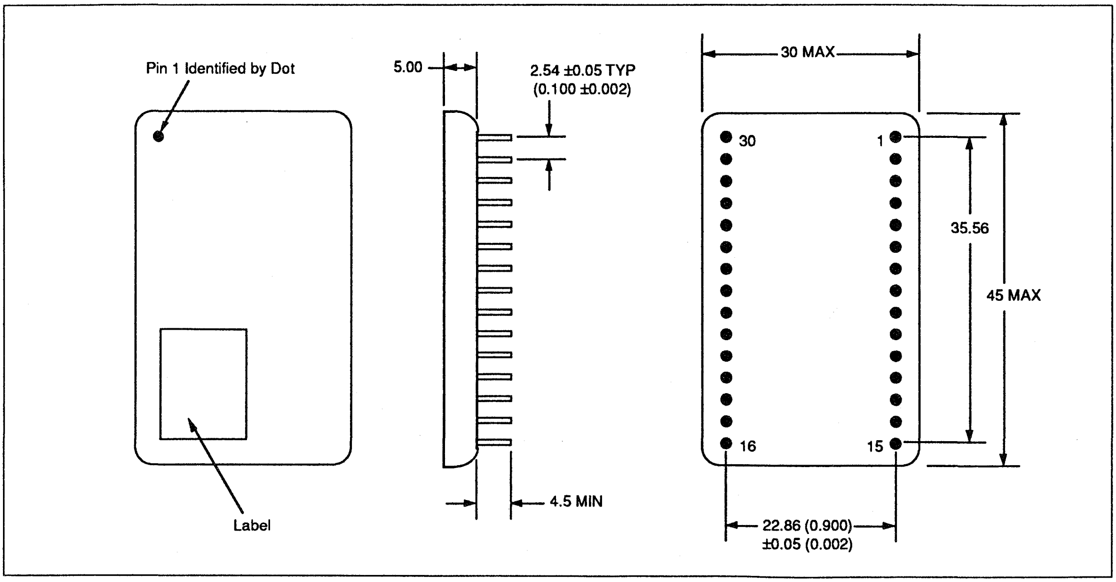
Power Supply	+15V
Operational Temperature Range	-55°C to +105°C
Storage Temperature Range	-55°C to +110°C

Characteristics @ 25 °C unless otherwise stated

Characteristics	Value		Unit
	Typical	Limits	
Frequency:	1152	-	MHz
Frequency Stability (Total): @ 25°C*	-	±6	kHz
-55°C to 105°C	-	±200	kHz
Tuning Voltage	+2 to +13	-	V
Output Power (Over Tuning Range):	8	-	dBm
@25°C	-	±1	dBm
-55°C to 105°C	-	±3	dBm
Harmonics	-25	-20 Max	dBc
Spurii (Excluding Harmonics)		-100 Max	dBc
Output Impedance	50 Nom	-	Ω
Supply Voltage	15		V
Supply Current	60	80 Max	mA

* with external voltage trimming.

PACKAGE DETAILS All dimensions in mm (inches)



DS3222-1.2 August 1992

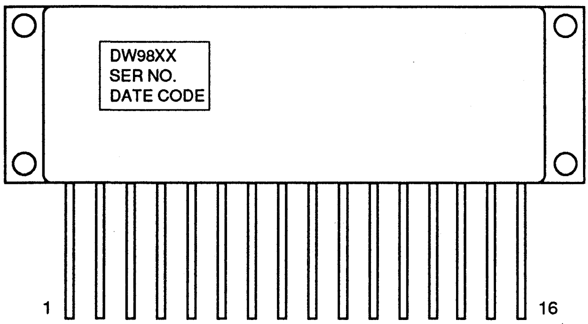
DW9846/52 Series

UHF DELAY LINE SAW VCO'S

These oscillators utilise SAW delay line technology with thin film hybrid circuitary to realise voltage controlled SAW oscillators. These units can be used as modulated sources or as a component of a phase locked loop.

FEATURES

- Up To 1200ppm Tuning Range
- Suitable As F.M. Sources
- Can Be Phase Locked



Pin No	Operation
1	Bias Voltage (V_B) 0V to 12V
2	Externally Grounded
3	Externally Grounded
4	-V (-12V)
5	Externally Grounded
6	Externally Grounded
7	Control Voltage (V_C) 0V to 12V
8	Externally Grounded
9	Externally Grounded
10	Externally Grounded
11	Externally Grounded
12	Externally Grounded
13	+V (+12V)
14	0V
15	Externally Grounded
16	RF O/P (6dBm to 9dBm)

Figure 1: Pin Connections - Top View

ELECTRICAL SPECIFICATION

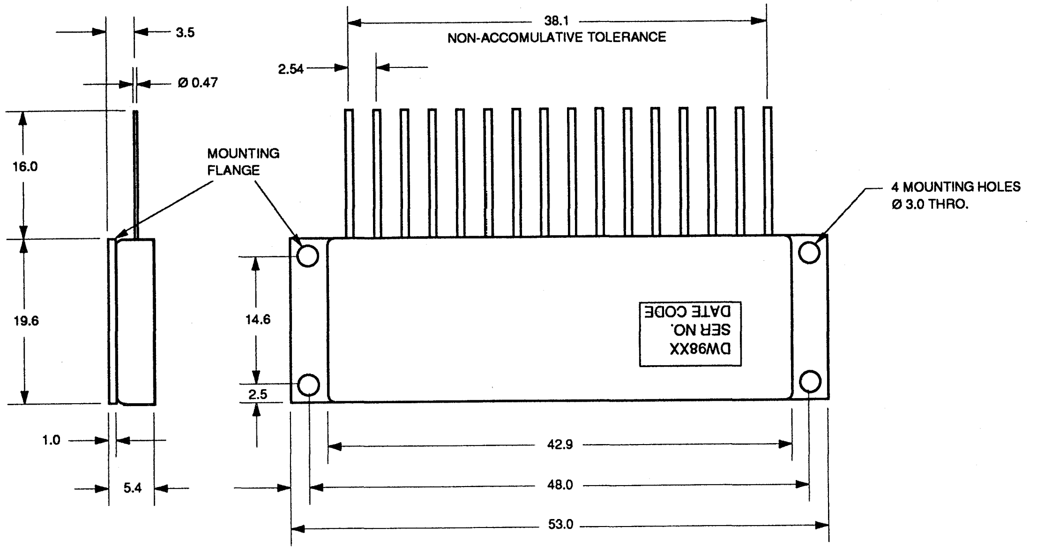
Limiting Conditions of Use:

Power Supply	±12V
Operational Temperature Range	-40°C to +100°C
Storage Temperature Range	-55°C to +110°C

Characteristics @ -40°C to +100°C unless otherwise stated

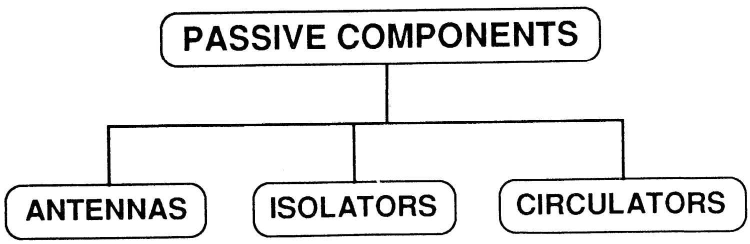
Characteristics		Value		Unit
		Typical	Limits	
Centre Frequency:	DW9846	827	-	MHz
	DW9847	811	-	MHz
	DW9852	1030	-	MHz
	DW9853	1090	-	MHz
Setting Accuracy:	DW9846	-	±40	kHz
	DW9847	-	±40	kHz
	DW9852	-	±50	kHz
	DW9853	-	±50	kHz
Temperature Stability:	All except DW9846	-	±150	ppm
	DW9846	-	±210	ppm
Tuning Range:	All except DW9846	-	±100	ppm
	DW9846	-	±600	ppm
Tuning Voltage		2 to 12	-	V
Spectral Noise (Static) @ 1kHz:				
	All except DW9846	-	-85 Max	dBc/Hz
	DW9846	-	-65 Max	dBc/Hz
Harmonics		-	-20 Max	dBc
Spur II (Excluding Harmonics)		-	-100 Max	dBc
Output Power		7.5 Nom	-	dBm
Output Impedance		50 Nom	-	Ω
Supply Voltage		±12	-	V
Supply Current:	@ +12V	-	80 Max	mA
	@ -12V	-	10 Max	mA

PACKAGE DETAILS All dimensions in mm



Section 5

Microwave Passive Components



GEC PLESSEY
SEMICONDUCTORS

Microwave Passive Components

Antennas	• DBS Polarisers • DBS Feedhorn Antannas • 8 to 12GHz Horn Antennas • 18 to 26GHz Horn Antennas
Isolators	• High Power • Waveguide Slimline • Air and Water Cooled
Circulators	• High Power • 3 and 4 Port • Frequency up to 40GHz • Air and Water Cooled

GEC PLESSEY
SEMICONDUCTORS

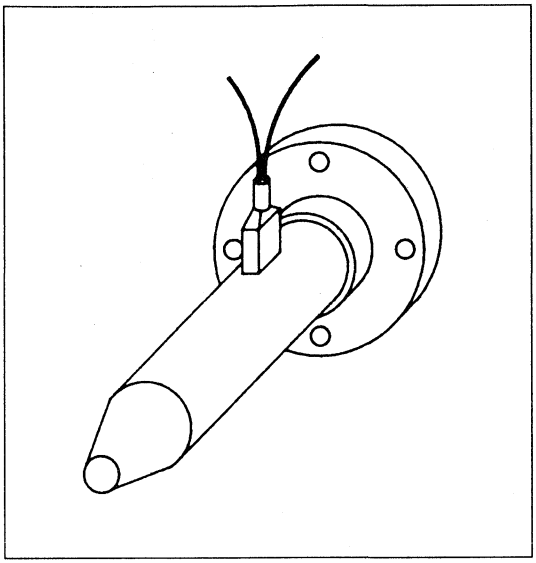
DS3034-2.2 August 1992

DF9607-10

FERRITE POLARISER AND FEED FOR Ku BAND APPLICATIONS

This low cost high efficiency ferrite polariser enables either vertical or horizontal polarisation switching to be achieved with no moving parts. The unit incorporates a dielectric antenna (polyrod) feed designed for use with parabolic reflectors with options optimised for the following f/D 0.35 - 0.50 (DF9607 and 09) and 0.50 to 0.80 (DF9608 and 10) and are suitable for both centre and offset fed arrangements.

The degree of polarisation rotation is current dependant. If a dual polarity supply is available then a lower drive current can be used. The unit is supplied with a WR75 or C120 waveguide interface flat flange.



FEATURES

- The E and H plane polar illumination is identical ensuring maximum antenna efficiency
- Rectangular beam shape ensuring a more efficient illumination of the dish
- Antenna gain/beamwidth product is virtually independant of frequency
- Including environmental protection cover
- Colour: Beige painted

Frequency Range (GHz)		10.95 - 12.75
Cross polarisation attenuation		> 16dB
Polariser current range	bipolar	+45mA,+3.5V max
(see NB below)	unipolar	+80mA, 6V max
Weight		100gms, approx
Coil resistance		70Ω approx

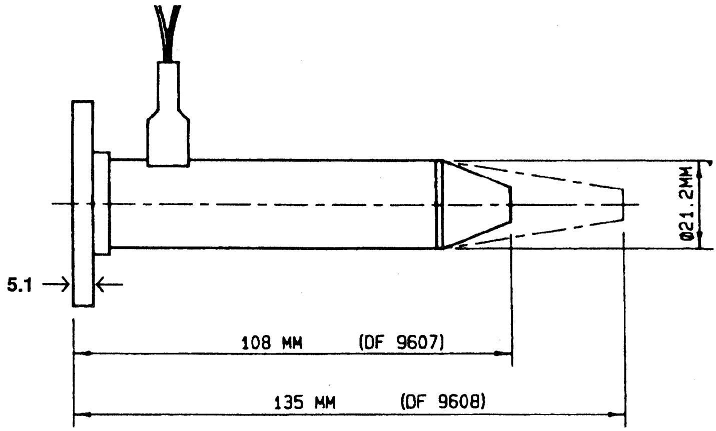
Note: With a dual polarity supply the unit plus LNB should be rotated through 45° as the dual supply swings the polarisation +45° with a further +15° available for skew control.

Table 1. Typical Electrical Characteristics

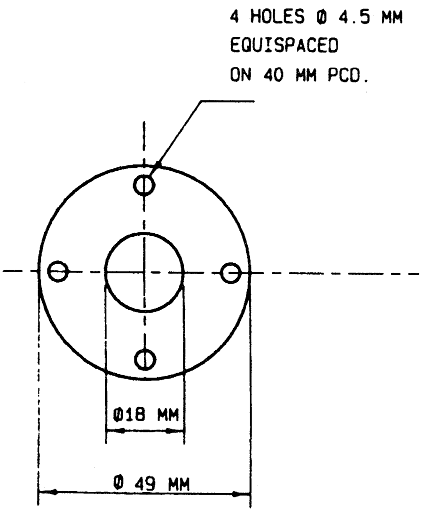
Dish Type	f/D	Nominal Feed at -10dB	Flange C120	Flange WR75
Prime Focus	0.35 to 0.5	122°	DF9607	DF9609
Offset Fed	0.5 to 0.8	66°	DF9608	DF9610

Table 2. Product Type Summary

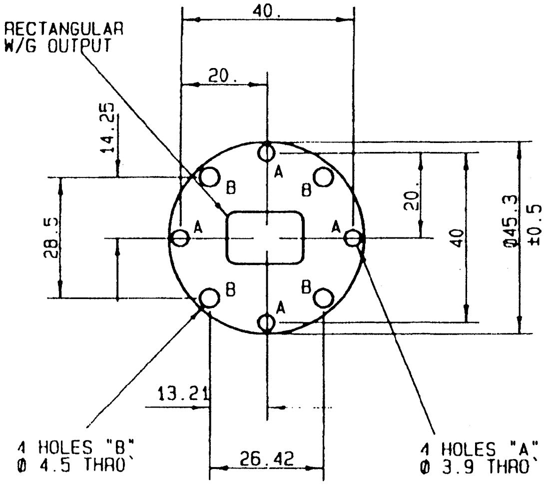
MECHANICAL OUTLINE



WAVE GUIDE OPTIONS



C120 Waveguide



WR75 Waveguide

GEC PLESSEY
SEMICONDUCTORS

DS3184-1.2 August 1992

DF9634

FEED HORN WITH INTEGRATED MAGNETIC POLARISER

FEATURES

- Linear Polarity (Vertical & Horizontal)
- Full ECS & Telecom DTH Band Operation
- Compact, Lightweight Design
- Magnetic Switching - No Moving Parts
- Integral Feed

Waveguide Flange	WR75, (WG17, R120)
Polarisation	Linear (Vertical & Horizontal)
Frequency Bands	10.95 - 12.75GHz 10.95 - 11.70GHz
Crosspolar Isolation	16 dB typical
Rotation	± 45.0° min.
Bias Current	± 45mA max.
Coil Resistance	68 ohms typical

Feed Horn Beamwidth (@ - 10dB)	85° (E plane), 86° (H plane) @ 11.30GHz 80° (E plane), 81° (H plane) @ 11.85GHz	
Phase centre	84mm from waveguide interface	
Weight	180 grams	
Colour	Black Passivated Grey Painted Beige Painted	- DF9634 - DF9634-G - DF9634-B

GEC PLESSEY
SEMICONDUCTORS

DS3185-1.2 August 1992

DF9644

UNIVERSAL MAGNETIC POLARISER AND OFFSET FEED HORN

The DF9644 Universal Magnetic Polariser offers a cost effective and flexible solution to customers who wish to receive signals from satellites across the whole Direct to the Home (DTH) frequency bandwidth, (10.95 to 12.75GHz).

Unlike flange-to-flange universal polarisers, the DF9644 does not require a separate feed horn, thus reducing system costs, without detracting from performance quality.

FEATURES

- Full DTH Bandwidth Operation
- Integral Feed
- Compact/Lightweight Design
- Magnetic Polarity Switching - No Moving Parts

Linear Polarity Operation		
Frequency (GHz)	10.95 - 11.7	12.5 - 12.75
Signal rotation (degrees)	+/- 45°	+/- 45°
Current drive (mA typical)	+/- 45	+/- 20
Cross Polar Isolation (dB)	16	16
Circular Polarity Operation		
Frequency (GHz)	11.7 - 12.5	
Signal rotation (degrees)		
Left Hand	Zero	
Right Hand	90°	
Current drive (mA)		
Left Hand	Zero	
Right Hand	55mA	
Cross Polar Isolation (dB)	16	

Table 1. Universal Polariser Selection

Flange Interface	WR75
Waveguide Apperture	WR75 or C120
Horn Beamwidth (@ -10dB)	
10.95 - 11.7GHz	84°
11.7 - 12.5GHz	78°
12.5 - 12.75GHz	74°
Weight	200 grams.
Colour	Black Passivated - DF9644
	Grey Painted - DF9644-G
	Beige Painted - DF9644-B

Table 2. Product Type Summary

DS3186-1.2 August 1992

DF9740

BLANK OFFSET FEED HORN

The DF9740 is a lightweight feed horn which offers a cost effective solution for discrete LNB and feeds. A universal flange also allows greater flexibility as the DF9740 can be used on WR75 or C120 flange connections.

Horn Beamwidth (@ -10dB) 10.95 - 11.7GHz 11.7 - 12.5GHz 12.5 - 12.75GHz	 84° 78° 74°
Waveguide	C120
VSWR	C120 <1.22 : 1 (>-20dB Return Loss)
Weight	136 grams
Flange	C120 or WR75
Polarisation	Circular or Linear
Colour	Black Passivated - DF9740 Grey Painted - DF9740-G Beige Painted - DF9740-B

FEATURES

- Linear or Circular Polarisation
- Compact Lightweight Design
- Designed for Offset Dishes with an f/d of 0.45 to 0.8
- Waterproof End Cap.

DS3187-1.2 August 1992

DF9741

SHORT FEED HORN FOR CIRCULAR POLARISED SIGNALS

The DF9741 has the same features as the DF9740 blank feed horn, but includes a de-polarising vane for circularly polarised signals.

FEATURES

- Circular De-polarising Vane
- Compact Lightweight Design
- Designed for Offset Dishes with an f/d of 0.45 to 0.8
- Waterproof End Cap.

Horn Beamwidth (@ -10dB) 10.95 - 11.7GHz 11.7 - 12.5GHz 12.5 - 12.75GHz	 84° 78° 74°
Waveguide	C120
VSWR	C120 <1.22 : 1 (>-20dB Return Loss)
Weight	150 grams
Flange	C120 or WR75
Polarisation	Circular
Colour	Black Passivated - DF9741 Grey Painted - DF9741-G Beige Painted - DF9741-B

DS3188-1.2 August 1992

DF9749

LONG FEED HORN FOR LINEARLY POLARISED SIGNALS

The DF9749 feed horn can be used as a lightweight cost effective solution for both circular and linear polarisation applications. The compact size also allows two feeds to be mounted on one dish; i.e. for satellite TV and radio from the same antenna.

Horn Beamwidth (@ -10dB) 10.95 - 11.7GHz 11.7 - 12.5GHz 12.5 - 12.75GHz	 84° 78° 74°
Waveguide	C120
VSWR	C120 <1.22 : 1 (>-20dB Return Loss)
Weight	170 grams
Flange	WR75
Polarisation	Circular or Linear
Colour	Black Passivated - DF9749 Grey Painted - DF9749-G Beige Painted - DF9749-B

FEATURES

- Circular or Linear Polarisation
- Compact Lightweight Design
- Designed for Offset Dishes with an f/d of 0.45 to 0.8
- Waterproof End Cap.

GEC PLESSEY
SEMICONDUCTORS

DS3189-1.2 August 1992

DF9750

LONG FEED HORN FOR LINEARLY POLARISED SIGNALS

The DF9750 is a blank feed horn designed as a lightweight cost effective solution for applications requiring a discrete LNB and feed.

FEATURES

- Linear Polarisation
- Compact Lightweight Design
- Designed for Offset Dishes with an f/d of 0.45 to 0.8
- Waterproof End Cap.

Horn Beamwidth (@ -10dB) 10.95 - 11.7GHz 11.7 - 12.5GHz 12.5 - 12.75GHz	 84° 78° 74°
Waveguide	WR75
VSWR	C120 <1.22 : 1 (>-20dB Return Loss)
Weight	170 grams
Flange	WR75
Polarisation	Linear
Colour	Black Passivated - DF9749 Grey Painted - DF9749-G Beige Painted - DF9749-B

GEC PLESSEY
SEMICONDUCTORS

DS3190-1.2 August 1992

DF9751/2

LONG FEED HORN FOR CIRCULARLY POLARISED SIGNALS

FEATURES

- Circular Depolarising Vane
- Compact Lightweight Design
- Designed for Offset Dishes with an f/d of 0.45 to 0.8
- Waterproof End Cap.

Horn Beamwidth (@ -10dB) 11.7 - 12.5GHz	78°
Waveguide	WR75
VSWR	C120 <1.22 : 1 (>-20dB Return Loss)
Weight	175 grams
Flange	WR75
Polarisation	Circular
Colour	Black Passivated - DF9749 Grey Painted - DF9749-G Beige Painted - DF9749-B

GEC PLESSEY
SEMICONDUCTORS

DS3543-1.2 August 1992

DA8009 & DA8042/43

8-12GHz ANTENNAS

A complementary range of horn antennas is offered at 8-12GHz frequency bands. They are designed to provide the optimum input conditions and radiation characteristics for the DA8504 and DA8506 Series of modules. However they are equally suitable for use with fixed or tunable oscillators from the GPS professional oscillator range.

FEATURES

- Low Sidelobe Levels
- Low Input VSWR
- Choice of Gain Value

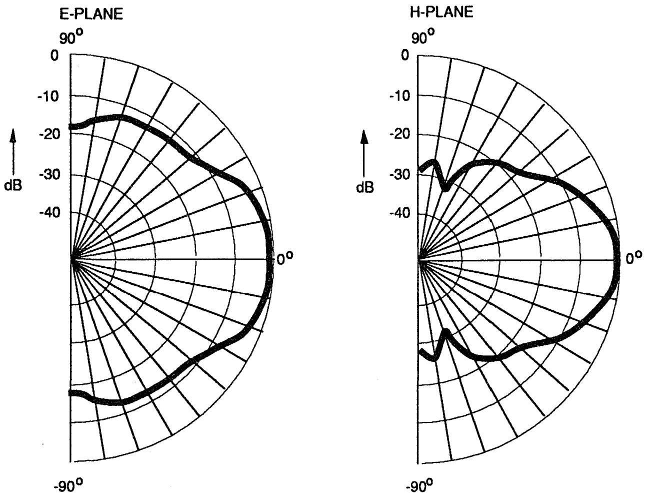
GENERAL CHARACTERISTICS

Operating Temperature Range	0° to +55°C
Waveguide Size	WG 16 (WR 90)
Flange	Compatible with UG 39/U or Equivalent

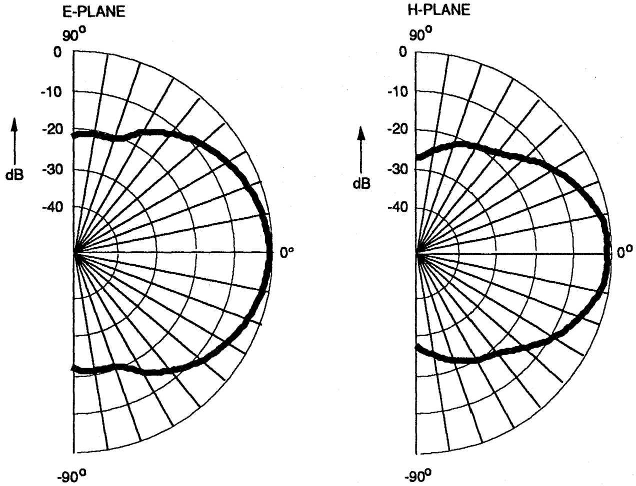
SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8009	DA8042	DA8043	Units
Centre Frequency[1]	8-12	8-12	8-12	GHz
Gain[2]	15	10	12	dB Nom
3dB Beamwidth - E Plane	27	37	32	Degrees
- H Plane	30	50	40	Degrees
VSWR	1.3:1	1.3:1	1.3:1	Typ
Type	Horn	Horn	Horn	

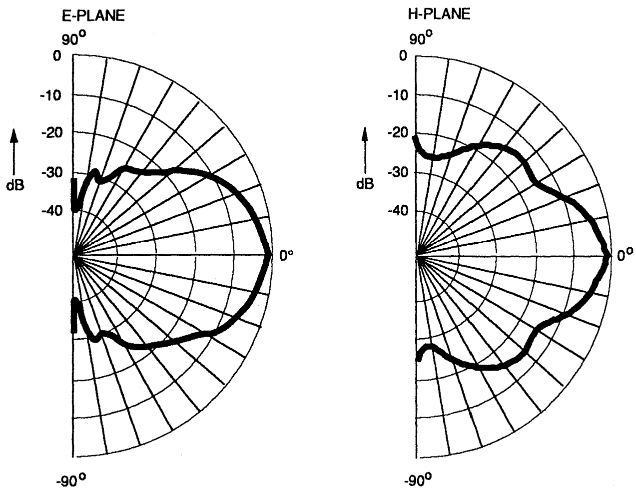
[1]All parameters are measured at 10.6GHz.
[2]Gain relative to isotropic radiator.



DA8009

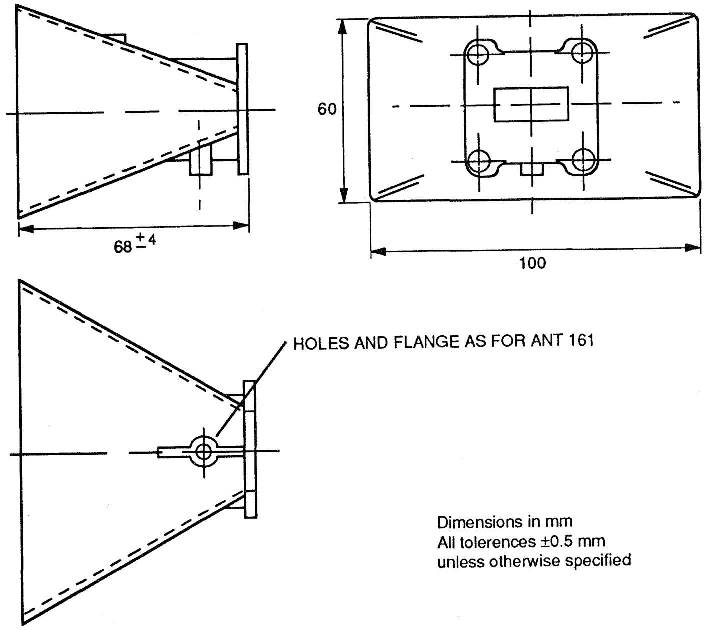


DA8042

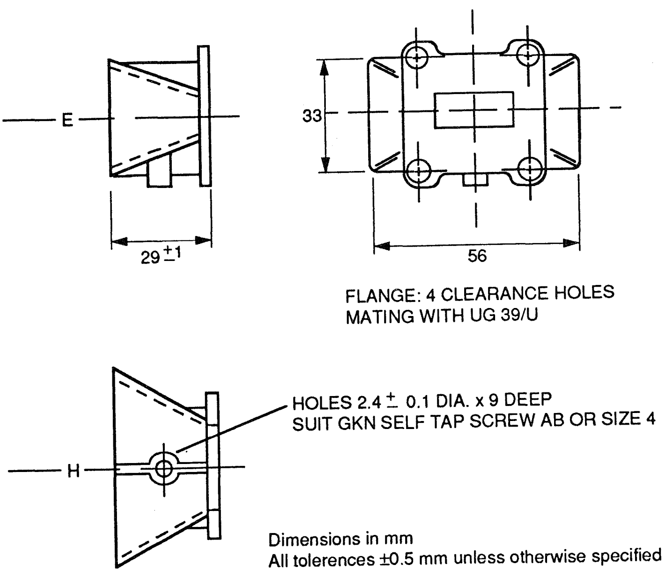


DA8043

PACKAGE DETAILS

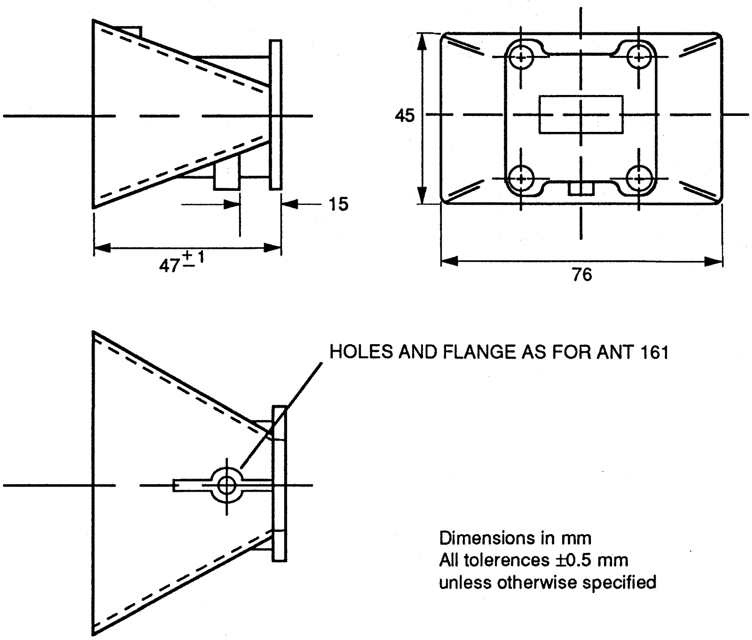


DA8009



DA8042

PACKAGE DETAILS (Continued)



Dimensions in mm
All tolerences ±0.5 mm
unless otherwise specified

DA8043

GEC PLESSEY
SEMICONDUCTORS

DS3544-1.2 August 1992

DA8044/45/46

18-26GHz ANTENNAS

A complementary range of horn antennas is offered at 8-12GHz frequency bands. They are designed to provide the optimum input conditions and radiation characteristics for the DA8505 and DA8507 Series of modules. However they are equally suitable for use with fixed or tunable oscillators from the GPS professional oscillator range. Dielectric rod antennas are also available at 24GHz.

GENERAL CHARACTERISTICS

Operating Temperature Range	0° to +55°C
Waveguide Size	WG 20 (WR 42)
Flange	Compatible with UG 595/U or Equivalent

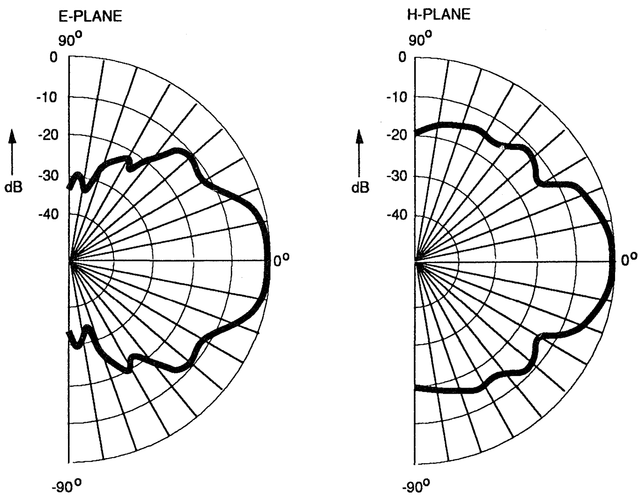
FEATURES

- Low Sidelobe Levels
- Low Input VSWR
- Choice of Gain Value

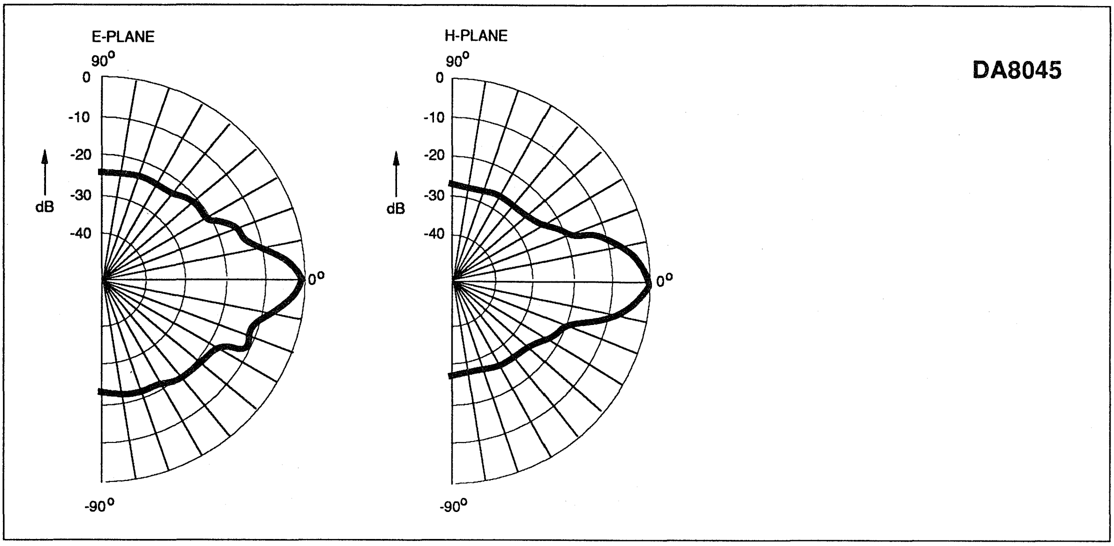
SPECIFICATION at 25°C unless otherwise stated

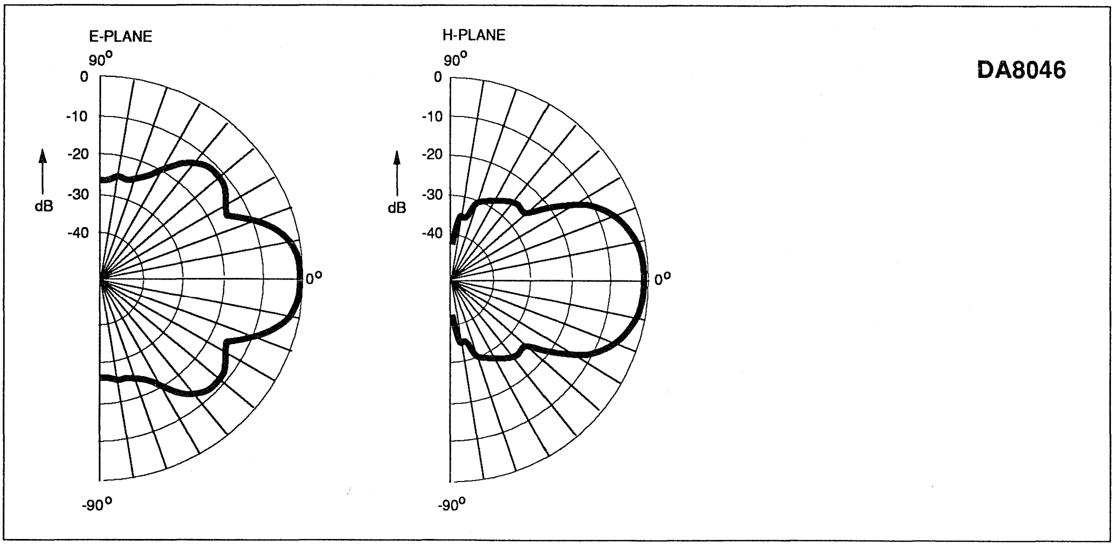
Parameter	DA8044	DA8045	DA8046	Units
Centre Frequency[1]	24-24.5	18-26	18-26	GHz
Gain[2]	12	20	15	dB Nom
3dB Beamwidth - E Plane	30	20	28	Degrees
- H Plane	33	12	25	Degrees
VSWR	1.4:1	1.3:1	1.3:1	Typ
Type	Dielectric	Horn	Horn	

[1]All parameters are measured at 24GHz.
[2]Gain relative to isotropic radiator.

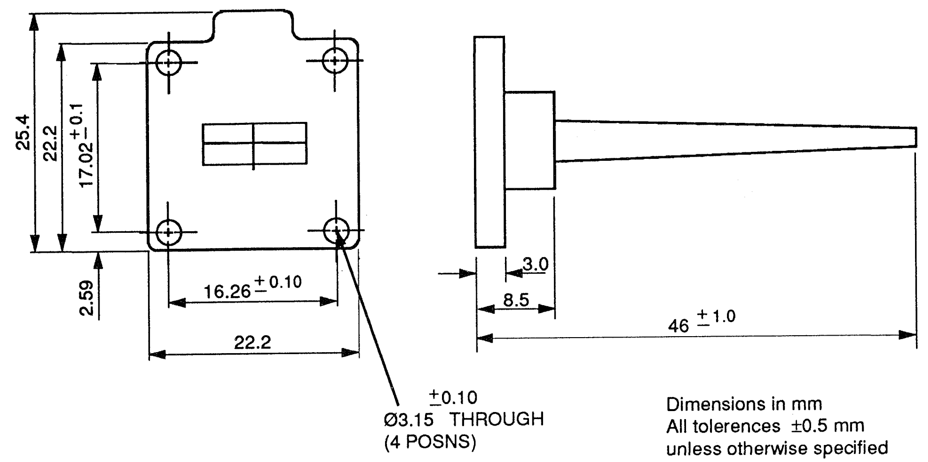


DA8044


E-PLANE
90°
0
-10
-20
-30
-40
dB
0°
-90°
H-PLANE
90°
0
-10
-20
-30
-40
dB
0°
-90°
DA8045

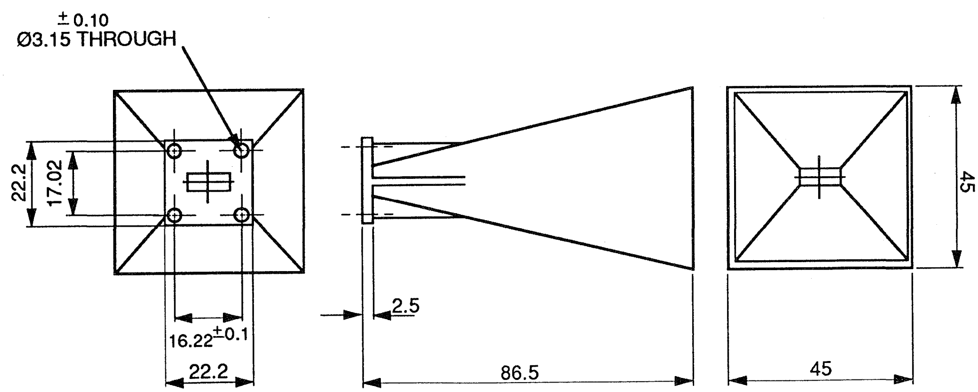

E-PLANE
90°
0
-10
-20
-30
-40
dB
0°
-90°
H-PLANE
90°
0
-10
-20
-30
-40
dB
0°
-90°
DA8046

PACKAGE DETAILS



Dimensions in mm
All tolerences ±0.5 mm
unless otherwise specified

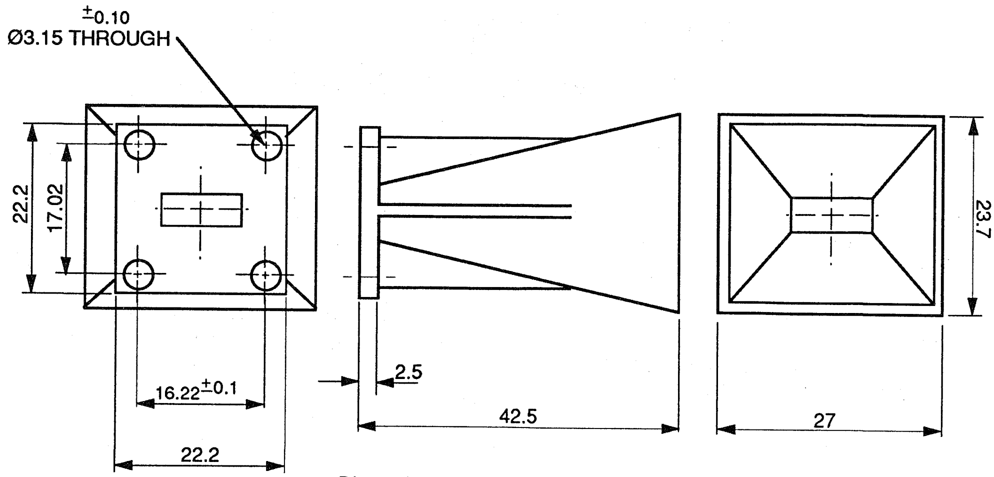
DA8044



Dimensions in mm
All tolerences ±0.5 mm unless otherwise specified

DA8045

PACKAGE DETAILS (Continued)



Dimensions in mm
All tolerences ±0.5 mm unless otherwise specified

DA8046

GEC PLESSEY
SEMICONDUCTORS

DS3536-1.1 August 1992

F1013-49 & F1147/48

LOW POWER WAVEGUIDE CIRCULATORS

* FREQUENCY COVERAGE 7.75 – 40.0GHz
* CIRCULATORS AND ISO-CIRCULATORS AVAILABLE
* 4-PORT VERSIONS IN R120 & R140
* COMPACT AND ROBUST CONSTRUCTION

This data sheet describes a standard range of 3-port circulators and iso-circulators in R84, R100, R120, R140 and R320 and also 4-port circulators in R120 and R140. These circulators and iso-circulators are designed for low-power applications in the communication and radar bands between 7.75 and 40.0GHz.

F1045, F1013	:	3-port circulators and iso-circulators in R84 covering 7.75 to 8.5GHz
F1046, F1015	:	3-port circulators and iso-circulators in R100 covering 8.2 to 12.4GHz
F1047	:	3-port circulators in R120 covering 10.7 to 14.5GHz
F1048	:	3-port circulators in R140 covering 12.4 to 18.0GHz
F1049	:	3-port circulators in R320 covering 26.5 to 40.0GHz
F1147, F1148	:	4-port circulators in R120 and R140

Enquiries are welcomed for any special requirements not covered by the components listed.

PERFORMANCE DATA 4-Port Circulators

Waveguide R120 (WG17, WR75) TYPE No. F1147 – 01

Frequency band GHz	Operating temp. °C	Isolation dB (min)		VSWR (max)	Insertion loss dB (max)		Forward power W (max)
		Ports 2 – 1	Ports 1 – 4, 3 – 2		Ports 1 – 2	Ports 2 – 3	
12.25 – 13.25	0 : +55	27	45	1.10:1	0.25	0.50	20
	– 40 : +0	23	—	1.15:1			

Weight approx (g)	Flange drilling		Dimensions (mm)				Fig. No.
	Hole centres	Hole details	A	B	C	X	
270	IEC .BR120	6 holes tapped M3	41.0	42.0	105.0	64.0	3

Note: Storage temperature – 40°C to + 85°C.

Waveguide R140(WG18, WR62) TYPE No. F1148 – 01

Frequency band GHz	Operating temp. °C	Isolation dB (min)		VSWR (max)	Insertion loss dB (max)		Forward power W (max)
		Ports 4-2 1-3, 2-4, 3-1 2-1, 4-3	Ports 1-4, 3-2		Ports 1-2, 3-4	Ports 2-3, 4-1	
13.62 – 13.85	– 40: + 70	25	50	1.10:1	0.30	0.60	20

Weight approx (g)	Flange drilling		Dimensions (mm)				Fig. No.
	Hole centres	Hole details	A	B	C	X	
110	UG419/U3 IEC .BR140	4 holes 3.66/3.74 dia	34.0	38.0	73.0	38.0	3

Note: Storage temperature – 55°C to + 85°C.

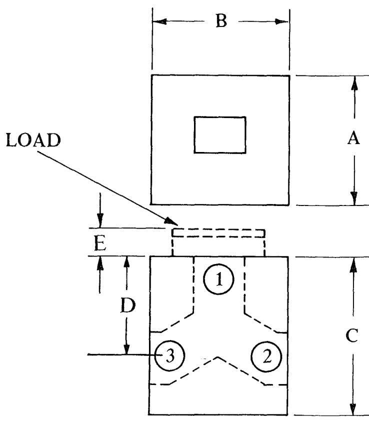


Fig. 1

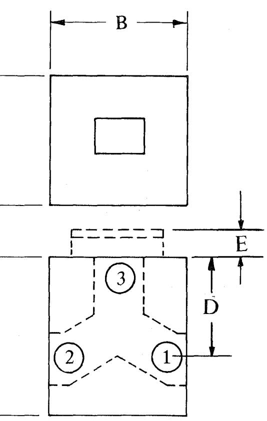


Fig. 2

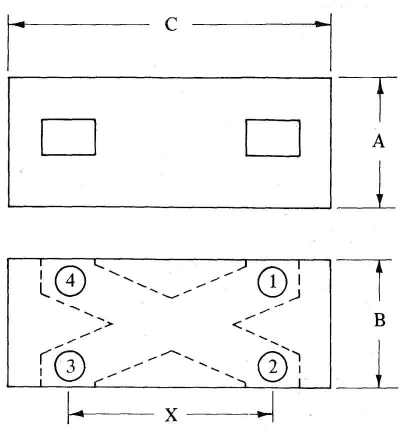


Fig. 3

PERFORMANCE DATA 3-Port Circulators and iso-circulators

Waveguide R84 (WG15, WR112) (See Notes 1 & 2)

TYPE NUMBERS		Frequency band GHz	Operating temp °C	Isolation dB (min)	VSWR (max)	Insertion loss dB (max)
Circulator	Isolator					
F1045 – 13	F1013 – 10 F1013 – 11 F1013 – 12	7.75 – 8.5	– 30 : + 60	25	1.10:1	0.2

Waveguide R100 (WG16, WR90) (See Notes 1, 3 & 4)

Circulator	Isolator	Frequency band GHz	Operating temp °C	Isolation dB (min)	VSWR (max)	Insertion loss dB (max)
F1046 – 32	F1015 – 22 F1015 – 32	8.2 – 10.0	0 : + 50	25	1.12:1	0.25
F1046 – 33	F1015 – 23 F1015 – 33	8.2 – 10.2	– 40 : + 85 0 : + 50	23 25	1.16:1 1.12:1	0.4
F1046 – 34	F1015 – 24 F1015 – 34	9.2 – 11.2	– 40 : + 85 0 : + 50	23 25	1.16:1 1.12:1	0.4
F1046 – 35	F1015 – 25 F1015 – 35	10.4 – 12.4	– 40 : + 85 0 : + 50	23 25	1.16:1 1.12:1	0.4
F1046 – 36	F1015 – 26 F1015 – 36	8.2 – 12.4	– 40 : + 85	20	1.22:1	0.5

Waveguide R120 (WG17, WR75) (See Notes 1 & 5)

Circulator	Isolator	Frequency band GHz	Operating temp °C	Isolation dB (min)	VSWR (max)	Insertion loss dB (max)
F1047 – 02	–	12.25 – 13.25	0 : + 55 – 40 : + 0	27 23	1.10:1 1.15:1	0.25
F1047 – 03	–	10.7 – 11.7	– 20 : + 60	26	1.10:1	0.2
F1047 – 04	–	11.7 – 12.5	– 20 : + 60	26	1.10:1	0.2
F1047 – 05	–	12.5 – 13.5	– 20 : + 60	26	1.10:1	0.2
F1047 – 06	–	14.0 – 14.5	– 20 : + 60 0 : + 50	26 30	1.10:1	0.2

Waveguide R140 (WG18, WR62) (See Notes 1 & 5)

Circulator	Isolator	Frequency band GHz	Operating temp °C	Isolation dB (min)	VSWR (max)	Insertion loss dB (max)
F1048 – 03	–	14.0 – 14.4	– 20 : + 60	30	1.10:1	0.3
F1048 – 04	–	14.0 – 14.5	0 : + 60	30	1.10:1	0.3
F1048 – 05	–	13.0 – 14.0	0 : + 50	25	1.12:1	0.3
F1048 – 06	–	13.8 ± 10%	0 : + 50	20	1.22:1	0.3
F1048 – 07	–	16.4 – 16.6	– 10 : + 60	35	1.04:1	0.3
F1048 – 09	–	14.5 – 15.35	– 40 : + 55	25	1.12:1	0.3
F1048 – 33	–	12.4 – 14.2	– 40 : + 85	20	1.22:1	0.3
F1048 – 34	–	14.2 – 16.0	– 40 : + 85	20	1.22:1	0.3
F1048 – 35	–	16.0 – 18.0	– 40 : + 85	20	1.22:1	0.3
F1048 – 36	–	12.4 – 18.0	0 : + 50	20	1.22:1	0.3

Waveguide R320 (WG22, WR28) (See Notes 1 & 5)

Circulator	Isolator	Frequency band GHz	Operating temp °C	Isolation dB (min)	VSWR (max)	Insertion loss dB (max)
F1049 – 20	–	In frequency range 26.5 – 40.0 2GHz Bandwidth* 1GHz Bandwidth*	 – 40 : + 85 – 40 : + 85	 20 25	 1.20 1.15	 0.5 0.5

* Centre frequency must be stated.

NOTES:
1 (R84 to R320) Storage temperature for all devices – 40°C to + 85°C.
2 (R84) Load fitted to port 1 (F1013 – 10), port 2 (F1013 – 11), port 3 (F1013 – 12) see figure 2.
3 (R100) Loads are normally fitted to port 1 of the isolator unless specified otherwise. The relevant circulator dimension is increased by the thickness of the load, i.e. 1W load = 13.2mm or 5W load = 37.7mm.

Mean Power W (max)		Weight approx. g		Flange Drilling		Dimensions mm					
Forward	Reverse (Isolator)	Circulator	Isolator	Hole centres	Hole details	A	B	C	D	E	Fig. No.
25	2	233	292	UG51/U IEC .BR84	4 holes 4.3 dia	48.0	66.60	63.50	38.5	20	2

25	1 5	115	150 156	UG135/U IEC .BR100	4 holes tapped 8.32 UNC	41.28	41.28	50.80	30.16	13.20 37.70	1
50	1 5	115	150 156	"	"	41,28	41.28	50.80	30.16	13.20 37.70	1
50	1 5	115	150 156	"	"	41.28	41.28	50.80	30.16	13.20 37.70	1
50	1 5	115	150 156	"	"	41.28	41.28	50.80	30.16	13.20 37.70	1
25	1 5	115	150 156	"	"	41.28	41.28	50.80	30.16	13.20 37.70	1

20	–	127	–	IEC .DR120	6 holes tapped M3	41.0	42.0	52.50	32.0	–	2
200*	–	127	–	IEC .BR120	4-holes 4.07/4.10 dia	41.0	42.0	52.50	32.0	–	1
200*	–	127	–	"	"	41.0	42.0	52.50	32.0	–	1
200*	–	127	–	"	"	41.0	42.0	52.50	32.0	–	1
200*	–	127	–	"	"	41.0	42.0	52.50	32.0	–	1

* Specification applies into 2:1 max load mismatch: Circulator will withstand operation into a short circuit.

10	–	91	–	UG419/U IEC .BR140	4 holes 3.66/3.74 dia	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	120	–	"	4 holes tapped M4	34.0	34.0	40.0	23.0	–	1
10	–	91	–	"	4 holes 3.66/3.74 dia	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1
10	–	91	–	"	"	34.0	42.60	48.60	32.0	–	1

5	–	41	–	UG 599/U IEC .BR320	4 holes tapped 4–40 UNC	25.4	25.4	25.4	15.9	–	1

4 (R100) The mean power capability of the load fitted to types F1015–32 to –36 is 10W, but operation at over 5W c.w. reverse power may degrade overall performance of isolator at upper extremes of ambient temperature due to heating of the circulator.

5 (R120, R140 and R320) Isolator versions for various power levels are available for all R120, R140 and R320 devices.

DS3537-1.1 August 1992

F1114-18

WAVEGUIDE SLIMLINE ISOLATORS

* ROBUST
* MINIATURE
* LIGHT WEIGHT

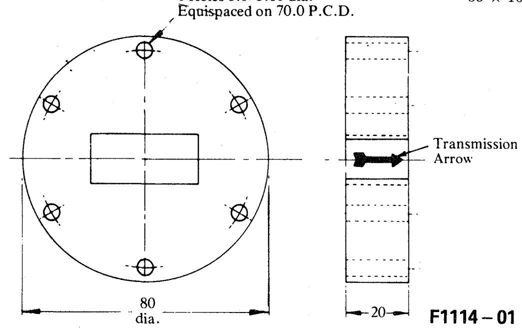
The F1114 to F1118 Series of low-power miniature slimline isolators are designed in waveguide sizes R70, R84, R100, R120 and R140 in the frequency range 5.9 to 18.0GHz.
They are ideal for use in modern communication and radar equipments providing excellent isolation with low insertion loss; their small size, light weight and wide temperature range, makes the F1114 to F1118 range of isolators particularly suitable for portable and mobile microwave systems. This type of isolator has many airborne and military applications.

ELECTRICAL SPECIFICATIONS (Centre frequency must be specified when ordering)

TYPE No.	F1114−01, −06	F1114−02, −07	F1115−01	F1115−02	F1116−01	F1116−02	F1116−03
Frequency range GHz*	5.9 to 8.0	5.9 to 8.0	6.8 to 8.6	6.8 to 8.6	8.4 to 12.4	8.4 to 12.4	8.4 to 12.4
Operating temperature range	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Bandwidth MHz	100	200	100	200	100	200	300
Power handling W (mean), (max)	2	2	2	2	2	2	2
Isolation dB (min):							
−over temp. range	25	20	25	20	30	25	20
−at 25°C	30	25	30	25	35	30	25
Insertion loss dB (max) over temperature range	0.4	0.4	0.4	0.4	0.4	0.4	0.4
VSWR (max):							
−over temp. range	1.20	1.25	1.20	1.25	1.20	1.25	1.25
−at 25°C	1.15	1.20	1.15	1.20	1.15	1.18	1.20
WG size (IEC)	R70	R70	R84	R84	R100	R100	R100
(British) WG	14	14	15	15	16	16	16
Approx. Weight (g)	−01 210 −06 142	−02 210 −07 142	100	100	51	51	51

*The operating bandwidth of isolator must be within this range.
Slimline Isolators are supplied in clear anodised aluminium alloy unless specified otherwise.
They all meet requirements of DEF. 151.

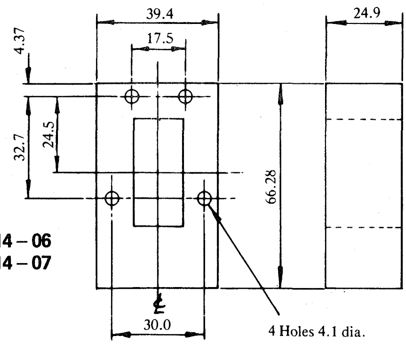
OUTLINE DRAWINGS Dimensions in millimetres



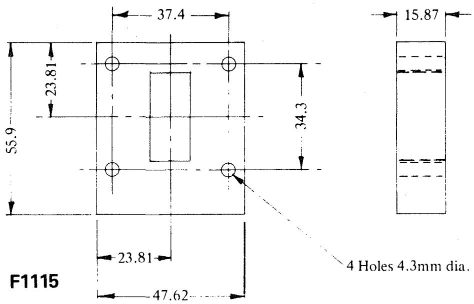
Waveguide Aperture Size 35 × 16 (R70)

F1114 – 01
F1114 – 02

Waveguide Aperture Size 35 × 16 (R70)

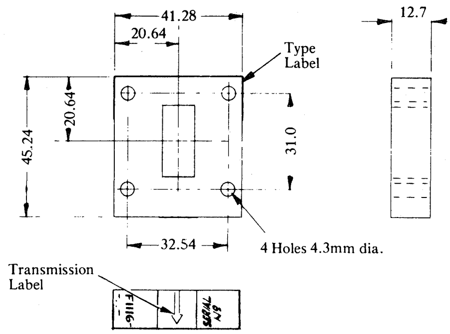


F1114 – 06
F1114 – 07



F1115

Waveguide Aperture Size 28.5 × 12.6 (R84)



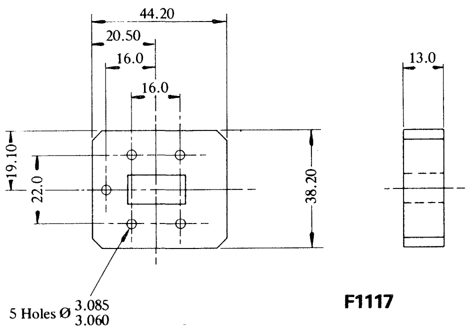
Waveguide Aperture Size 23 × 10.2 (R100)

F1116

ELECTRICAL SPECIFICATION (Centre frequency must be specified when ordering)

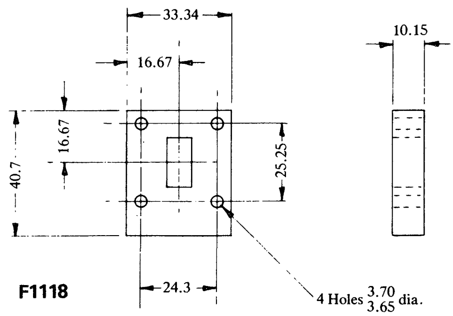
TYPE No.	F1117 – 01	F1117 – 02	F1117 – 03	F1118 – 01, – 21□	F1118 – 02, – 22□	F1118 – 03, – 23□	F1118 – 06
Frequency range GHz*	10.0 to 15.0	10.0 to 15.0	10.0 to 15.0	12.4 to 18.0	12.4 to 18.0	12.4 to 18.0	12.4 to 18.0
Operating temperature range	– 40°C to + 85°C	– 40°C to + 85°C	– 40°C to + 85°C	– 40°C to + 85°C	– 40°C to + 85°C	– 40°C to + 85°C	– 40°C to + 85°C
Bandwidth MHz	100	200	300	100	200	300	600
Power handling W (mean), (max)	2	2	2	2	2	2	2
Isolation dB (min):							
– over temp. range	30	25	20	30	25	20	18
– at 25°C	35	30	25	35	30	25	23
Insertion loss dB (max) over temperature range	0.4	0.4	0.4	0.4	0.4	0.4	0.4
VSWR (max):							
– over temp. range	1.20	1.25	1.25	1.20	1.25	1.30	1.45:1
– at 25°C	1.15	1.18	1.20	1.15	1.18	1.25	1.30:1
WG size (IEC)	R120	R120	R120	R140	R140	R140	R140
(British) WG	17	17	17	18	18	18	18
Approx. Weight (g)	51	51	51	31	31	31	31

□Isolator Type F1118 – 21, – 22 and – 23 as (– 01, – 02 and – 03) but flange drilled as IEC UBR 140.



F1117

Waveguide Aperture Size 19.05 × 9.53 (R120)



F1118

Waveguide Aperture Size 15.8 × 8 (R140)

DS3538-1.1 August 1992

F1001/04/08/10

HIGH POWER WAVEGUIDE RESONANCE ISOLATORS

* L, S & C BAND COVERAGE
* HIGH POWER CAPABILITY

This data sheet describes a range of high-power water and aircooled waveguide resonance isolators covering the frequency range 1.215 to 6.4GHz suitable for radar and communication applications.

The type numbers and general frequency range are tabulated below.

F1001	in M14	covering	1.215	to	1.365GHz
F1004	in R32	covering	2.7	to	3.4GHz
F1008	in R48	covering	5.2	to	5.85GHz
F1010	in R70	covering	5.9	to	6.4GHz

A range of 4-port high-power waveguide differential phase shift circulators and 3-port junction circulators is available; details of these will be supplied on request.

PERFORMANCE DATA HIGH-POWER WAVEGUIDE RESONANCE ISOLATORS

WAVEGUIDE M14 (Half Height WG6, Half Height WR650)

TYPE NUMBER	Frequency band GHz	Bandwidth MHz	Isolation dB (min)	Insertion loss dB (max)	VSWR (max)	Power (max) (see Note 1)	
						Peak MW	Mean kW
F1001 – 06	1.25 – 1.365	115	14	0.5	1.1:1	3	3.25
F1001 – 20	1.215 – 1.365	150	15	0.4	1.1:1	5	12.5
F1001 – 30	1.215 – 1.365	150	15	0.5	1.1:1	5	28

WAVEGUIDE R32 (WG10. WR284)

F1004 – 20	2.9 – 3.1	200	10	0.5	1.1:1	1.4	1.1
F1004 – 31 / – 39	2.7 – 3.4*	200	10	0.6	1.1:1	5	5
F1004 – 55	2.7 – 3.4*	200	10	0.6	1.1:1	5	5
F1004 – 51**	2.85 – 3.0	150	10	0.6	1.1:1	5	5
F1004 – 52†	2.9 – 3.1	200	5	0.6	1.1:1	5	5
F1004 – 53†	2.7 – 2.9	200	5	0.6	1.1:1	5	5

WAVEGUIDE R48 (WG12. WR187)

F1008 – 35	5.2 – 5.85*	300	10	0.5	1.1:1	1.5	2

WAVEGUIDE R70 (WG14. WR137)

F1010 – 31	5.9 – 6.4	500	10	0.45	1.1:1	–	5

NOTE 1
The power handling of the isolators listed is a function of the pulse length, p.r.f. cooling and waveguide pressurisation; the figures given in the tables are for typical operating conditions but the maximum power handling capability must ultimately be determined for each specific application.

* Specify centre frequency when ordering.

** Performance out of Band.
Isolation 10dB (min) from 2.85 to 3.5GHz. VSWR 2:1 (max) from 3.0 to 3.5GHz.

† Performance out of Band. Isolation 8dB (min) at 3.75GHz.

OUTLINE DRAWINGS — Dimensions in millimetres.

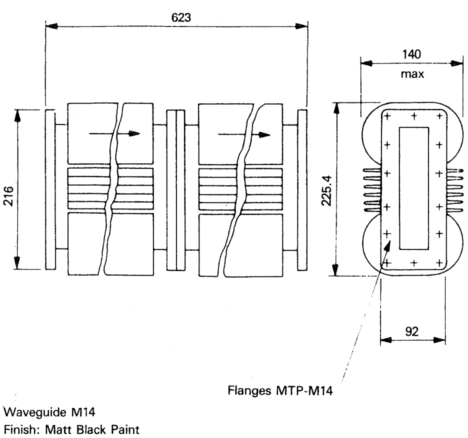


FIG. 1 F 1001 – 06

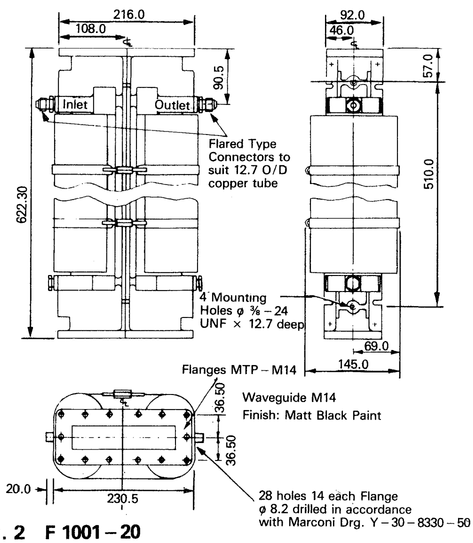


FIG. 2 F 1001 – 20

Storage temp. °C	*** WG Air Pressure kg/cm² gauge (max)	Type of Cooling	Water flow litres/min (min)	Water Pressure kg/cm² gauge (max)	Inlet Water temp. °C (max)	Weight approx kg	Fig. No.
−20: +80	0.7	Forced Air	—	—	—	40	1
−20: +80	1.05	Water ††	2.27	4.2	60	40	2
−40: +80	1.05	Water ††	6.75	4.2	30	83	3
−40: +80	2.2	Air	—	—	—	13	4
−20: +80	2.2	Water	2	4.2	60	13	5 6
−20: +80	2.2	Water	2	7.0	60	13	5
−20: +80	—	Water	2	3.2	60	16	7
−20: +80	2.2	Water	2	4.2	60	13	6
−20: +80	2.2	Water	2	4.2	60	13	6
−20: +80	—	Water	2	4.2	60	8	8
−20: +80	—	Water	2.5	4.2	50	8	9

†† Cooling channels are aluminium; fully inhibited coolant required.
*** Adequate waveguide pressure must be maintained: See Technical Specification.

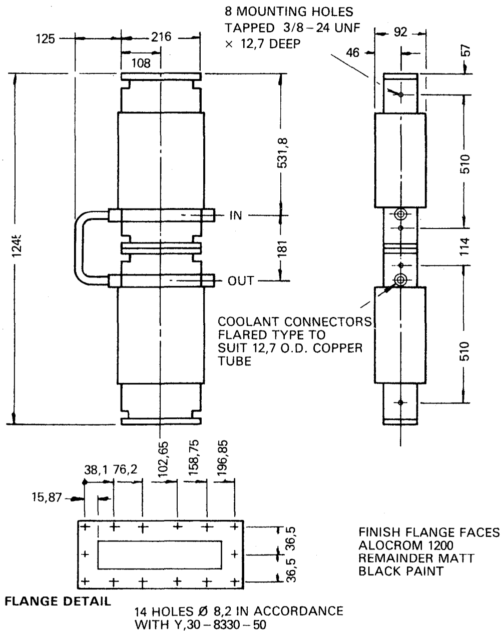


FIG. 3 F 1001 – 30

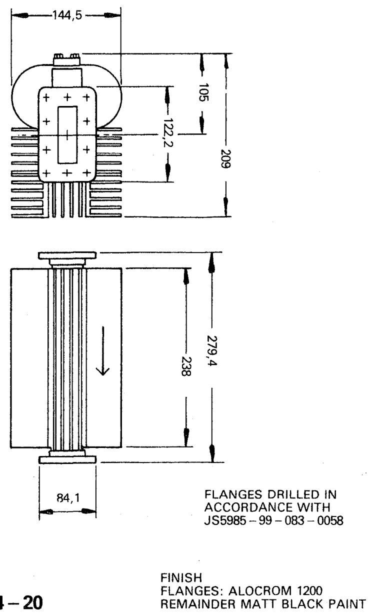
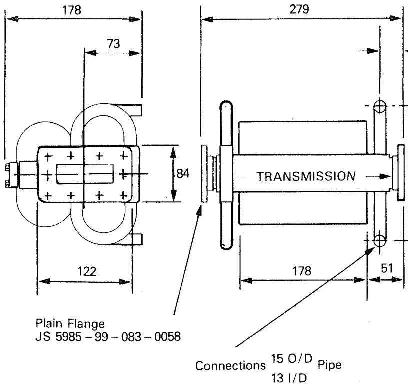


FIG. 4 F 1004 – 20



Waveguide R32
Finish: Oyster Hammer Paint
(Flange faces Silver Plated)

FIG. 5 F 1004 – 31

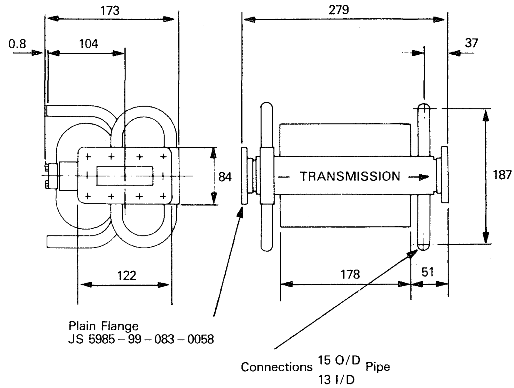


FIG. 6 F 1004 – 39
F 1004 – 52
F 1004 – 53

Waveguide R32
Finish: Oyster Hammer Paint
(Flange faces Silver Plated)

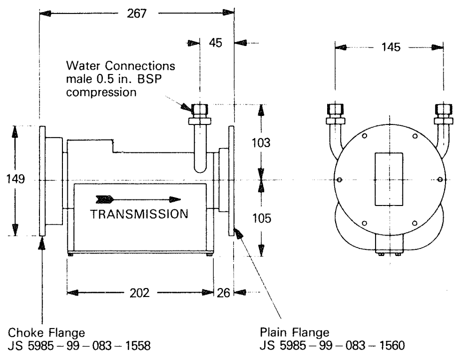
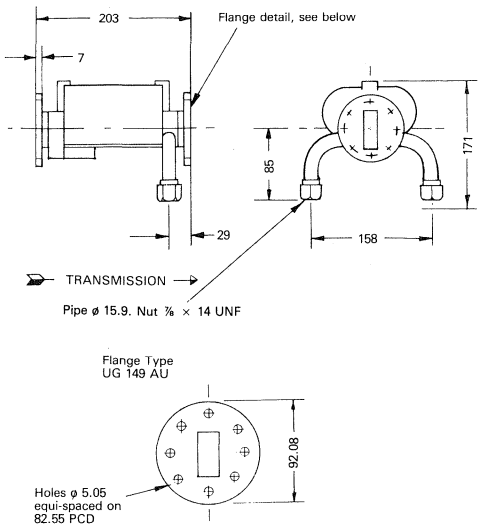


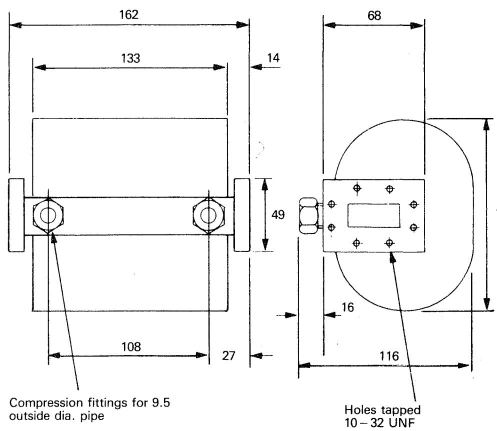
FIG. 7 F 1004 – 51

Waveguide R32
Finish: Oyster Hammer Paint
(Flange faces Silver Plated)



Waveguide R48
Finish: Matt Black Paint

FIG. 8 F 1008 – 35



Waveguide R70
Finish: Oyster Hammer Paint
(Flange: faces Silver Plated)

FIG. 9 F 1010 – 31

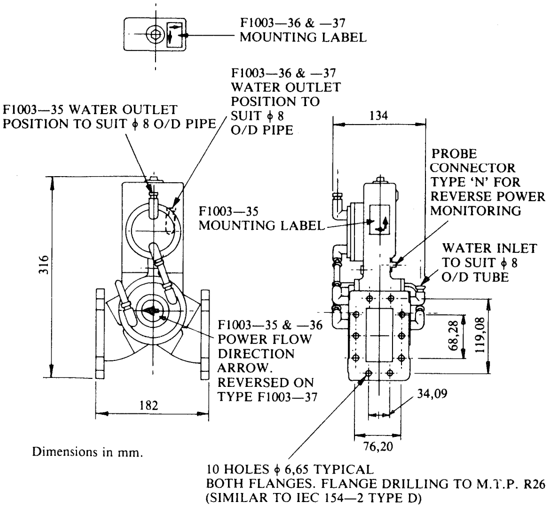
DS3539-1.1 August 1992

F1003, F1152, F1241 & F1284

R26 WAVEGUIDE COMPONENTS FOR MICROWAVE HEATING SYSTEMS

This data sheet describes a range of components in R26 (WG9A, WR340) for use in microwave heating systems at 2450MHz. The range includes a 6.5kW water-cooled isolator, 6kW water-cooled circulator and load, 1kW air-cooled circulator, 0.5kW air-cooled load and a transformer from R26 to R32, with type numbers:

6.5kW Water-cooled Isolator	F1003 – 35, – 36, – 37
6kW Water-cooled Circulator	F1152 – 12, – 13
6kW Water dielectric Load	F1284 – 60, – 61
1kW Air-cooled Circulator	F1152 – 01
0.5kW air-cooled Load	F1284 – 11
R26 to R32 Transformer	F1241 – 02, – 03



MOUNTING POSITION
THE ISOLATOR MUST BE MOUNTED SO THAT ONE OF THE ARROWS ON THE MOUNTING LABEL IS VERTICALLY UPRIGHT

6.5kW ISOLATOR F1003−35, −36, −37

A water-cooled isolator, capable of operating with up to 6.5kW forward and reverse power simultaneously. The three editions available offer a choice of mounting positions and direction of power flow.

The isolator is fitted with a probe and N-type output connector to allow monitoring of the reverse power.

Operation can be continuous into a full short circuit load condition of any phase.

SPECIFICATION

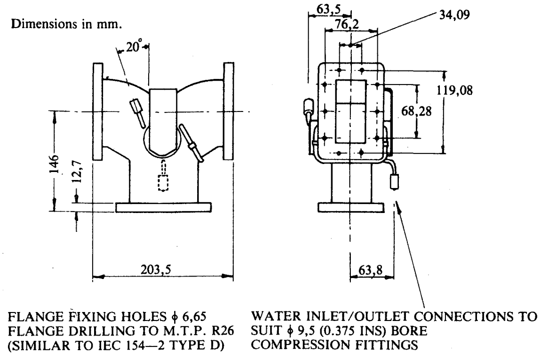
Frequency range	2.425 to 2.475GHz
Isolation	20dB (min)
Insertion loss	0.2dB (max)
Input return loss	20dB (min) with output port matched
	17dB (min) with short circuit at output port
Forward power	9kW peak (max)
	6.5kW mean (max)
Reverse power	9kW peak (max)
	6.5kW mean (max)
Waveguide pressure	0.2kg/cm^2 gauge (max)
	0.0kg/cm^2 gauge (min)
Water pressure	6.32kg/cm^2 (max)
Water flow	2.8 litres/min (min)
Inlet water temperature	10°C (min)
	40°C (max)
Finish	Matt black paint
Mass	6kg (excluding coolant)
Probe sensitivity	1 to 4mW with full reverse power

Mounting instructions on the fitted label must be observed.

The materials in the water-cooling circuit are copper, brass and polypropylene. Water flow must be smooth and bubble-free. The use of flow sensing switch external to the isolator is recommended as a protection against failure of water supply.

6kW CIRCULATOR F1152 – 12, – 13

A water-cooled T-configuration three-port junction circulator in cast aluminium alloy capable of handling 6kW forward and reverse power simultaneously.



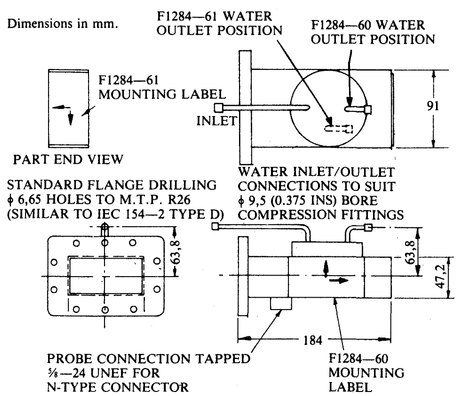
SPECIFICATION

Frequency range	F1152 – 12	2.425 to 2.475GHz
	F1152 – 13	2.35 to 2.40GHz
Isolation		20dB (min)
Insertion loss		0.2dB (max)
Return loss		20dB (min)
Forward power		9kW peak (max)
		6kW mean (max)
Reverse power		9kW peak (max)
		6kW mean (max)
Waveguide air pressure		0.2kg/cm^2 gauge (max)
		0.0kg/cm^2 gauge (min)
Water pressure		6.5kg/cm^2 (max)
Water flow		1.0 litre/min (min)
Inlet water temperature		10°C (min)
		50°C (max)
Finish		Matt black paint
Mass		4.075kg

6kW WATER DIELECTRIC LOAD F1284 – 60, – 61 SPECIFICATION

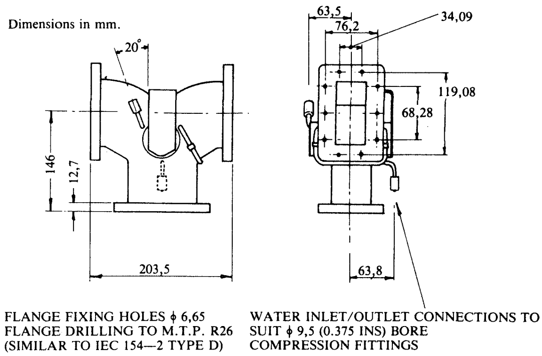
Frequency range	2.37 to 2.48GHz
Power	9kW peak (max)
	6kW mean (max)
VSWR	1.2:1 (max)
Water pressure	6.5kg/cm^2 gauge (max)
Water flow	2.8 litres/min. (min)
Inlet water temperature	10°C (min)
	40°C (max)
Finish	Matt black paint
Mass	2.65kg (excluding coolant)

Mounting instructions on the fitted label must be observed.



6kW CIRCULATOR F1152 – 12, – 13

A water-cooled T-configuration three-port junction circulator in cast aluminium alloy capable of handling 6kW forward and reverse power simultaneously.



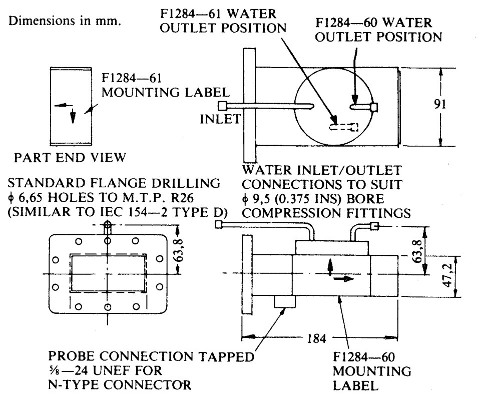
SPECIFICATION

Frequency range	F1152 – 12	2.425 to 2.475GHz
	F1152 – 13	2.35 to 2.40GHz
Isolation		20dB (min)
Insertion loss		0.2dB (max)
Return loss		20dB (min)
Forward power		9kW peak (max)
		6kW mean (max)
Reverse power		9kW peak (max)
		6kW mean (max)
Waveguide air pressure		0.2kg/cm^2 gauge (max)
		0.0kg/cm^2 gauge (min)
Water pressure		6.5kg/cm^2 (max)
Water flow		1.0 litre/min (min)
Inlet water temperature		10°C (min)
		50°C (max)
Finish		Matt black paint
Mass		4.075kg

6kW WATER DIELECTRIC LOAD F1284 – 60, – 61 SPECIFICATION

Frequency range	2.37 to 2.48GHz
Power	9kW peak (max)
	6kW mean (max)
VSWR	1.2:1 (max)
Water pressure	6.5kg/cm^2 gauge (max)
Water flow	2.8 litres/min. (min)
Inlet water temperature	10°C (min)
	40°C (max)
Finish	Matt black paint
Mass	2.65kg (excluding coolant)

Mounting instructions on the fitted label must be observed.



DS3540-1.1 August 1992

F1003, F1152 & F1282

R9 WAVEGUIDE COMPONENTS FOR MICROWAVE HEATING SYSTEMS

This data sheet describes a range of high power components in R9 (WG 4, WR 975) for use in microwave industrial heating systems at 896MHz and 915MHz.

Type Number	Unit
F1003 – 52	Isolator — frequency 894 – 898MHz
F1003 – 53	Isolator — frequency 913 – 917MHz
F1152 – 52	3 port junction circulator — frequency 894 – 898MHz
F1152 – 53	3 port junction circulator — frequency 913 – 917MHz
F1282 – 20	Water dielectric load — frequency 886 – 925MHz

F1003 – 52, F1003 – 53 High Power Isolators

These units are designed principally for the protection of high power magnetrons from high levels of reverse power. The isolators consist of a high power water cooled three port junction circulator with a high power water dielectric load on one port.

SPECIFICATION:

Frequency range: F1003 – 52	894 – 898MHz
F1003 – 53	913 – 917MHz
Isolation	18dB min
Return loss	18dB min
Insertion loss	0.2dB max
Forward power	30kW max
Reverse power	30kW max (i.e. full short circuit load condition of any phase)
Coolant flow	15 litres/minute min
Coolant pressure	6.3kg/cm^2 max
Coolant temperature (inlet)	10°C min to 40°C max
Outline	As F1152 – 52/53 with F1282 – 20 load on one port

F1152 – 52, F1152 – 53 High Power Circulators

These units are high power water cooled three port junction circulators.

SPECIFICATION:

Frequency range: F1152 – 52	894 – 898MHz
F1152 – 53	913 – 917MHz
Isolation	18dB min*
Return loss	18dB min*
Insertion loss	0.2dB max
Forward Power (Mean)	30kW max
Reverse Power (Mean)	30kW max (i.e. full short circuit load condition of any phase)
Coolant flow	10 litres/minute min
Coolant pressure	6.3kg/cm^2 max
Coolant temperature (inlet)	10°C min to 40°C max
Outline	See fig. 1

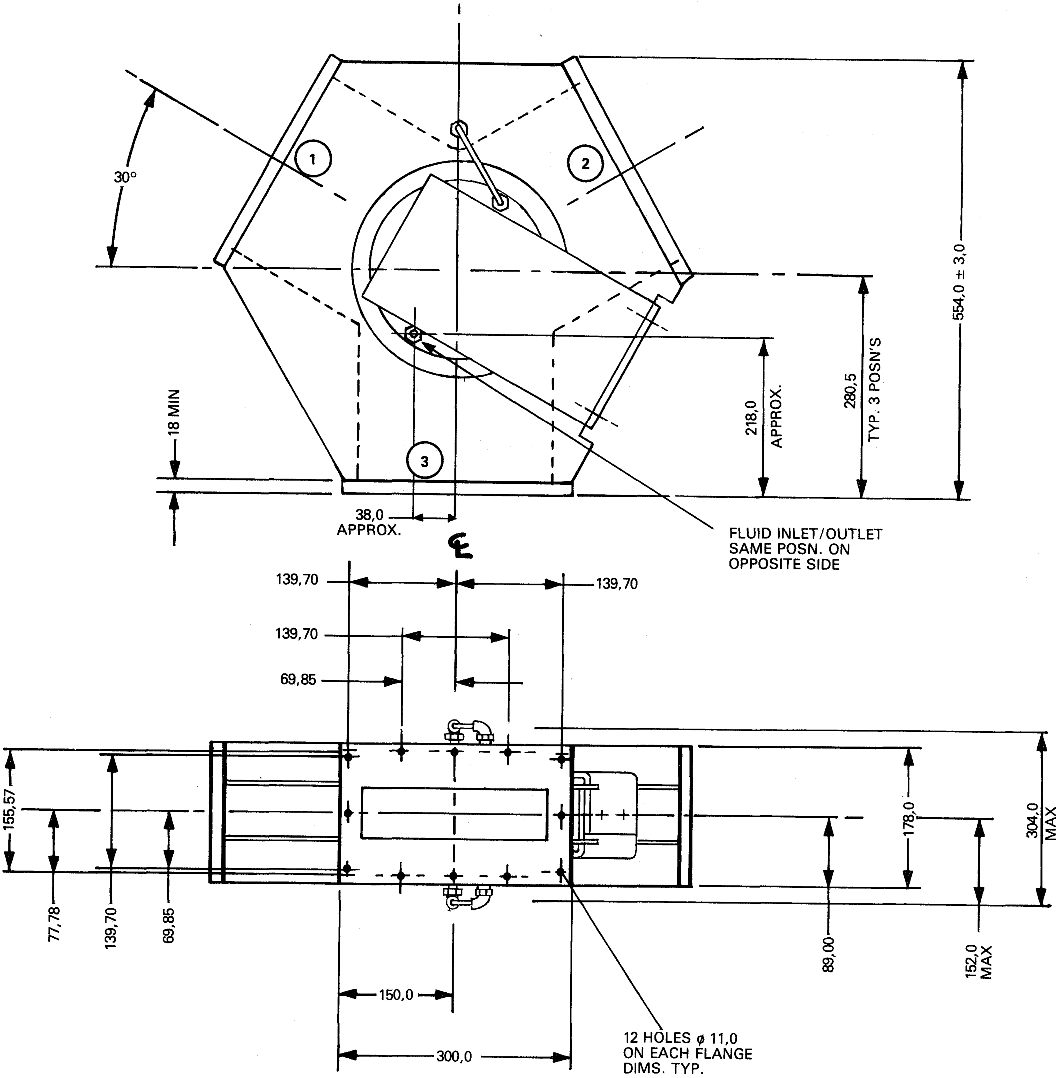
* Return loss of loads terminating circulator ports must be 21dB min

F1282 – 20 Water dielectric load

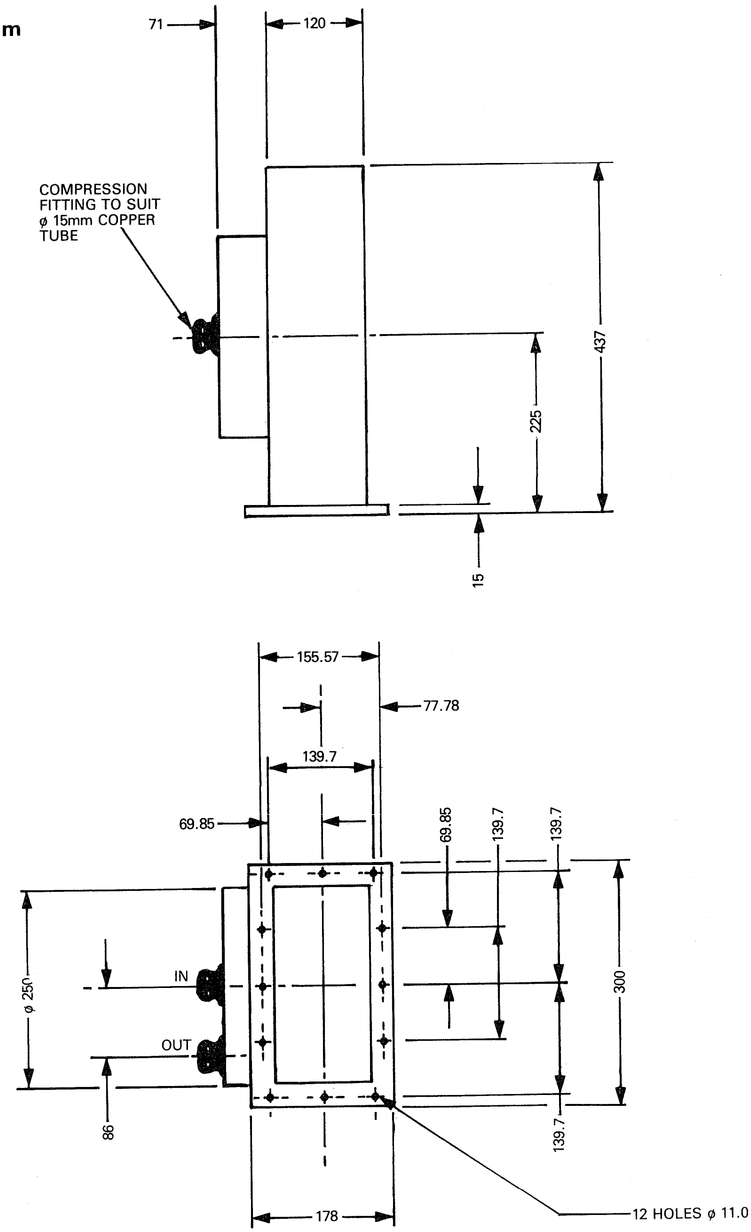
SPECIFICATION:

Frequency range	886 – 925MHz
Return loss	14dB min
Return loss (typical)	35dB at 896MHz 25dB at 915MHz
Power (mean)	30kW max
Water flow	15 litre/minute min
Water pressure	6.3kg/cm^2 max
Water temperature (inlet)	10°C min to 40°C max
Outline	See fig. 2

OUTLINE DRAWING
FIG. 1
Dimensions in mm



OUTLINE DRAWING
FIG. 2
Dimensions in mm



DS3541-1.1 August 1992

F1052-57

HIGH POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATORS

* FREQUENCY COVERAGE 2.7 to 37.0GHz
* HIGH-POWER CAPABILITY

This data sheet describes a range of 4-port differential phase shift circulators that may also be operated as isolators by the addition of suitable waveguide loads on the appropriate ports.
These circulators are used in particular as duplexers in high-power radar applications.
The type numbers and general frequency ranges are tabulated below.

F1052	in R32	covering	2.7 to 3.1GHz
F1054	in R48	covering	5.2 to 5.85GHz
F1056	in R70	covering	5.9 to 6.5GHz
F1057	in R84	covering	8.5 to 9.5GHz
F1053	in R120	covering	13.4 to 14.0GHz
F1053	in R140	covering	13.4 to 14.5GHz
F1055	in R320	covering	34.0 to 37.0GHz

A range of waveguide loads, gaskets and junction circulators covering the above frequency ranges are also available, details of these will be supplied on request.

PERFORMANCE DATA
HIGH-POWER WAVEGUIDE DIFFERENTIAL PHASE SHIFT CIRCULATORS

WAVEGUIDE R32 (WG10. WR284)

TYPE NUMBER	Frequency band GHz	Bandwidth MHz	Isolation dB (min)		Insertion loss dB (max)	Input V.S.W.R. (max)	Power (max) (See Note 1)	
			Ports 1–3	Ports 2–1, 1–4			Peak MW	Mean kW
F1052–03	2.7–3.1	400	25	23	0.5	1.15:1	1.0	1.5
F1052–17	2.7–3.1	400	25	23	0.6	1.15:1	2.5	4.0
F1052–20	2.8–3.1	300	20	20	0.5	1.15:1	1.4	14.0

WAVEGUIDE R48 (WG12. WR187)

F1054–09	5.25–5.71	460	25	20	0.4	1.15:1	0.5	1.5
F1054–11	5.3–5.6	300	25	23	0.5	1.15:1	1.0	1.5
F1054–15	*5.2–5.85	550	20	20	0.5	1.2:1	1.0	1.5

WAVEGUIDE R70 (WG14. WR137)

F1056–20	5.925–6.425	500	25	23	0.35	1.15:1	—	10.0

WAVEGUIDE R84 (WG15. WR112)

F1057–09	8.6–9.5	900	20	20	0.3	1.25:1	0.3	0.3
F1057–30	8.5–9.0	500	25	20	0.3	1.15:1	0.65	3.0
F1057–31	8.5–9.3	800	23	20	0.3	1.2:1	1.5	6.0

WAVEGUIDE R120 (WG17. WR75)

F1053–30	13.4–14.0	600	20	20	0.4	1.2:1	—	8.0

WAVEGUIDE R140 (WG18. WR62)

F1053–02	13.4–14.0	600	20	20	0.4	1.15:1	—	0.35
F1053–03	14.0–14.5	500	23	23	0.4	1.15:1	—	2.5

WAVEGUIDE R320 (WG22. WR28)

F1055–21	34.0–37.0	3000	25	20	0.6	1.2:1	0.005	0.5

* Specify centre frequency when ordering.

NOTE 1
The power handling of the circulators listed is a function of the pulse length, p-r-f, cooling and waveguide pressurisation; the figures given in the tables are for typical operating conditions but the maximum power handling capability must ultimately be determined for each specific application.

DOUBLE WAVEGUIDE DIVERSION ASSEMBLIES
WAVEGUIDE R32 (WG10. WR284)

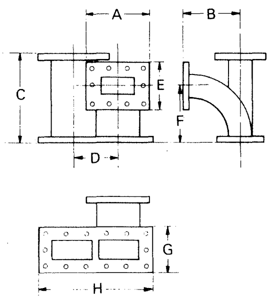
For use in conjunction with 3dB sidewall couplers or on output ports (2 and 4) of 4-port circulators.

TYPE NUMBER	Fig No.	Description	Air pressure gauge (max)	
			lb/in²	kg/cm²
F1230–03	11	Straight and 90° E-bend (Right Hand)	45	3.2
F1230–04	12	Straight and 90° E-bend (Left Hand)	45	3.2
F1230–05	13	Straight and 90° H-bend	45	3.2

TYPE NUMBER	Fig No.	Dimensions (mm)								Single Flange Drilling
		A	B	C	D	E	F	G	H	
F1230–03 F1230–04	11 12	122	95	152	76	84	95	84	198	JS 5985–99–083–0058 DEF 5352
F1230–05	13	250	189	84	152	122	113	198	—	

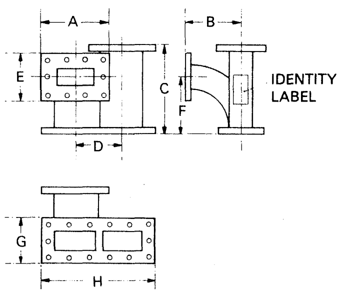
Temperature range °C (max)	** Waveguide Pressure kg/cm^2 gauge (max)	Type of cooling	Water flow litres/min. (min)	Water pressure kg/cm^2 gauge (max)	Weight approx. kg	Fig No.
0: +60	0.35	Air	—	—	13.6	1
0: +70	2.45	Water	2.0	4.2	13.6	1
+10: +65	2.45	Water	6.75	8.5	13.6	1
0: +60	1.6	Air	—	—	10	2
0: +60	2.45	Water	2.0	4.2	11.5	3
0: +60	2.45	Water	2.0	4.2	11.5	3
0: +60	—	Water	3.0	7.0	11.3	4
+15: +45	2.1	Air	—	—	1.32	5
+15: +45	2.8	Water	2.0	10.5	1.6	6
+15: +45	2.8	Water	4.0	10.5	1.6	6
0: +45	0.7	Water	3.5	10.5	—	7
−30: +70	3.2	Air	—	—	0.305	8
0: +55	0.7	Forced Air	—	—	1.55	9
0: +50	0.7	Heat Sink/ Air	—	—	0.5	10

**Adequate waveguide pressure must be maintained; see Technical Specification.



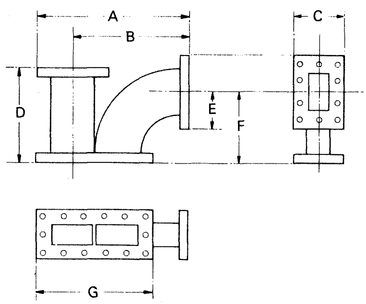
FINISH:—MATT BLACK PAINT

FIG. 11 F 1230−03



FINISH:—MATT BLACK PAINT

FIG. 12 F 1230−04



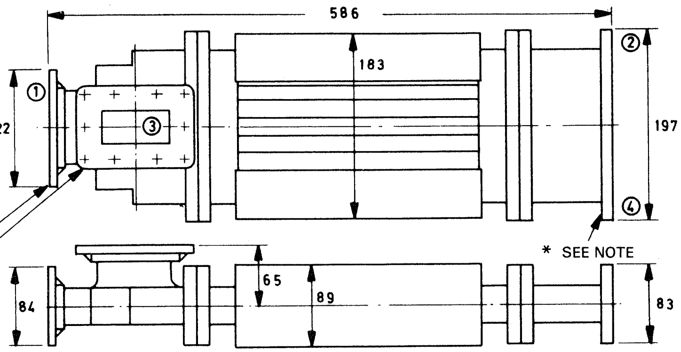
FINISH:—MATT BLACK PAINT

FIG. 13 F 1230−05

OUTLINE DRAWINGS — dimensions in millimetres
Port Numbers indicated thus ②
Finish — Matt Black paint.

FIG. 1

F 1052 – 03



BOTH FLANGES DRILLED AS
JS 5985-99-083-0058 DEF 5352

Outlines F 1052-17 and F 1052-20 are similar.

*NOTE: Circulator normally supplied with Diversion assembly fitted to customers requirements.
See type number F 1230.

FIG. 2

F 1054 – 09

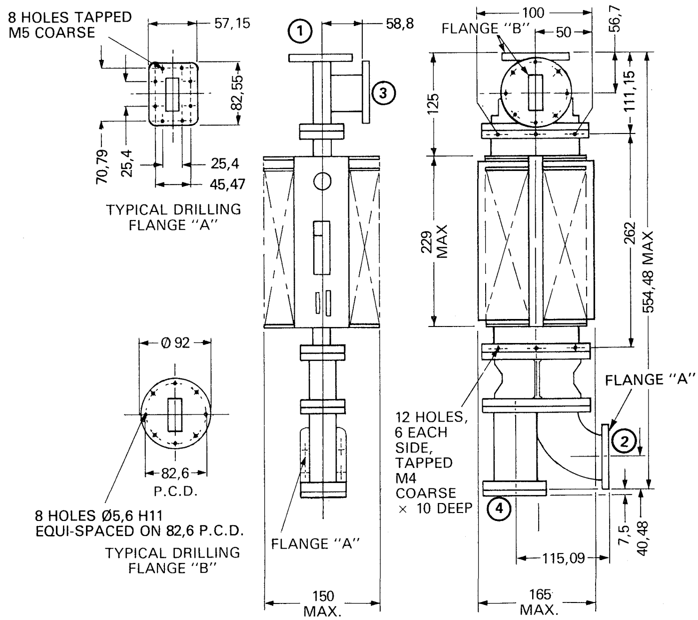
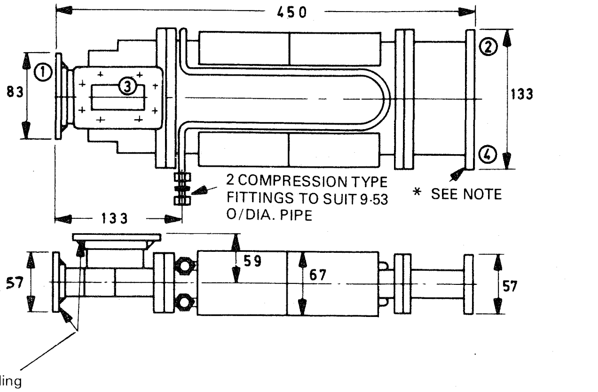


FIG. 3

F 1054 – 11
F 1054 – 15



F 1054-11 Marconi E/RAD 81600
F 1054-15 CPR 187 F

*NOTE: Circulator normally supplied with Diversion assembly fitted to customers requirements. Type number F 1232.

FIG. 4

F 1056 – 20

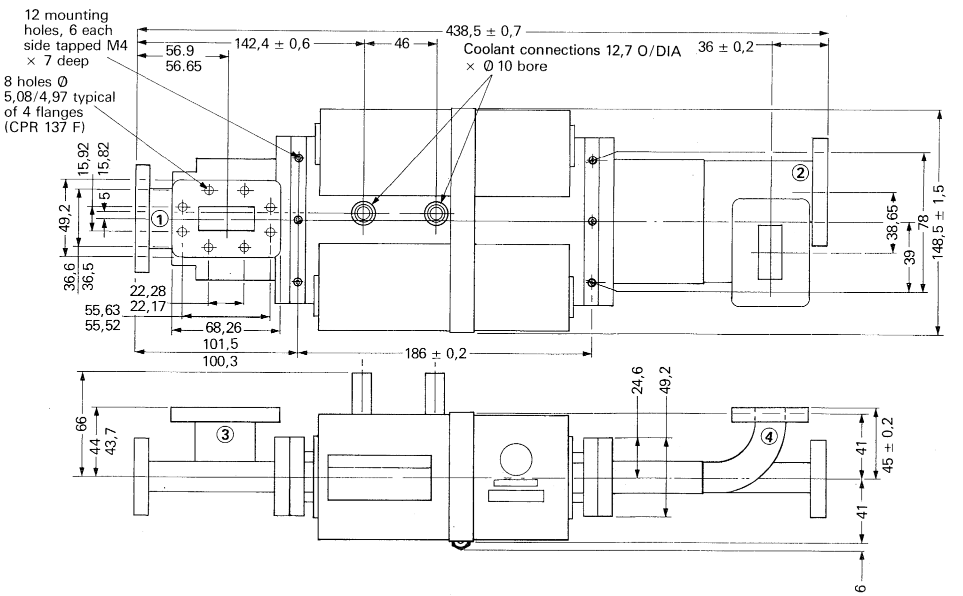
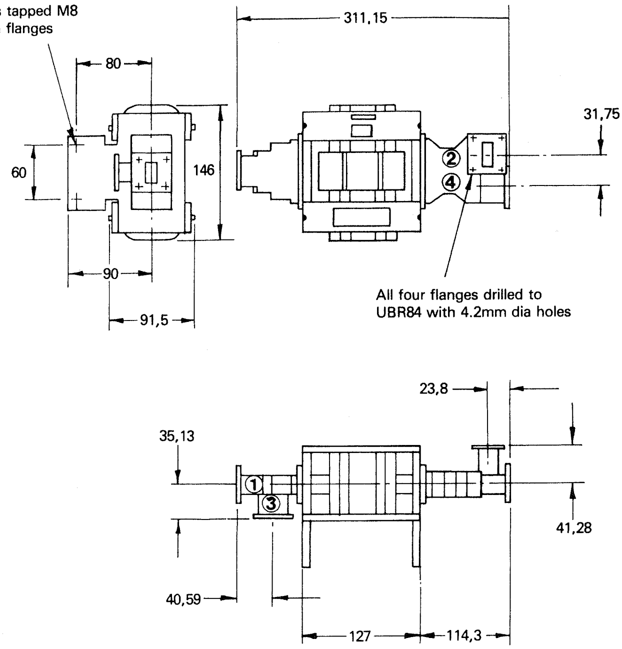
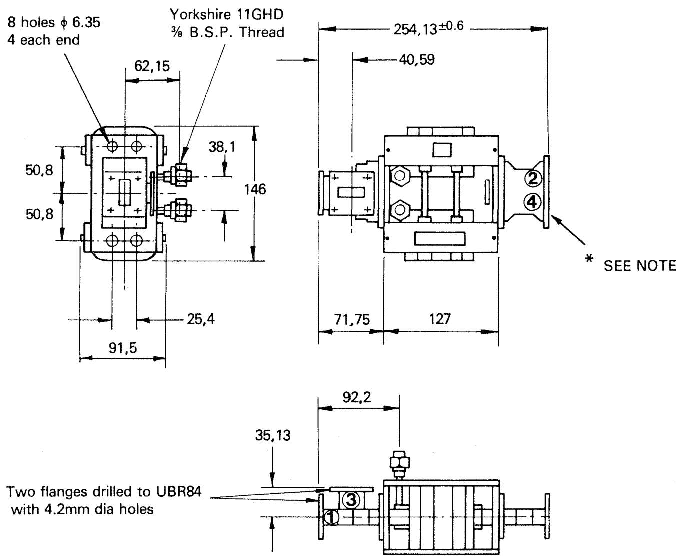


FIG. 5



F 1057 – 09

FIG. 6

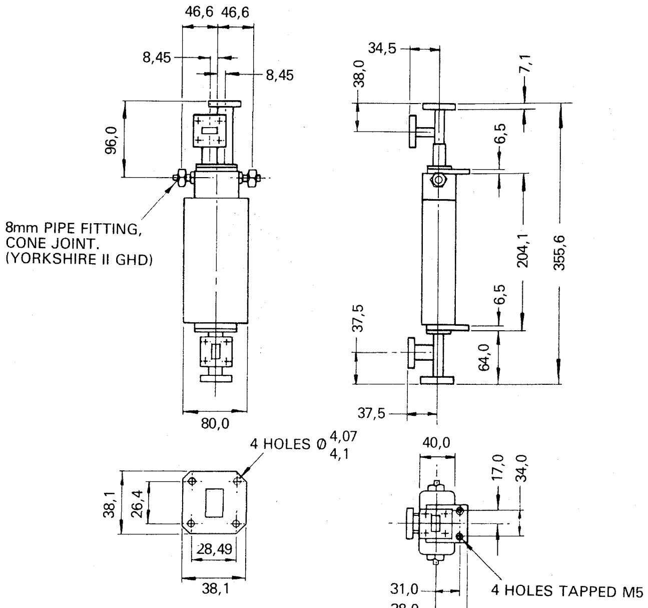


F 1057 – 30
F 1057 – 31 is similar

*NOTE: Circulator normally supplied with Diversion assembly fitted to customers requirements.

FIG. 7

F 1053 – 30



FLANGE DETAIL

FIG. 8

F 1053 – 02

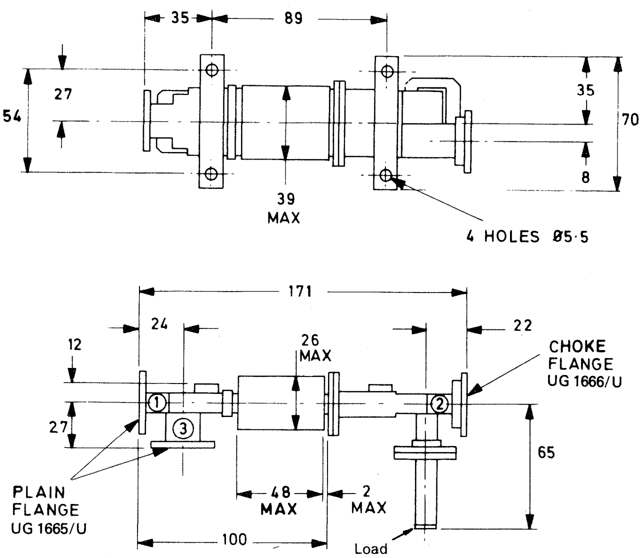
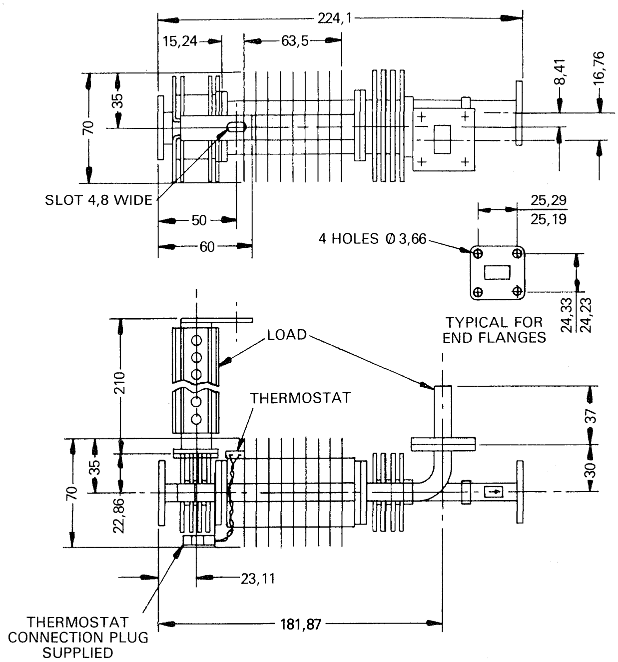
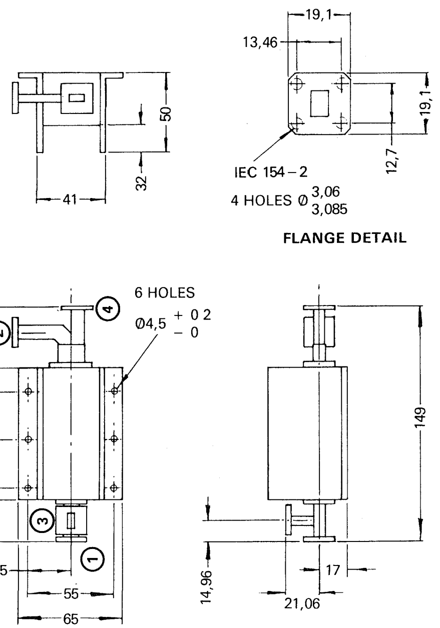


FIG. 9



F 1053 – 03

FIG. 10



F 1055 – 21

DS3542-1.1 August 1992

F1158

HIGH POWER AIR COOLED X-BAND WAVEGUIDE JUNCTION CIRCULATOR

* AIR COOLED
* HIGH POWER
* LIGHTWEIGHT
* COMPACT

Circulator Type F1158 – 02 is a compact (50.8 × 50.8 × 50.8mm) high power air-cooled junction circulator in R100 waveguide, designed to operate over the frequency band 8.5 to 9.6GHz at a normal working power rating of 60kW peak, 500W mean. Isolation is 18dB minimum and insertion loss 0.2dB maximum over the temperature range −40°C to +85°C. The circulator also gives good performance over the extended frequency range 8.2 to 10.3GHz.

The circulator is ideal for use in Radar applications, at both high peak and mean power levels, without the need for water cooling. It can also be operated as an isolator by the addition of a suitable load on one port, the power rating being dependent on the expected reflected power.

SPECIFICATION FOR F1158 – 02 CIRCULATOR

Performance over frequency range 8.5 to 9.6GHz

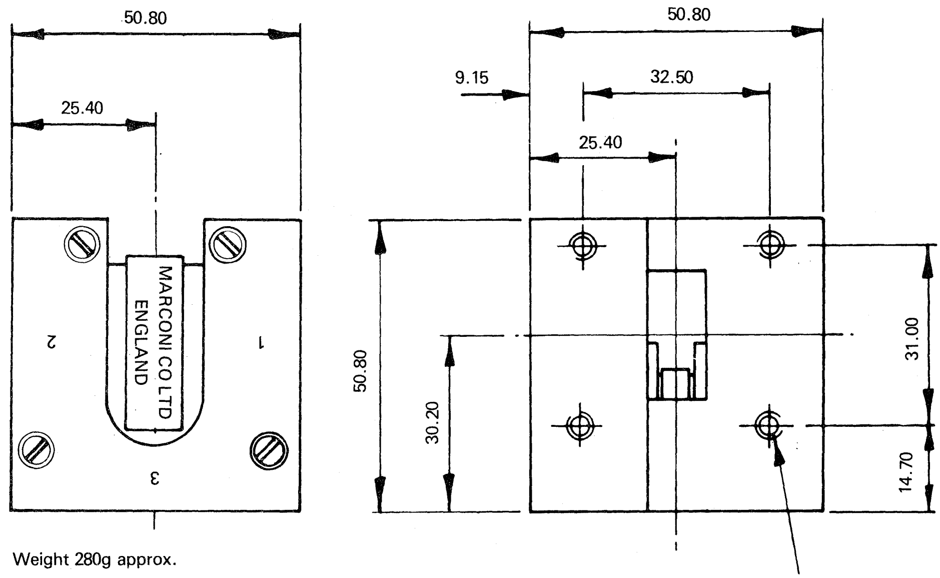
Isolation dB (min)	Insertion loss dB (max)	VSWR (max)	Peak Power kW (max)	Mean Power W (max)	WG Air Pressure	Max Load VSWR (at output port)	Ambient Temperature °C
18	0.2	1.3:1	60	500	32psia (min) 29psig (max)	2.5:1	−40 to +85

Performance over frequency range 8.2 to 10.3GHz

Isolation dB (min) at frequency of			VSWR (max) at frequency of			Insertion loss dB (max)	Ambient Temperature °C
8.2GHz	10.0GHz	10.3GHz	8.2GHz	10.0GHz	10.3GHz		
16	19	16	1.4:1	1.25:1	1.4:1	0.4	+20
14	17	14	1.5:1	1.35:1	1.5:1	0.5	−40 to +85

The above performance figures are under steady state operating conditions on power.

OUTLINE DRAWING



Weight 280g approx.

Dimensions in millimetres

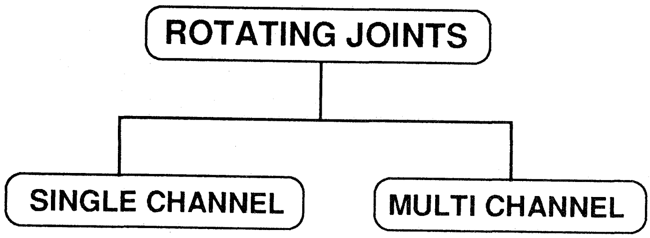
12 holes, 4 on each flange, fitted with M4 x 0.7 x 2D thread inserts

NOTE:

Circulator Type F1158 – 02 will accept a mismatch at the output port of up to 2.5:1, and can be used as an isolator by the addition of a suitable R100 waveguide load to the third port in order to absorb reflected power.

The choice of load depends upon the reflected power to be absorbed. Details of suitable loads are available on request.

Section 6
Rotating Joints



GEC PLESSEY
SEMICONDUCTORS

Rotating Joints

Single Channel

- Coax and Waveguide
- Brush Blocks / Slip Rings
- Up to 96GHz
- I and L Configuration

Multi Channel

- Modular Construction
- Waveguide and Coax
- Power - Up to 1mW at S Band
- High Isolation Between Channels
- Brush Blocks / Slip Rings

GEC PLESSEY
SEMICONDUCTORS

CT3167-1.3 August 1992

ROTATING JOINTS

INTRODUCTION

GPS Advanced Microwave Facility at Lincoln collaborates with the GEC - Marconi Research Centre (MRC) at Great Baddow to offer a wide range of microwave rotary joints.

The following features are available in Single and Multi-Channel Waveguide and Coaxial Designs:

- Integral sliprings
- High power (peak and mean)
- Low insertion loss and VSWR
- Low VSWR variation with rotation (WOW)
- Low phase variation
- High isolation between channels
- Modular/stackable designs
- Hertzian and Bearing Stress Analysis
- Environmental testing
- Space qualification
- Custom design service at MRC
- Valuation and qualification to specific customer requirements

FEATURES

The result of some 30 years experience of design and manufacture of single and multichannel complex joints, these components are designed to service the following markets:

- Radar Tracking and Surveillance
- Electronic Surveillance Measures
- Electronic Countermeasures
- Electronic Warfare
- Satellite Communications Ground Stations
- Mobile Satcoms (DBS)
- Satellite Pointing Mechanisms

This catalogue features the standard production designs manufactured at Lincoln as well as the specialist designs developed jointly by GPS and MRC.

QUALITY ASSURANCE

GPS Microwave Facility, Lincoln and MRC at Great Baddow are approved to AQAP-1.

CUSTOMER SUPPORT SERVICE

GPS recognise the need for close vendor/customer collaboration during the development of rotary joints, and, to this end, offer the following a services:-

- A comprehensive sales and marketing organisation for professional processing of enqulries
- Visit from engineering staff for non-standard product requirements
- Formal structured project management to service contracts of high technical content or complexity
- After sales service

TYPE NUMBERS

TYPE NUMBER	NUMBER OF CHANNELS
F9100-01	One
F9100-04	Three
F9100-05	Eight
F9100-06	Six
F9100-07	Four
F9100-08	Three
F9100-09	Two
F9100-10	Three
F9100-11	Two
F9100-12	One
F9100-13	Four
F9100-16	One
F9100-23	Two
F9100-24	Two
F9100-25	One
F9101-01	Three
F9101-02	Two
F9101-03	Three
F9101-04	Four
F9101-05	Two
F9101-06	Four
F9101-07	Three
F9101-08	Seven
F9101-09	Two
F9101-10	One
F9101-11	Two
F9101-12	One
F9101-13	Two
F9101-14	One
F9101-15	Two
F9101-16	One
F9101-17	One
F9101-19	One
F9101-20	One

SINGLE CHANNEL ROTARY JOINTS: WAVEGUIDE AND COAXIAL DESIGNS

GPS experience with waveguide single channel rotary joints is based on proven techniques for transitions from a rectangular waveguide to a coaxial line or circular waveguide. The plane of rotation within a rotary joint, must, of necessity, be in a circularity symmetrical mode. The coaxial TEM mode is both symmetric and inherently broadband in nature. The impedance of the line is a function of the line geometry. Most single channel rotary joints employ two waveguide to coaxial transitions, in a back-to-back arrangement. Spaced apart by one or more bearings. The physical break, at the rotational interface is electrically'choked' to provide RF continuity and broad band operation.

Generally the coaxial line is of 50 ohms characteristic impedance; this being the optimum compromise for power handling, insertion loss and impedance ratio to the very much higher waveguide impedance. This latter ratio determines the type of transition required to achieve a specific bandwidth. Multi channel operation frequently dictates the use of lower impedance coaxial lines however.

Transition designs encompass the traditional 'doorknob' right angle approach, and the stepped ridge in-line method. Both techniques are capable of broadband operation by the proper selection of impedance steps. Simple 'doorknob' transitions without any additional impedance steps offer typical bandwidths up to 10%. These designs offer a low cost solution for narrowband application and generally achieve high peak power handling capability. By selecting up to typically five additional impedance steps, together with a 'doorknob' transition, the full operating bandwidth of the waveguide can be approached.

The design of Doorknob transitions is mainly empirical but GPS/MRC have developed sufficiently broad-based library of designs to accommodate a wide range of waveguide sizes, frequencies and operational requirements.

High mean power designs are addressed by the selection of high conductivity low loss materials and brazing techniques. Typically OFHC copper is used. High peak power designs are fully 'contoured' to reduce voltage stresses.

GPS can also offer TM01 rotary joints for high power applications and TE11 circular polarised rotary joints for millimetric frequencies.

Construction of the GPS standard range of rotary joints is generally in Aluminium Alloy, but where the product experiences large temperature excursions, stainless steel and titanium are employed to maximise reliability. Bearings are generally greased for life and require no maintenance over a typical operating life of 5 years.

GPS have studied many types of pressure seals and can offer a wide choice of seal designs, depending on the pressure differential across the seal, the temperature excursion, desired leak rate and frictional torque. Designs are available that offer extremely low leak rates at temperatures down to -70°C.

Type No.	Configuration	Waveguide Size/Coaxial Connector Type		Frequency Range (GHz)	VSWR (max)	WOW (max)	Insertion Loss (dB)	Power at Atmospheric Pressure	
		WG	R					Peak (kW)	Mean (W)
F9101-10		12	48	5.3-5.6	1.15:1	-	0.15	500	5000
F9101-12		14	70	7.9-8.4	1.2:1	0.05	0.1	-	8000
F9100-16	I	15	84	8.5-9.6	1.15:1	0.02	0.15	8	200
F9100-01		16	100	9.2-9.6	1.2:1	0.04	0.15	50	50
F9101-14	I	17	120	11.0-14.5	1.25:1	-	0.15	-	3000
F9101-16		21	260	27.9-29	1.15:1	0.05	0.25	-	1000
F9101-17		23	400	43.5-45.5	1.4:1	-	0.4	-	250
F9100-12	I	27	900	92-96	1.2:1	-	1.0	-	10
RIDGED WAVEGUIDE									
F9101-19	I	WRD	180	18.9-19.5 28-28.7	1.35:1 1.35:1	0.05	1.0	-	100
CIRCULAR WAVEGUIDE									
F9101-20	I	C890		92-96	1.1:1	-	0.5	-	-
COAXIAL									
F9100-25		SMA		DC-18.0	1.5:1	-	0.4	1	50

NOTE: Isolation between channels coaxial/coaxial 60dB minimum. Waveguide/coaxial 80dB minimum.

Coaxial single channel rotary joints are generally less complex than waveguide designs, and, since they operate throughout in the TEM mode with a constant impedance, are usually broadband designs. Bandwidth is limited only by the choking arrangements.

Very broadband designs (e.g. DC -18GHz) employ precious metal sliding contacts, instead of chokes, both on inner and on outer conductors. These designs offer reduced lifetimes in comparison with non-contacting arrangements.

Slip rings and angular take-off devices can also be integrated to customer specifications. The slipring unit is generally mounted around the bearing housing and uses the main rotary joint bearings to achieve the necessary running clearances and tolerances for long life operation.

DESIGN PHILOSOPHY

GPS, in conjunction with MRC, operates a programme of continual research and development. This programme seeks to improve and enlarge the range of standard rotary joints, to investigate the use of modern materials and to offer cost effective multichannel designs of increasing complexity. The programme aims also at value engineering aspects of design to improve both new and existing products, their price and delivery. Planned developments in the GPS/MRC rotary joint programme encompass dual mode designs, stripline coupled joints, integrated bearing designs and further expansion of their space capability, all of which are scheduled for availability in the near future.

ANNULAR ROTARY JOINTS

Multi-channel rotary joints frequently require one or more channels with a large bore to accomodate the additional channels. Angular rotary joints employing traditional transmission lines are inevitably bulky. To reduce this bulk an annular rotary joint employing close-coupled striplines is currently at the research and development stage. This technique will obviate the need for electrical chokes, thus substantially simplifying the low power auxilliary coaxial channels.

This development will result in smaller, more compact assemblies.

INTEGRATED BEARING ASSEMBLIES

GPS future design philosophy will feature increasing utilisation of fully integrated bearing assemblies in their rotary joint designs. The use of these assemblies not only minimises the overall mass and size of rotary joints but also the separation between the waveguide outlet arms. This development taken in association with continual research into machining and joining techniques will make a significant contribution to the improvement of rotary joint design across the whole product range.

SPACE QUALIFIED ROTARY JOINTS

The GPS/MRC collaboration serves to put knowhow into products and products into payloads. In particular, their expertise in rotary joints is recognised and has led to involvement in important contract studies for ESA. Currently under development is a coaxial rotary joint for application in two and three axis satellite pointing mechanisms. This programme will result in a space-qualified design development from MRC's experience with their qualified waveguide switch designs as used on the OLYMPUS programme.

This development will establish GPS/MRC as the prime European source for this type of component.

DUAL MODE ROTARY JOINTS

One example of research which is currently under way is to design a dual channel circular waveguide joint which will operate on the basis of two different circularly symmetric modes of propagation. This development is targetted at commercial and military communications with a wide frequency separation such as the 4/6GHz, 10/14GHz and 20/30GHz bands. These bands are particularly applicable for satellite ground stations and co-mounted radar applications.

The finished product will provide an alternative option which will offer substantial improvement over conventional dual channel arrangements in as much as it will be smaller, lighter and more cost effective.

MULTICHANNEL ROTARY JOINTS: WAVEGUIDE AND COAXIAL DESIGNS

CONCENTRICALLY MOUNTED DESIGNS

The individual channels in multichannel rotary joint designs employ the principles of concentric mounting. This technique uses the outer conductor of the innermost channel, in the co,axial rotating section, to form the inner conductor of the next channel. This process is repeated for additional channels. These techniques are limited by design trade-offs that encompass the following parameters:

- Power handling
- Insertion loss
- Physical properties of conductors (outer and inner)
- Coaxial line size selection (to avoid overmoding)
- Overall size constraints

MODULAR DESIGNS

Modular designs in the GPS range are generally employed where the design calls for one or two waveguide channels with a mix of low power coaxial channels. The coaxial channels and the waveguide channels all carry a hole through the centre conductor which is large enough to carry semi-rigid cables to feed successively each joint or channel as they pass along the axis of the assembly. These techniques lead to modularity in design and reduce the use of long thin inner and outer conductors. This modularity also lends itself to more rapid and cost effective design changes as well as changes in the mix of channel frequencies.

Design trade-offs for this product group encompass the following:

- Insertion loss
- Power handling
- Waveguide channel inner conductor line size choice
- Number of required channels
- Assembly length/mass constraints

ANNULAR AROUND THE-MAST DESIGNS

GPS Microwave has considerable experience in the design and development of both Boronski type annular designs and multilaunched designs employing oversize coaxial lines. This latter group can employ stripline or waveguide launching networks to force feed pure TEM mode into a line that will support higher order asymmetric of propogation. This method characteristically provides also a large borehole through the rotational centre-line.

Around-the-mast designs permit the stacking of many similar joints for multichannel applications. A further advantage is that this type of joint may be integrated with a conventional coaxial channel to provide a cost-effective solution for updating an existing radar system.

These techniques are for very specialised applications calling for close customer/supplier liaison in development and manufacture.

ANALYSIS CAPABILITY

Together, GPS and MRC, offer the comprehensive analysis capability necessary to support the design and supply space components. Included within the analysis pack.age are the following:

- Hertzian Stress Analysis
- Dynamic Analysis
- Multipactor Analysis
- EMC and PIM Analysis
- Linear Elastic Fracture Analysis
- Bearing Thermal and Torque Analysis

FACILITIES

To support the joint capability established by GPS and MRC, the comprehensive facilities provide:

- a dedicated Class 100 clean room complex, purpose-built for the assembly and test of satellite components
- thermal vacuum chambers
- dedicated test equipment
- design and qualification resources
- environmental test facilities
- in-house manufacture of ferrite, dielectric and load absorbing materials

Type No.	Configuration	Channel No.	Waveguide Size/Coaxial Connector Type		Frequency Range (GHz)	VSWR (max)	WOW (max)	Insertion Loss (dB)	Power at Atmospheric Pressure	
			WG	R					Peak (kW)	Mean (W)
F9101-01		1	6	14	1.2-1.45	1.2:1	0.04	0.1	3800	2000
		2	6	14	1.2-1.45	1.2:1	0.04	0.1	3800	2000
		3	H2		0.97-1.13	1.15:1	0.04	0.25	30	100
F9101-02		1	6	14	1.2-1.45	1.2:1	0.04	0.1	3800	2000
		2	H2		0.97-1.13	1.15:1	0.04	0.25	30	100
F9101-03		1	6	14	1.215-1.365	1.2:1	0.06	0.1	2500	1200
		2	10	32	2.7-3.1	1.2:1	0.04	0.1	850	3000
		3	H2		0.97-1.13	1.15:1	0.04	0.25	-	100
F9101-04		1	6	14	1.215-1.365	1.2:1	0.04	0.1	2500	12000
		2	10	32	2.7-3.1	1.2:1	0.04	0.1	850	3000
		3	H2		0.97-1.13	1.2:1	0.04	0.6	10	100
		4	H2		0.97-1.13	1.2:1	0.10	0.25	10	100
F9101-05	I	1	6	14	1.215-1.415	1.2:1	0.04	0.1	220	6000
		2	H2		0.97-1.13	1.15:1	0.04	0.25	30	10
F9101-06		1	6	14	1.215-1.365	1.2:1	0.04	0.1	3500	10600
		2	N		1.02-1.10	1.3:1	0.08	0.75	10	100
		3	N		1.225-1.36	1.35:1	0.08	1.3	10	100
		4	N		1.39-1.51	1.35:1	0.08	1.3	10	100
F9101-07		1	6	14	1.215-1.365	1.15:1	0.07	0.1	3500	15000
		2	10	32	2.7-3.2	1.2:1	0.07	0.15	1500	10000
		3	N		0.97-1.13	1.25:1	0.04	0.25	10	100
F9101-08		1	10	32	2.7-3.3	1.2:1	0.04	0.15	1300	10000
		2	10	32	2.7-3.3	1.35:1	0.4	0.35	1500	10000
		3	H2		0.97-1.13	1.25:1	0.04	0.4	50	100
		4	N		2.7-3.3	1.35:1	0.04	1.2	5	-
		5	N		2.7-3.3	1.35:1	0.04	1.2	5	-
		6	N		2.7-3.3	1.35:1	0.04	1.2	5	-
		7	N		2.7-3.3	1.35:1	0.04	1.2	5	-
F9101-09		1	10	32	2.7-3.2	1.15:1	0.04	0.1	1500	10000
		2	H2		0.97-1.13	1.2:1	0.04	0.15	50	100
F9100-05		1	10	32	2.7-3.1	1.2:1	0.02	0.15	200	7500
		2	N		2.7-3.1	1.3:1	0.05	1.1	1	10
		3	N		1.0-1.1	1.3:1	0.05	0.7	2	10
		4	N		2.7-3.1	1.3:1	0.05	1.0	1	10
		5	N		2.7-3.1	1.3:1	0.05	0.9	1	10
		6	N		2.7-3.1	1.3:1	0.05	0.8	1	10
		7	N		2.7-3.1	1.3:1	0.05	0.7	1	10
		8	N		2.7-3.1	1.3:1	0.05	0.6	1	10
F9100-06		1	10	32	2.7-3.1	1.2:1	0.05	0.1	850	5000
		2	N		2.7-3.1	1.3:1	0.05	0.75	1	10
		3	N		2.7-3.1	1.3:1	0.05	0.75	1	10
		4	N		0.97-1.13	1.3:1	0.05	1.0	10	30
		5	N		0.97-1.13	1.3:1	0.05	1.0	10	30
		6	N		0.97-1.13	1.3:1	0.05	1.0	10	30

NOTE: Isolation between channels coaxial/coaxial 60dB minimum. Waveguide/coaxial 80dB minimum.

ROTATING JOINTS

Type No.	Configur-ation	Channel No.	Waveguide Size/Coaxial Connector Type WG	R	Frequency Range (GHz)	VSWR (max)	WOW (max)	Insertion Loss (dB)	Power at Atmospheric Pressure Peak (kW)	Mean (W)
F9100-07		1	10	32	2.7-3.1	1.2:1	0.05	0.1	850	5000
		2		N	2.7-3.1	1.3:1	0.05	0.75	1	10
		3		N	2.7-3.1	1.3:1	0.05	0.75	1	10
		4		N	1.0-1.12	1.3:1	0.05	1.0	10	30
F9101-11		1	14	70	5.9-6.45	1.15:1	0.05	0.1	-	5000
		2	14	70	5.9-6.45	1.15:1	0.05	0.1	-	5000
F9101-15		1	14	70	7.25-7.75	1.15:1	0.05	0.1	-	-
		2	14	70	7.9-8.4	1.20:1	0.05	0.1	-	8000
F9100-13		1	14	70	5.4-5.9	1.25:1	0.05	0.2	80	1600
		2	16	100	8.5-9.6	1.3:1	0.05	0.4	20	30
		3		N	1.0-1.1	1.4:1	0.08	0.5	2	20
		4		N	1.0-1.1	1.4:1	0.08	0.5	2	20
F9100-11		1	15	84	8.5-9.6	1.2:1	0.02	0.15	250	2000
		2		SMA	DC-18.0	1.3:1	0.05	0.4	1	100
F9100-10		1	16	100	9-9.5	1.2:1	0.08	0.2	300	-
		2		SMA	DC-2	1.35:1	0.08	0.5	-	-
		3		SMA	DC-18	1.5:1	0.08	2.0	-	-
F9101-13		1	15	84	8.2-9	1.2:1	0.04	0.15	150	-
		2	15	84	8.4-9.3	1.2:1	0.04	0.3	-	-
F9100-23		1	18	140	13-14.5	1.2:1	0.05	0.2	50	-
		2		TNC	DC-15	1.75:1	0.06	1.5	-	-
RIDGED WAVEGUIDE										
F9101-18		1	WRD750		7.5-16	1.5:1	0.05	0.5	20	350
		2	SMA		DC-18	1.75:1	0.05	1.0	-	-
COAXIAL										
F9100-04	-	1		N	1.0-1.12	1.3:1	0.05	0.6	10	100
	-	2		N	1.0-1.12	1.3:1	0.05	0.6	10	100
	-	3		N	1.0-1.12	1.3:1	0.05	0.6	10	100
F9100-08	-	1		N	1.0-1.12	1.3:1	0.05	0.5	10	100
	-	2		N	1.22-1.36	1.3:1	0.05	0.5	10	100
	-	3		N	1.39-1.51	1.3:1	0.05	0.5	10	100
F9100-09	-	1		N	7.9-8.4	1.2:1	0.05	0.3	-	250
	-	2		N	7.25-7.75	1.5:1	0.05	0.5	-	-
F9100-24	-	1		N	1.0-1.1	1.3:1	-	0.7	2	10
	-	2		N	2.7-3.1	1.3:1	-	0.8	2	10

NOTE: Isolation between channels coaxial/coaxial 60dB minimum Waveguide/coaxial 80dB minimum.

OUTLINES All dimensions in mm

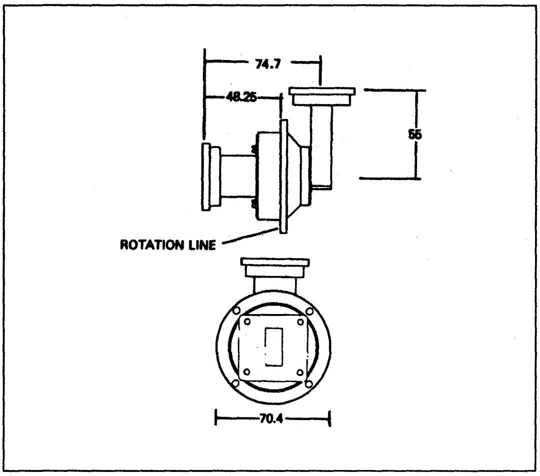


Figure 1: F9100-01

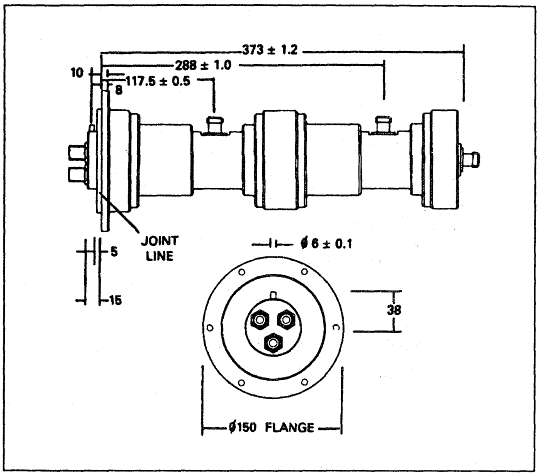


Figure 2: F9100-04

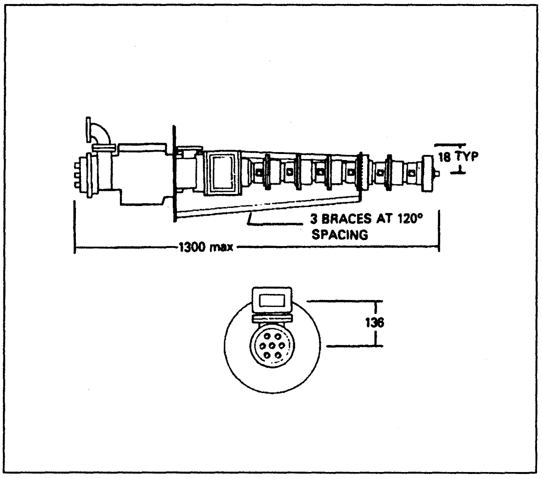


Figure 3: F9100-05

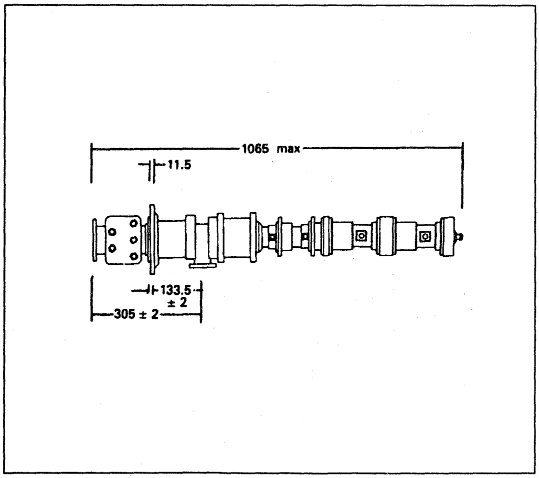


Figure 4: F9100-06

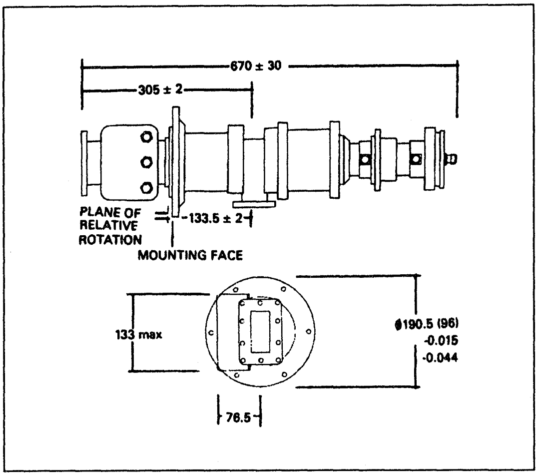


Figure 5: F9100-07

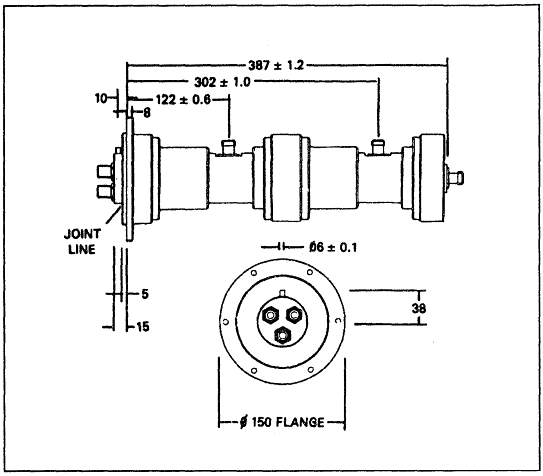


Figure 6: F9100-08

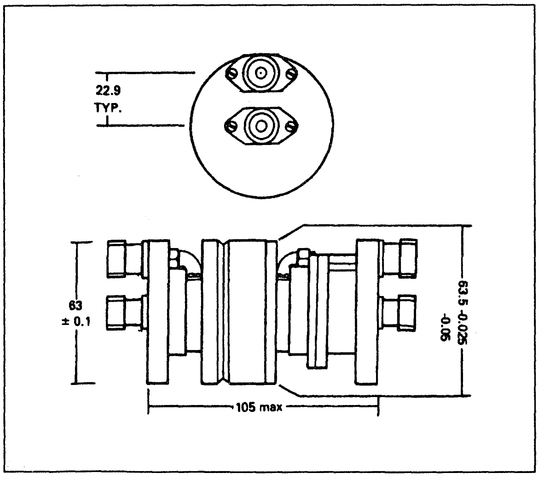


Figure 7: F9100-09

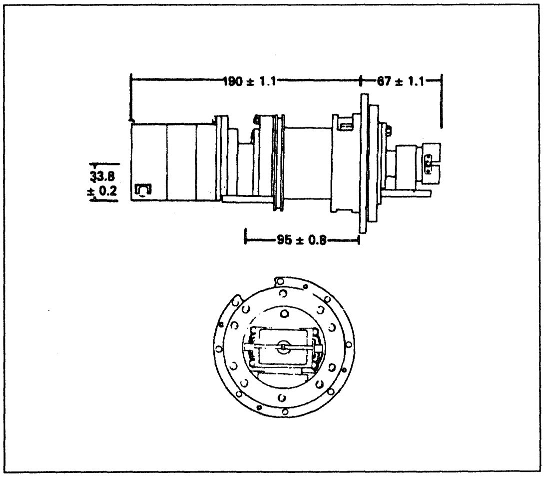


Figure 8: F9100-10

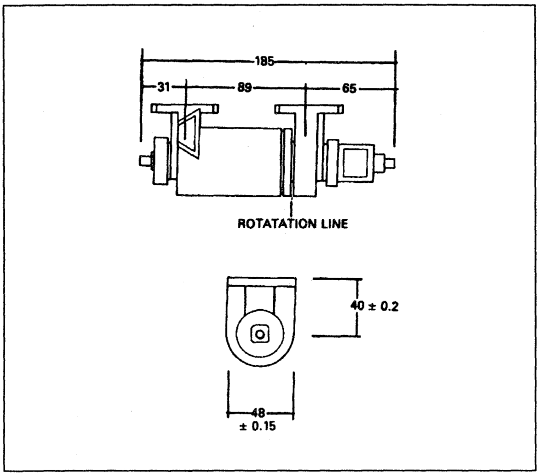


Figure 9: F9100-11

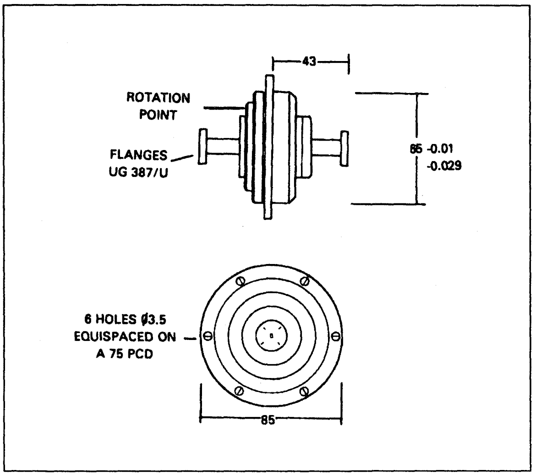


Figure 10: F9100-12

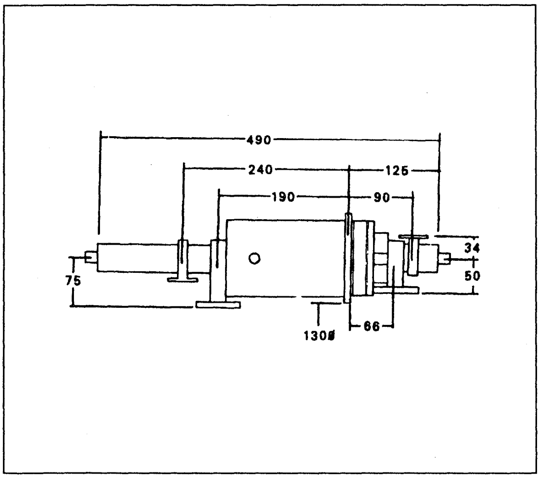


Figure 11: F9100-13

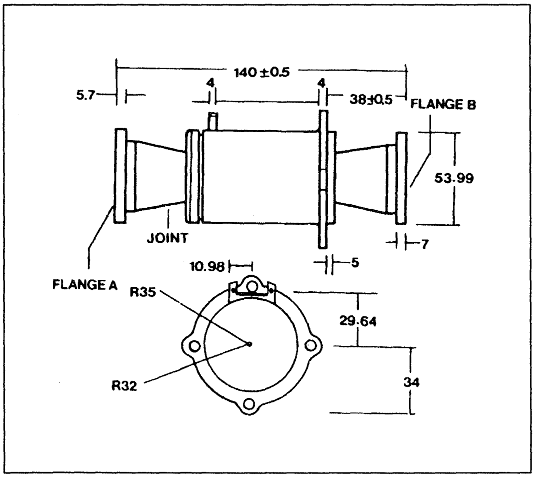
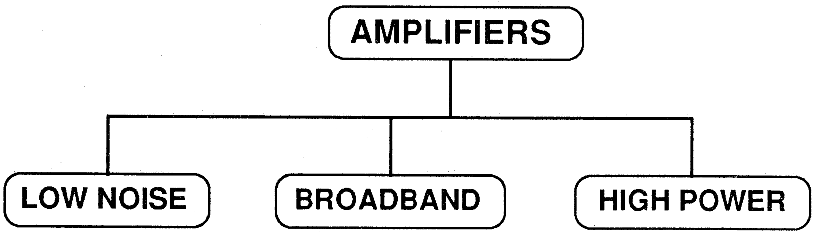


Figure 12: F9100-16

Section 7
Amplifiers



GEC PLESSEY
SEMICONDUCTORS

Amplifiers

Broadband
- 10MHz - 40GHz
- Balanced and Distributed
- Temperature Compensation
- Variable Gain
- Integral Limiters
- SDLA Combinations
- Limiting

Low Noise
- 10MHz - 60GHz
- Ultra Low Noise HEMTS
- Integral Limiters and Isolators
- Temperature Compensation
- Peltier Cooling

Power
- Up to 120W at X-Band
- High Efficiency
- Power Supply Failure Protection
- AGC
- Temperature Compensation
- Pulsed

Section 8

Mixers & Detectors

MIXERS / DETECTORS

- BALANCED
- HARMONIC
- IMAGE REJECTION
- SINGLE ENDED
- DETECTORS

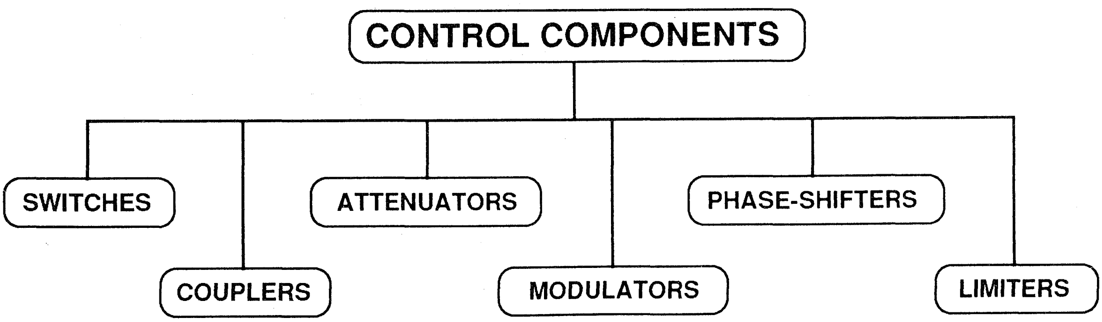
GEC PLESSEY
SEMICONDUCTORS

Mixers & Detectors

Balanced	• Frequencies up to 110GHz • Broad RF and IF Bandwidths • High LO AM Noise Rejection • Starved LO Versions Available • Compact
Harmonic	• 26 to 110GHz Coverage in Full Waveguide Bands • Units with Integral Diplexers Available • High Conversion Efficiency • Compatible with HP Series Spectrum Analysers and EIP Counters
Image Rejection	• Frequencies up to 100GHz • High Image Rejection >25dB • Phased or Filtered
Single Ended	• Frequencies up to 100GHz • Compact • Low Cost
Detectors	• Biased • Zero Biased • Silicon Schottky • Germanium • GaAs Schottky • GaAs PDB • Coaxial • Waveguide • Microstrip

Section 9

Control Components

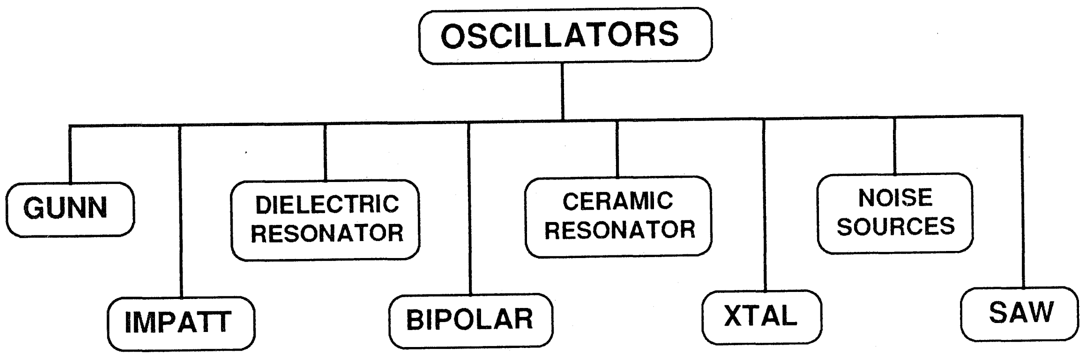


GEC PLESSEY
SEMICONDUCTORS

Control Components

Switches	• 10MHz to 110GHz • Phase Matching • High Speed • Integral Drivers • Multiway
Attenuators	• 10MHz to 20GHz • Reflective or Matched • High Dynamic Range • Digital or Analogue Control
Limiters	• 1GHz to 110GHz • Active or Passive • Low Insertion Loss • Wideband
Modulators	• 10MHz to 40GHz • High Dynamic Range • Low Insertion Loss
Phase Shifters	• 10MHz to 20GHz • Analogue to Digital • High Power
Couplers	• 10MHz to 110GHz • Multi Octave • Low Insertion Loss • High Directivity • Lounge • Proximity

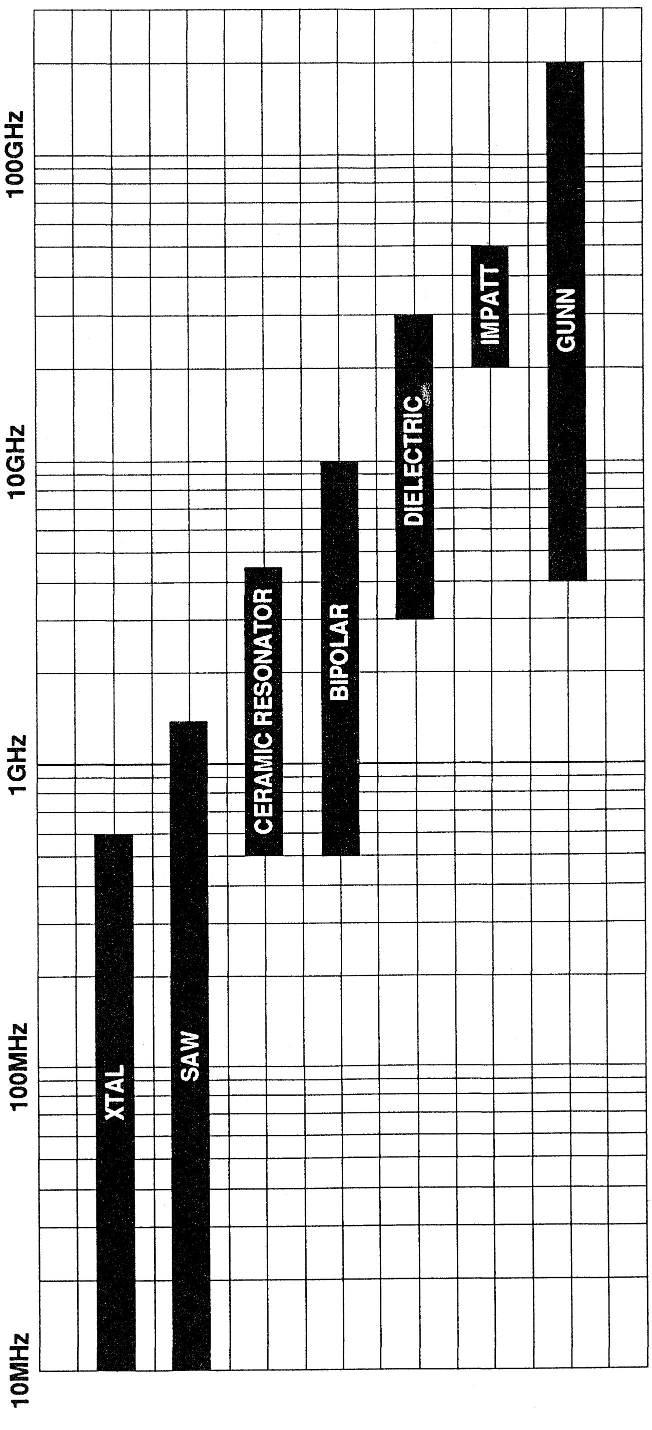
Section 10
Oscillators



GEC PLESSEY
SEMICONDUCTORS

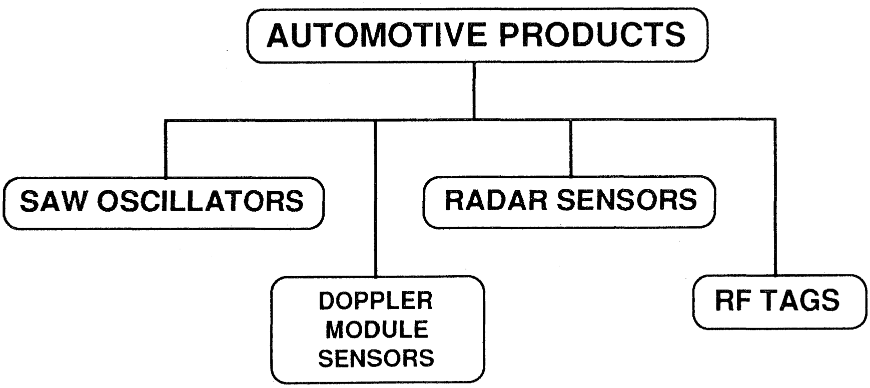
Oscillators

Gunn	• 5GHz to 110GHz • High Power (300mW @ 35GHz) • High Stability • Frequency Agile • Low Phase Noise
Impatt	• 35GHz • High Power • Pulsed CW
Bipolar	• 10MHz to 20GHz • VCO • Low Phase Noise • Linearity
DRO	• 3GHz to 30GHz • Low Phase Noise • VCO • High Stability • Cost Competitive
Co-axial Resonator	• 200MHz to 4.5GHz • Cost Competitive • High Stability
SAW	• 10MHz to 1.5GHz • High Stability • High Power • High Efficiency • Low Phase Noise • VCO
Crystal	• 10MHz to 750MHz • High Vibration Environments • Low Phase Noise • VCO • High Stability
Noise Sources	• High ENR • Solid State • 10GHz to 110GHz


10MHz
100MHz
1GHz
10GHz
100GHz
XTAL
SAW
CERAMIC RESONATOR
BIPOLAR
DIELECTRIC
IMPATT
GUNN

Section 11

Automotive Products



GEC PLESSEY
SEMICONDUCTORS

Automotive Products

SAW Oscillators	• 418, 433MHz • Car FOB Keys • Alarms
Doppler Module Sensors	• S, X, Ka Band • Planar • Waveguide • Car Alarms • Traffic Control
Radar Sensors	• FMCW • Pulsed Frequency • Cruise Control • Collision Awareness
RF Tags	• Auto-Tolling • IVHS Tags • "On the fly" > 100mph

PRELIMINARY INFORMATION

DS3204-2.1 July 1992

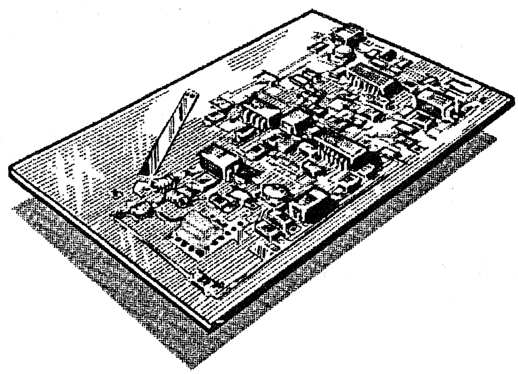
DA5800

MICROWAVE DOPPLER VEHICLE ALARM SENSOR *
For Central Vehicle Mounting

The DA5800 car alarm sensor is a microwave doppler movement detector working at 2.45GHz. It is designed to be mounted in the centre of the vehicle and gives coverage of the whole vehicle from this point, (the protection zone generated is a dome centred on the sensor). The unit is planer in construction with one hybrid board containing the microwave circuit and the signal processing.

Connection to the sensor is by 3 wires, supply (positive +12V), ground and alarm trigger output. The alarm trigger output is a conventional open collector transistor which gives an output 'low' for >20ms. Two outputs are available, every event and a weighted event. The weighted event is connected as standard. Alarm sensitivity/range can be adjusted when the alarm is mounted in position, using a simple screwdriver gain adjustment. An 'every event' LED is provided for this purpose.

The DA5800 unit is designed to be housed in the customer's own cases, using the GPS design guidelines, and is supplied as a fully assembled and tested unit.



FEATURES

- High Sensitivity to Movement
- Sees Through Seats etc.
- Simple to Install
- Insensitive to Environment Changes
- Small Size
- Compliant to European and U.S. Standards
- No License Required
- Coverage of car from one Centrally Mounted Sensor
- Compatible with most Current Alarm Systems

* Patent Pending

SPECIFICATION

Characteristics	Value
Frequency	2.45GHz
Output Power	<1mW CW
Range	>2 Metres
Input Voltage	9-16V d.c.
Quiescent Current	8mA Max
Alarm Output	Open Collector Transistor
Output Current Sink	10mA Max
Operating Temperature Range	-40°C to +85°C
License	Not Required

The unit complies with FCC and European Regulations and is approved to MPT1349.

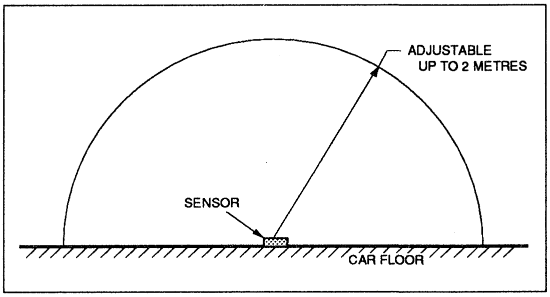
Electrical Transient

Reverse Voltage (Continuous)	-80V Min.
Over Voltage (Continuous)	+27V Min.

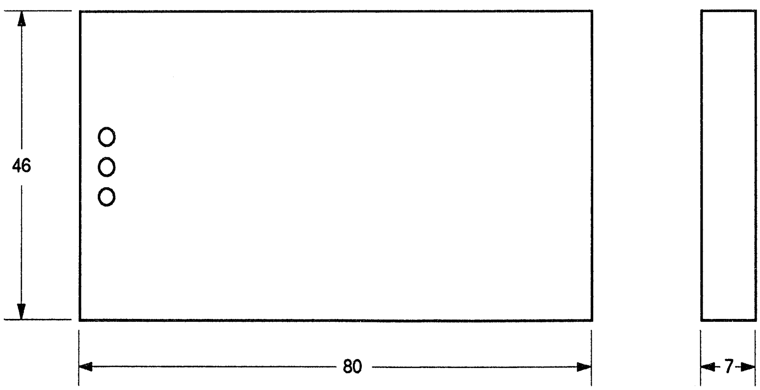
CONNECTION TO ALARM SYSTEM

Solder Connection Pins (3 Wire System).

ALARM AREA OF COVERAGE

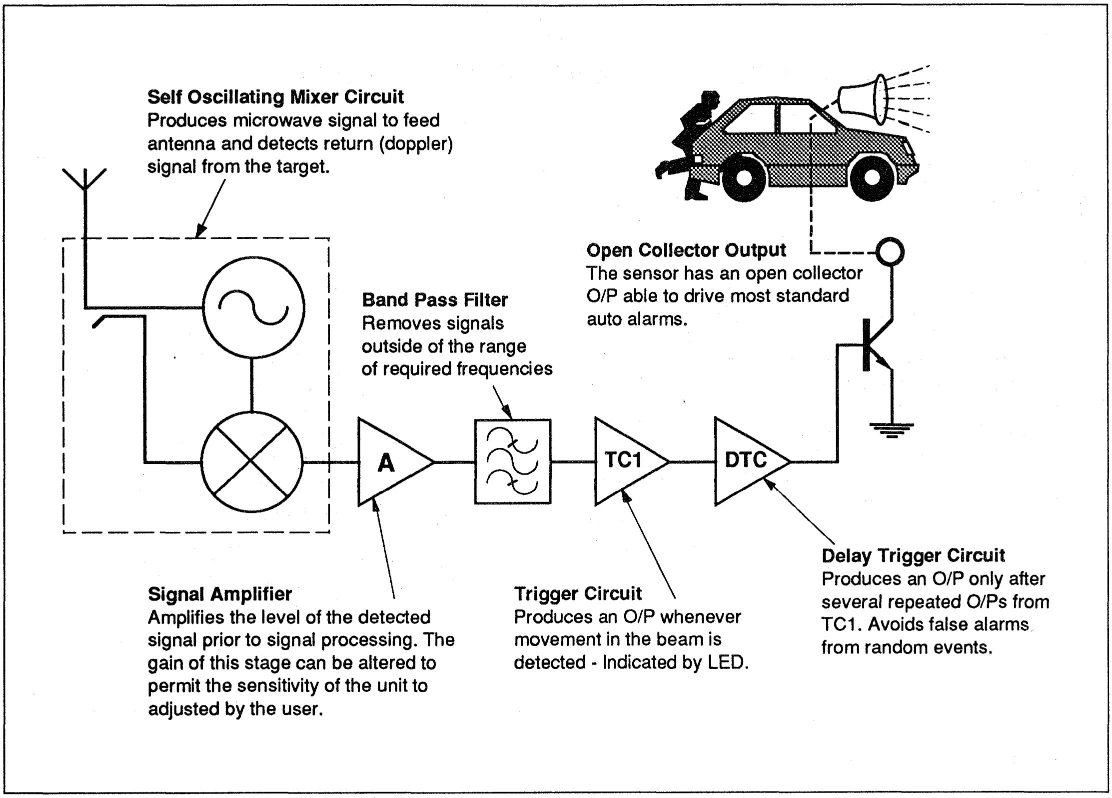


BOARD DIMENSIONS



All dimensions in mm. Size is approximate.

ALARM SCHEMATIC



GEC PLESSEY
SEMICONDUCTORS

PRELIMINARY INFORMATION

DS3455-1.2 March 1992

DA5802

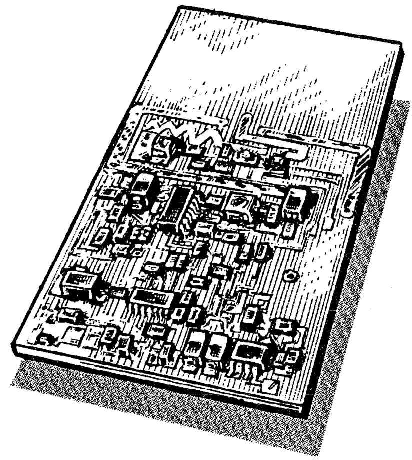
MICROWAVE DOPPLER VEHICLE ALARM SENSOR *
For Front or Rear Vehicle Mounting

The DA5802 car alarm sensor is a microwave doppler movement detector working at 2.45GHz. It is designed for mounting at either the front (dashboard area) of the car or at the back. The protection zone generated by the sensor is very carefully controlled using a directional antenna. The unit is planer in construction with one hybrid board containing the microwave circuit and the signal processing.

Connection to the sensor is by 3 wires, supply (positive +12V), ground and alarm trigger output. The alarm trigger output is a conventional open collector transistor which gives an output 'low' for >20ms. Two outputs are available, every event and a weighted event. The weighted event is connected as standard.

Alarm sensitivity/range can be adjusted when the alarm is mounted in position, using a simple screwdriver gain adjustment. An 'every event' LED is provided for this purpose.

The DA5802 unit is designed to be housed in the customer's own custom cases, using the GPS design guidelines, and is supplied as a fully assembled and tested unit.



FEATURES

- High Sensitivity to Movement
- Sees Through Seats etc.
- Simple to Install and Set
- Insensitive to Environment Changes
- Small Size
- Compliant to European and U.S. Standards
- No License Required
- Controllable Area of Coverage
- Compatible with most Current Alarm Systems

* Patent Pending

DA5802

SPECIFICATION

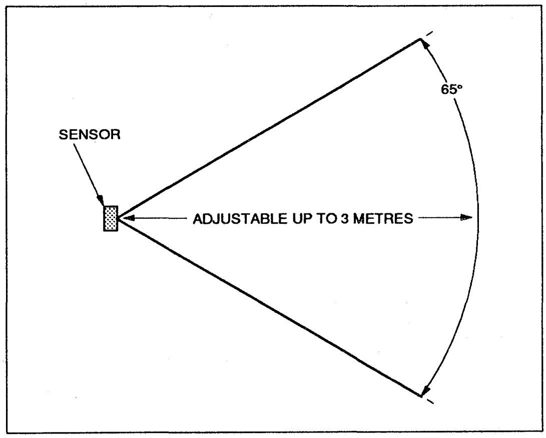
Characteristics	Value
Frequency	2.45GHz
Output Power	<1mW CW
Range of Detection	>3 Metres
Input Voltage	9-16V d.c.
Quiescent Current	8mA Max
Alarm Output	Open Collector Transistor
Output Current Sink	10mA Max
Operating Temperature Range	-40°C to +85°C
License	Not Required

The unit is contructed in complience with DTI, FCC and European Regulations.

Electrical Transient

Reverse Voltage (Continuous)	-80V Min.
Over Voltage (Continuous)	+27V Min.

ALARM AREA OF COVERAGE

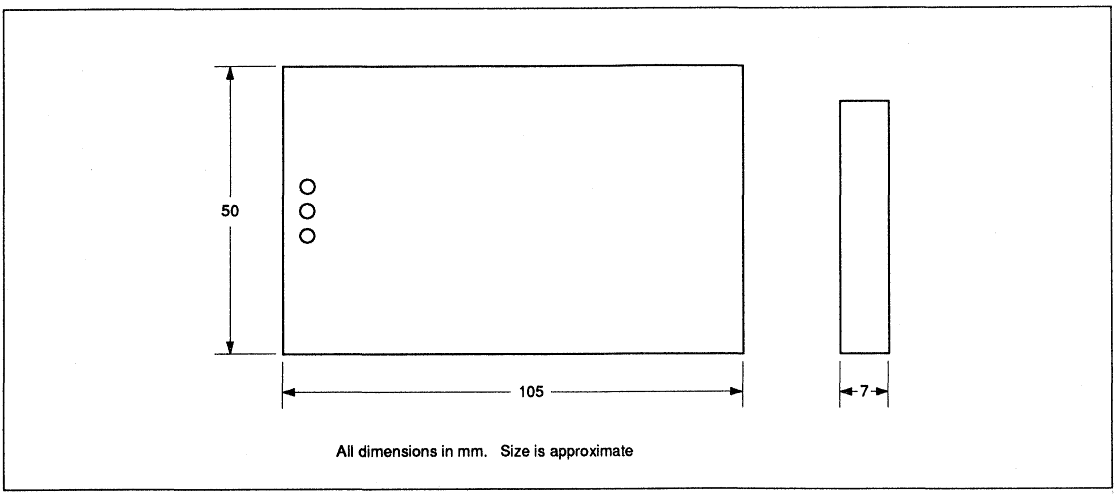


CONNECTION TO ALARM SYSTEM

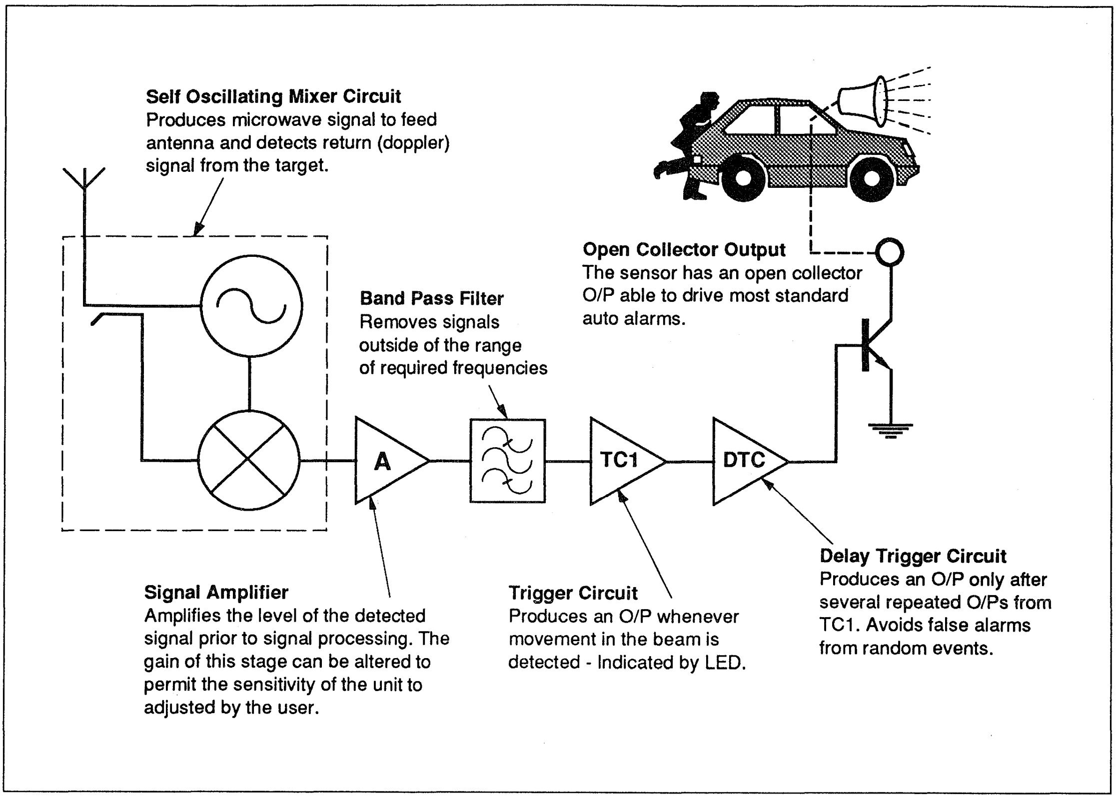
2 Metre Length Of Cable:

Red: 9-16V d.c.
Green: Ground
Blue: Alarm Output

BOARD DIMENSIONS



ALARM SCHEMATIC



DA5800 and DA5802 Application Note

MICROWAVE CAR ALARM SENSORS

GENERAL DESCRIPTION

The DA5800 and DA5802 microwave car alarm sensors are designed to be compatible with most car alarm systems currently in production. Both units are of single board construction with 3 wire connection to the alarm system - positive 12v, ground and alarm trigger (open collector transistor). The units are small, lightweight and with low power consumption and are designed to be housed in a plastic box constructed to the alarm system manufacturer's particular design (using GPS design guidelines).

OPERATIONS

The units work on the Doppler RADAR principle, whereby a transmitted frequency reflects off moving targets with a small shift in frequency (proportional to the velocity of the moving target). If this "reflected" frequency is then compared or mixed with the original frequency, the difference (or change) in frequency is proportional to the velocity of the target.

In this particular case, the transmitted frequency is generated in a very stable transistor-oscillator. The frequency is transmitted via an antenna (either an omni-directional or semi-directional antenna printed on the same hybrid board as the oscillator). The power transmitted (<1mW) will be reflected off stationary objects (eg objects within the car) with no Doppler shift ie. no change in frequency. However, if any object within the range of the unit is moving, then a Doppler shift will be generated. The reflected power (plus Doppler shift) will then be received (via the same antenna) and the non-linear action of the transistor oscillator will mix the two (transmitted and received) frequencies together. The difference frequency (ie. the Doppler frequency which is proportional to the velocity of the object) is then amplified in the sensor and then goes into an active filter. This rejects any frequencies outside the known area of interest.

The advantages of the Doppler RADAR detection as per the DA5800 and DA5802 sensors are:

- Only moving targets within the defined RADAR beam or area of coverage produce an output (alarm).
- Sensitivity does not vary as a very stable/high quality factor oscillator is used.

One alternative to the Doppler that is currently used in car alarm applications is the microwave "Volumetric" sensor. These work on the principle that if a low quality factor oscillator is used, any movement or change within the antenna field will change the oscillator frequency. This simulates a Doppler shift. However, the oscillator frequency drift with temperature is high and will not conform to European standards for frequency stability. The sensitivity of the system also varies with temperature (ie with the absolute frequency).

Other competing alarm sensor technologies include:

1. Ultrasonic (U/S)
2. Infra-red (IR)

Both these technologies, particularly the latter suffer from high false alarm rates due to pressure waves (U/S) or temperature changes (IR).

INSTALLATION

The two sensors, DA5800 and DA5802, are designed for installation in different positions within the car.

DA5800 - designed for mounting centrally in the vehicle.
DA5802 - designed for mounting at either the front or the back of the car interior.

A) DA5800 Installation

If the unit is placed above a large metal surface (eg the car floor), the polar diagram, or area of coverage by this unit is like a dome, centred on the alarm unit. In fact, the antenna radiates out in all directions and uses the metal surface as a reflector. The ideal position to mount the unit is approximately 20mm above the metal floor, central in the vehicle (see Figure 1) eg. under the handbrake. The distance above the reflector or metal floor will determine the efficiency of the unit and will result in a reduction of range if the 20mm gap is reduced. Adequate gain is available by adjusting the sensitivity setting adjustment potentiometer to give a minimum of two metres coverage range when the alarm is mounted in this way. The alarm can be mounted under plastic enclosures but not behind metal.

The polar diagram produced by this alarm (as shown in Figure 1) is in fact very slightly non-symetrical. The effect is that slightly greater coverage is given in one direction (see Figure 2). This can be used to effect when the alarm is mounted in the centre of the car, as shown in Figure 1.

The alarm should be securely mounted in position, using non-metallic spacer material to realise the 20mm height (eg carpet etc). Metal objects near the alarm may distort the area of coverage and lead to areas not covered by the alarm - move the alarm slightly to overcome this. Once installed and connected to the alarm system, the sensitivity can then be adjusted in accordance with the instructions issued with the alarm system.

B) DA5802 Installation

This alarm has an area of coverage like a torchlight with a broad beam. Ideally the unit is placed at either the front or back of the car (see Figure 4). The range is adjustable up to 3 metres. The area of coverage can be distorted by metallic objects close to the alarm sensor, and this should be avoided.

Suggested areas of placement are:

1. Middle of the dashboard - behind or on the facia.
2. Behind the rear seat - but not behind metal (see Figure 3).
3. On the rear parcel shelf pointing forwards.

To establish the optimum position, remember that (from Figure 4) an area of 2.0 metres (approximately) will be covered, 1.5 metres from the alarm.

ADJUSTMENT

To set up the sensitivity of the microwave unit, it is suggested that you start with the adjustment setting in the position it was originally in when you received the alarm. Note the red LED light flashes when the alarm is activated (10 seconds should be allowed to enable the unit to stabilise). The LED will then only flash when the alarm detects movement within its defined area of coverage. Simulated targets eg. hands being waved on the outside of the car (up to the windows/sun-roof etc.) should not set the alarm off. With a window in the open position, check that movement of a hand into the car then triggers the alarm.

To increase the sensitivity : turn setting screw clockwise. (ie. increase the range)

To decrease the sensitivity : turn the setting screw anti-clockwise. (ie. decrease the range)

Do not use pressure on the setting screw as this may damage the alarm.

When you have adjusted the alarm so that movement outside the car is not detected, and movement into the car, either through a door or window is, the alarm is then set and will require no further adjustments.

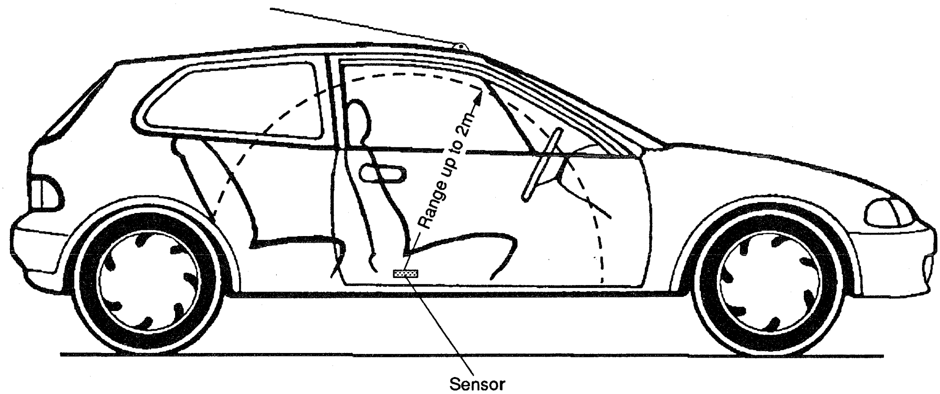


Figure 1: Mounting of DA5800 on the floor of the vehicle - Side View

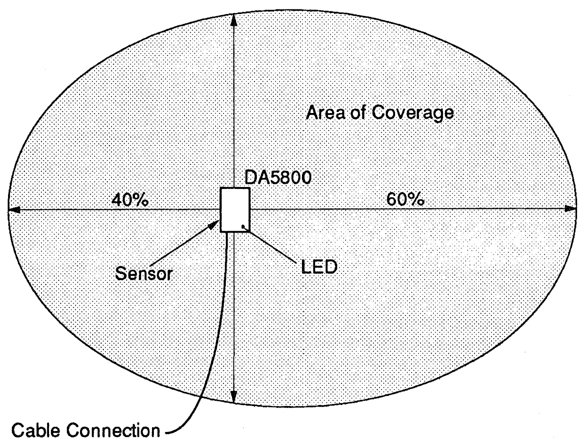


Figure 2: Mounting of DA5800 showing non-symmetry of the area covered

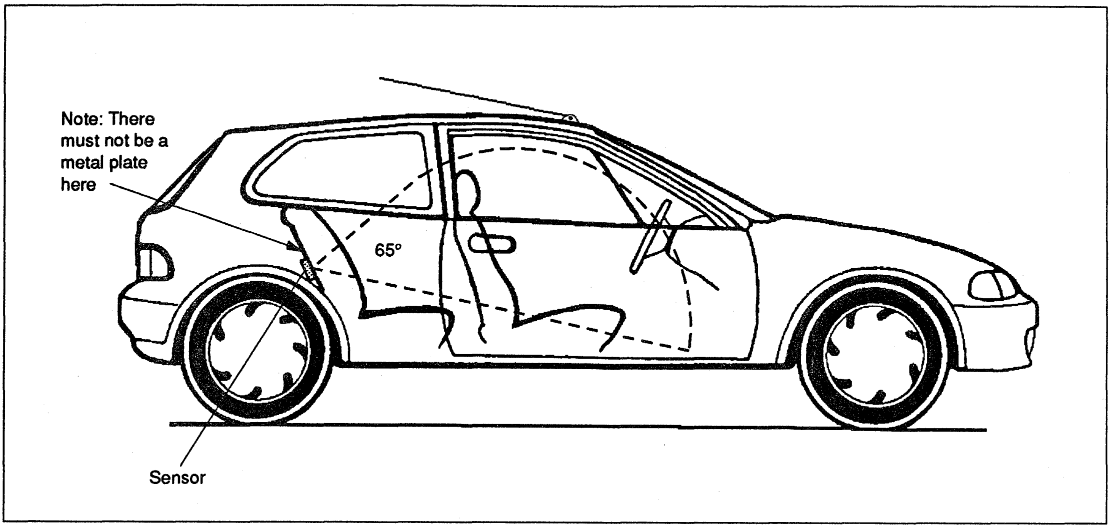


Figure 3: Mounting of DA5802 at the rear of the vehicle - Side View

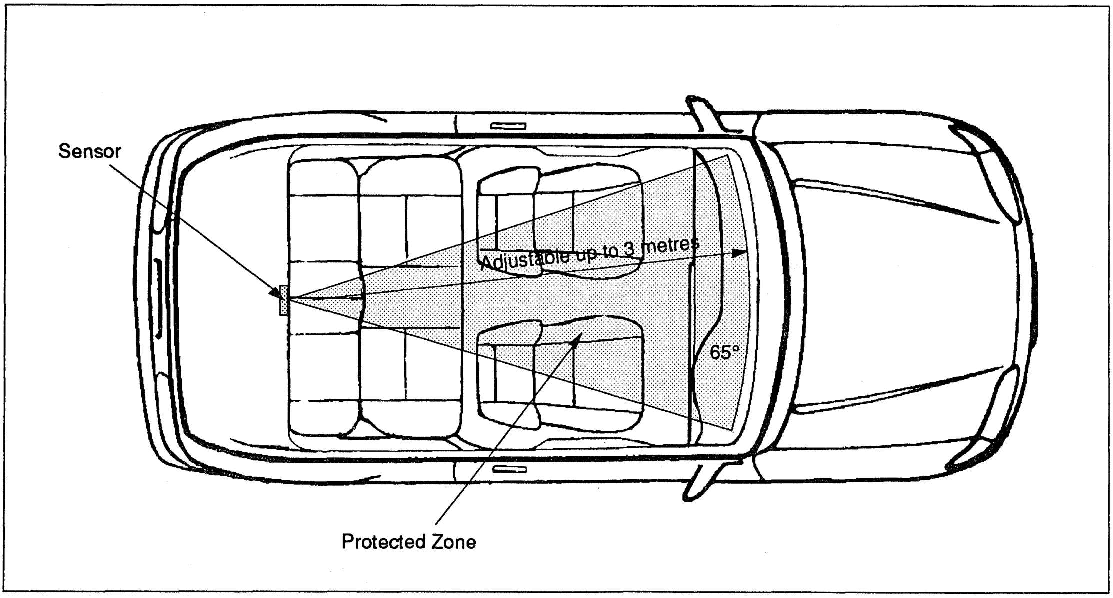


Figure 4: Mounting of DA5802 at the rear of the vehicle - Top View

DA8030/31

9.4-10.7GHz DETECTOR MODULES

The DA3030/31 range of detector modules is ideal for line-of-sight and microwave fence type applications. A low constant current bias is required for use as a detector, but the unit may also be used with a local oscillator as the basis of a low-cost superheterodyne system.

GENERAL CHARACTERISTICS

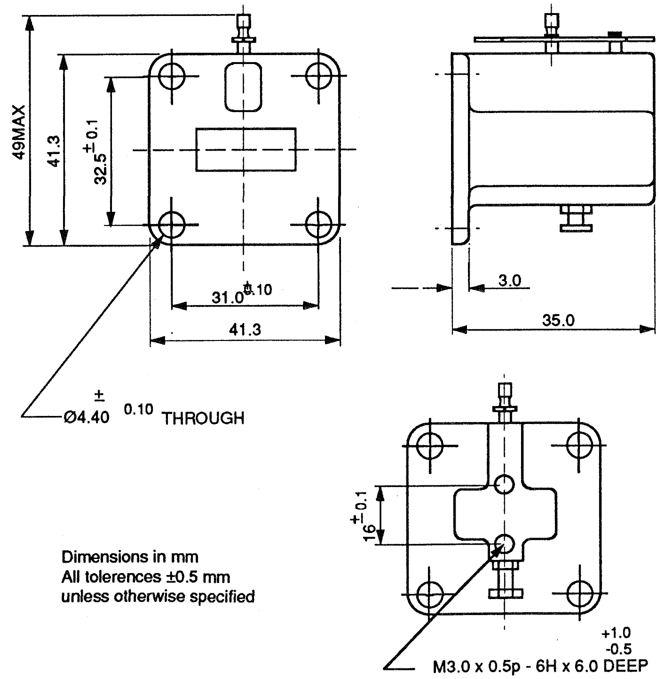
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 16 (WR 90)
Flange	Compatible with UG 39/U or Equivalent

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8030	DA8031	Units
Centre Frequency[1]	9.4-10.0	10.0-10.7	GHz
DC Bias Current	+5	+5	µA
Sensitivity	20	20	mV/µW Typ
Noise[2]	10	10	µV Max
RF Bandwidth[3]	300	300	MHz Typ
VSWR	1.5:1	1.5:1	Typ
Package	MX1	MX2	

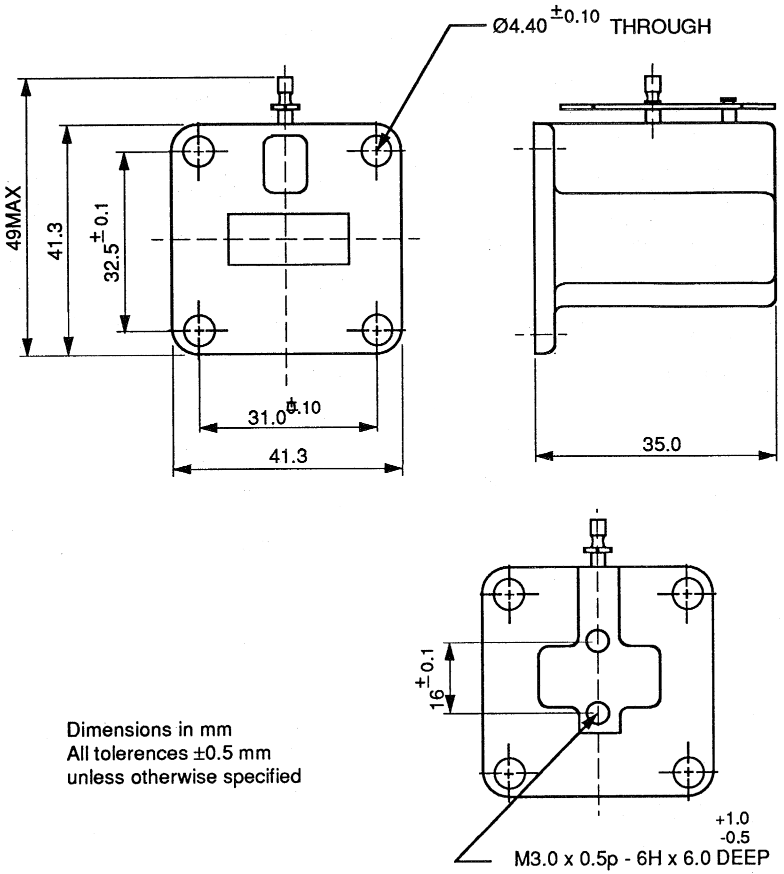
[1]Centre frequency to be specified by customer at time of ordering.
[2]Measured in an IF bandwidth of 10Hz to 10kHz.
[3]Nominal 3dB bandwidth around specified centre frequency.

PACKAGE DETAILS



MX1

PACKAGE DETAILS (Continued)



Dimensions in mm
All tolerences ±0.5 mm
unless otherwise specified

MX2

GEC PLESSEY
SEMICONDUCTORS

DS3249-1.2 August 1992

DA8032

24.0-24.5GHz DETECTOR MODULE

The DA803X range of detector modules is ideal for line-of-sight and microwave fence type applications. A low constant current bias is required for use as a detector, but the unit may also be used with a local oscillator as the basis of a low-cost superheterodyne system.

GENERAL CHARACTERISTICS

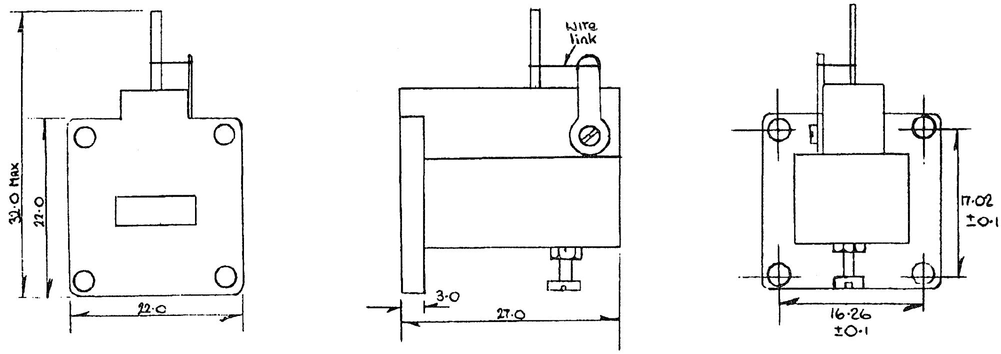
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 20 (WR 42)
Flange	Compatible with UG 595/U or Equivalent

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8032	Units
Centre Frequency[1]	24.0-24.5	GHz
DC Bias Current	+8	µA
Sensitivity	2.5	mV/µW Typ
Noise[2]	10	µV Max
RF Bandwidth[3]	1.0	GHz Typ
VSWR	2.5:1	Typ
Package	MK1	

[1]Centre frequency to be specified by customer at time of ordering.
[2]Measured in an IF bandwidth of 10Hz to 10kHz.
[3]Nominal 3dB bandwidth around specified centre frequency.

PACKAGE DETAILS



MK1

DS3244-1.2 August 1992

DA8504

10.5-10.7GHz* DOPPLER MOTION DETECTION MODULE

The DA8504 Doppler module is designed to offer very high sensitivity and low noise, and to meet the requirements of international broadcasting regulations.

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8504	Units
Output Power	5	mW
Operating Voltage	+8.0	mA
Operating Current	125	mA Typ
Mixer Sensitivity†	-106	dBc Min
Mixer Noise	10	µV Max
Second Harmonic	-35	dBm Typ
Package	DX1	

* Operating Frequency is fixed to a given range. Please state frequency required at time of ordering.
†Measured in an IF bandwidth of 10Hz to 1kHz rms.

FEATURES

- Good Stability
- Low Harmonic and Spurious Outputs
- Excellent Signal to Noise Characteristics
- J-Band Operation

GENERAL CHARACTERISTICS

Parameter	
Frequency Stability with Temperature	-350kHz/°C Typ.
Power Variation with Temperature	-0.03dB/°C Typ.
Frequency Pushing	10MHz/V Typ.
IF Conversion Factor	32Hz/mph (20Hz/kph)
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 16 (WR 90)
Flange	Compatible with UG 39/U or Equivalent

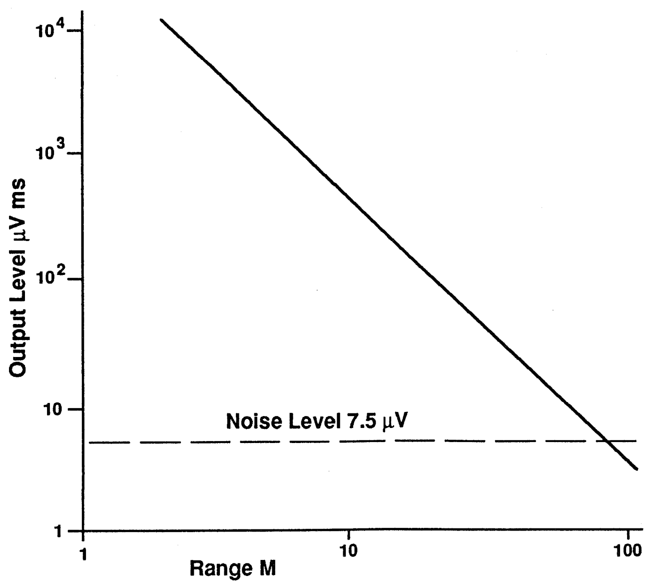
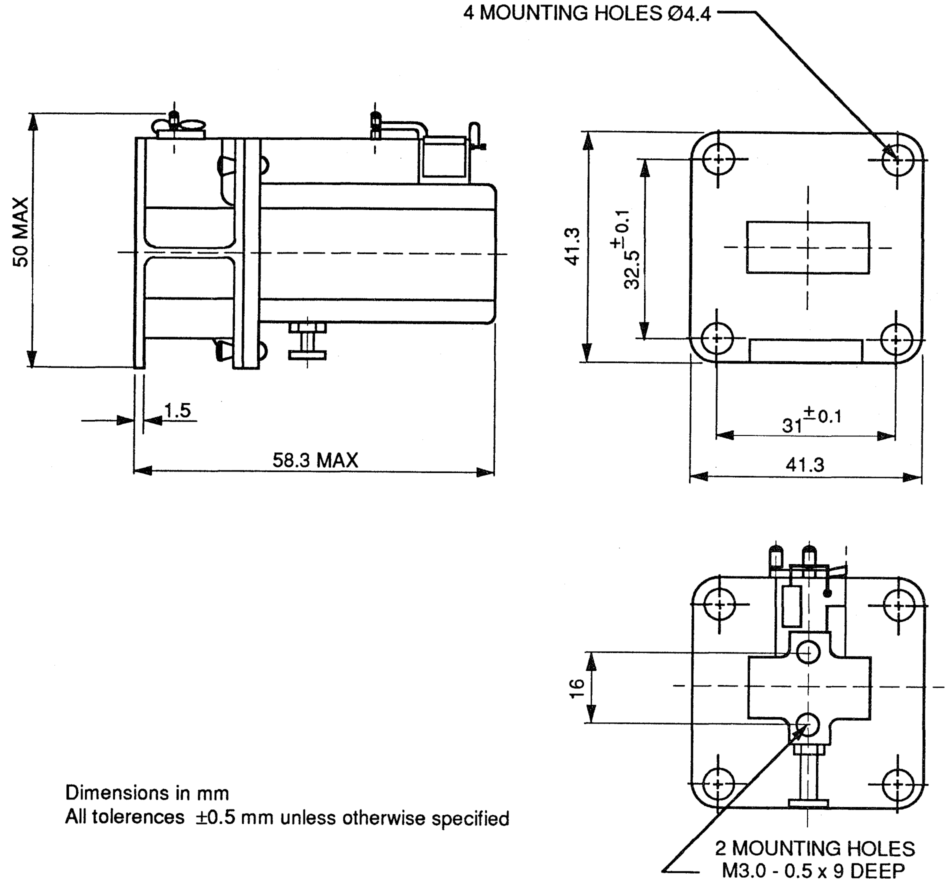


Figure 1: Typical Doppler Output for Human Target (1m²) DA8504 with DA8009 (15dB Gain)

PACKAGE DETAILS



Dimensions in mm
All tolerences ±0.5 mm unless otherwise specified

DX1

DS3245-1.2 August 1992

DA8505/05-1

24.0-24.5GHz* DOPPLER MOTION DETECTION MODULES

The DA8505 range of Doppler modules is designed of offer very high sensitivity and low noise, and to meet the requirements of various international broadcasting regulations.

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8505	DA8505-1	Units
Output Power	5	5	mW
Operating Voltage	-5.0	+5.0	V
Operating Current	180	180	mA Typ
Mixer Sensitivity†	-100	-100	dBc Min
Mixer Noise	10	10	µV Max
Second Harmonic	-35	-35	dBm Typ
Package	DK1	DK1	

* Operating Frequency is fixed to a given range. Please state frequency required at time of ordering.
†Measured in an IF bandwidth of 10Hz to 10kHz.

FEATURES

- Good Stability
- Low Harmonic and Spurious Outputs
- Excellent Signal to Noise Characteristics
- K-Band Operation

GENERAL CHARACTERISTICS

Parameter	
Frequency Stability with Temperature	-800kHz/°C Typ.
Power Variation with Temperature	-0.03dB/°C Typ.
Frequency Pushing	10MHz/V Typ.
IF Conversion Factor	72Hz/mph (45Hz/kph)
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 20 (WR 42)
Flange	Compatible with UG 595/U or Equivalent

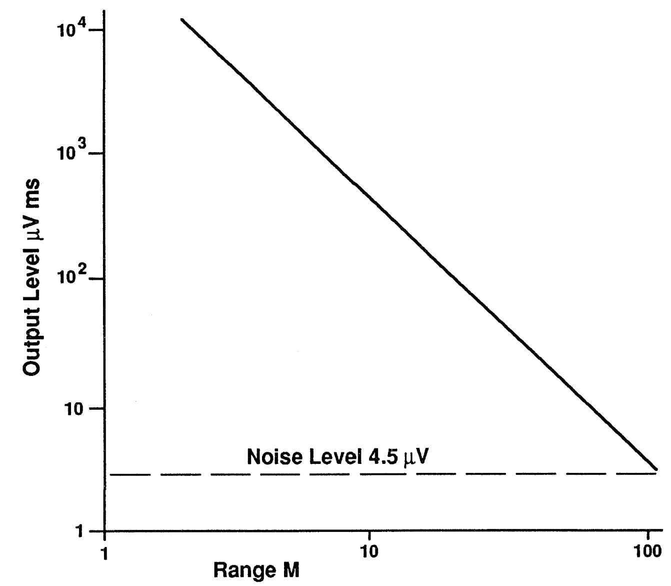
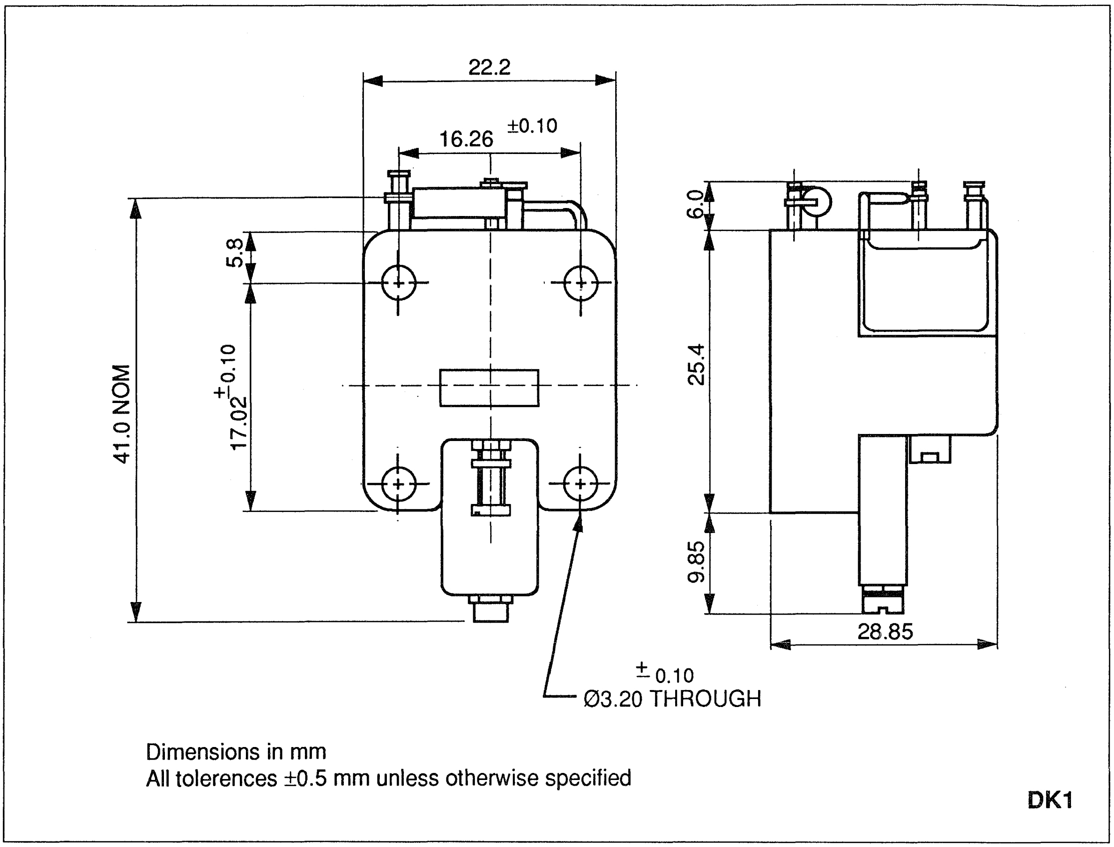


Figure 1: Typical Doppler Output for Human Target (1m²) DA8505 with DA8045 (20dB Gain Antenna)

PACKAGE DETAILS



DS3434-1.2 August 1992

DA8506

10.5-10.7GHz* DIRECTION SENSING DOPPLER MODULE

The DA8506 range of direction sensing Doppler modules offers all the main features of the DA8504 modules, but with the addition of a second mixer diode to give a quadrature IF output. This provides the capability to distinguish between approaching and receding motion, or to filter out periodic motion such as vibration.

FEATURES

- Good Stability
- Low Harmonic and Spurious Outputs
- Excellent Signal to Noise Characteristics
- J-Band Operation

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8506	Units
Output Power	5	mW
Operating Voltage	+8.0	V
Operating Current	150	mA Typ
Mixer Sensitivity †	-106	dBc Min
Mixer Noise	10	µV Max
Phase Difference	90±20	Degrees
Second Harmonic	-35	dBm Typ
Package	SX1	

* Operating Frequency is fixed to a given range. Please state frequency required at time of ordering.
† Measured in an IF bandwidth of 10Hz to 1kHz rms.

GENERAL CHARACTERISTICS

Parameter	
Frequency Stability with Temperature	-350kHz/°C Typ.
Power Variation with Temperature	-0.03dB/°C Typ.
Frequency Pushing	10MHz/V Typ.
IF Conversion Factor	32Hz/mph (20Hz/kph)
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 16 (WR 90)
Flange	Compatible with UG 39/U or Equivalent

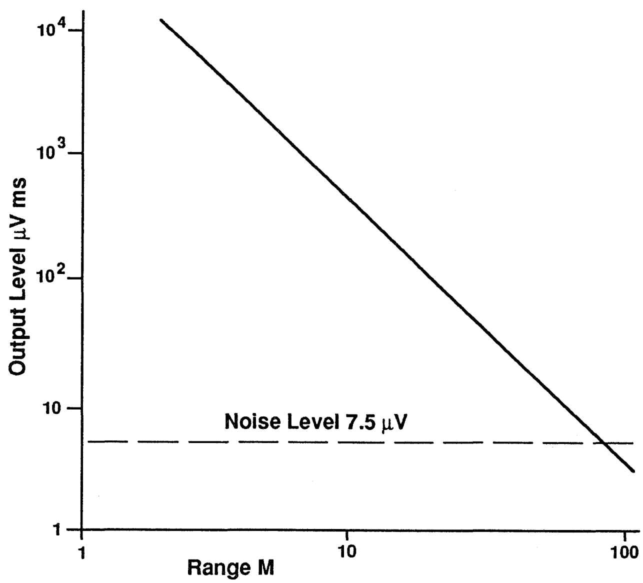
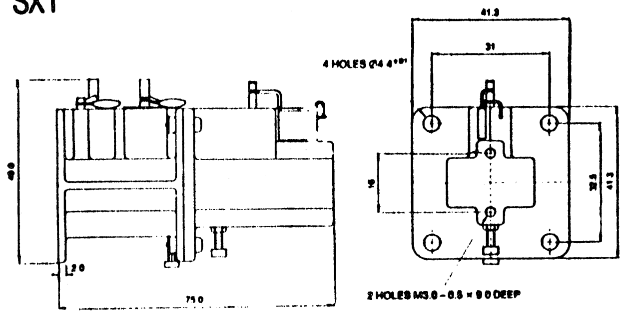


Figure 1: Typical Doppler Output for Human Target (1m²) DA8506 with DA8009 (15dB Gain Antenna)

PACKAGE DETAILS

SX1



Dimensions in mm
All tolerances ±0.5 mm unless otherwise specified

DS3247-1.2 August 1992

DA8507/07-1

24.0-24.5GHz* DIRECTION SENSING DOPPLER MODULES

The DA8507 range of direction sensing Doppler modules offers all the main features of the DA8505 modules, but with the addition of a second mixer diode to give a quadrature IF output. This provides the capability to distinguish between approaching and receding motion, or to filter out periodic motion such as vibration.

FEATURES

- Good Stability
- Low Harmonic and Spurious Outputs
- Excellent Signal to Noise Characteristics
- K-Band Operation

SPECIFICATION at 25°C unless otherwise stated

Parameter	DA8507	DA8507-1	Units
Output Power	5	5	mW
Operating Voltage	-5.0	+5.0	V
Operating Current	180	180	mA Typ
Mixer Sensitivity†	-100	-100	dBc Min
Mixer Noise	10	10	µV Max
Phase Differences	90±20	90±20	Degrees
Second Harmonic	-30	-30	dBm Typ
Package	SK1	SK1	

* Operating Frequency is fixed to a given range. Please state frequency required at time of ordering.
†Measured in an IF bandwidth of 10Hz to 1kHz.

GENERAL CHARACTERISTICS

Parameter	
Frequency Stability with Temperature	-800kHz/°C Typ.
Power Variation with Temperature	-0.03dB/°C Typ.
Frequency Pushing	10MHz/V Typ.
IF Conversion Factor	72Hz/mph (45Hz/kph)
Operating Temperature Range	0° to +55°C
Waveguide Size	WG 20 (WR 42)
Flange	Compatible with UG 595/U or Equivalent

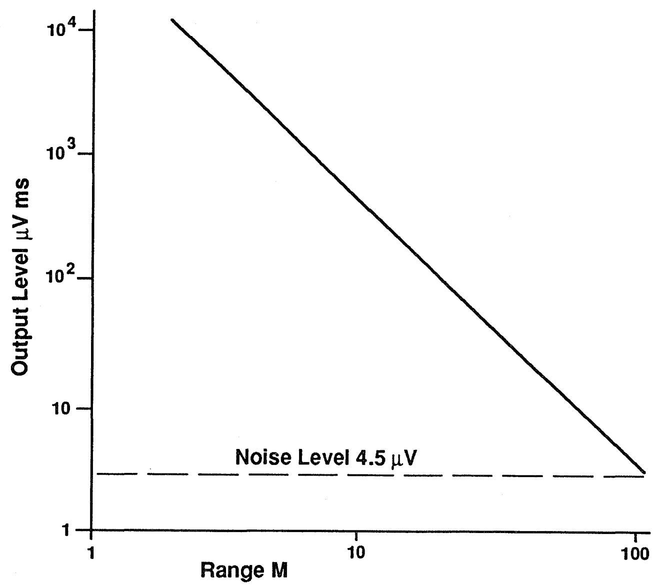
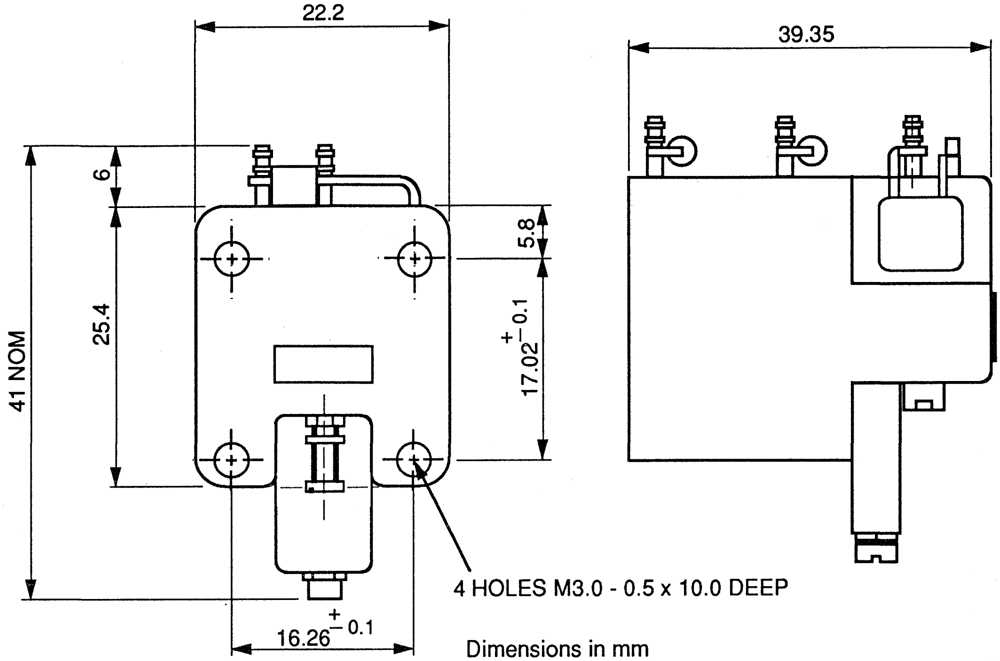


Figure 1: Typical Doppler Output for Human Target (1m²) DA8507 with DA8045 (20dB Gain Antenna)

PACKAGE DETAILS



Dimensions in mm
All tolerences ±0.5 mm unless otherwise specified

SK1

AUTOMOBILE CRUISE CONTROL SYSTEM

Active Cruise Control (ACC) enables a driver to engage cruise control when travelling at a safe distance behind a selected vehicle travelling at an acceptable cruising speed. As the selected vehicle speeds up or slows down the vehicle fitted with ACC tracks the changes in speed and accelerates or decelerates accordingly. As the speed increases the distance between the vehicles will be increased and correspondingly the gap closes as speeds are reduced.

The ACC continuously monitors the activity of the vehicle(s) in front, and constantly relates this to brake and accelerator actions.

It consists of a GPS sensor which operates at 77GHz using proven FMCW Radar principles. Quasi-optical switched beam steering with 3 beams of 3° beamwidth each overlapping by 0.5° enables scanning of the road ahead, tracking of selected vehicles round corners as well as monitoring of vehicle activity in adjacent traffic lanes.

The information from the sensor is fed back to the vehicles' on-board Electronic Control Unit (ECU) which controls braking and accelerating functions.

WITH GPS ACC SENSOR ENGAGED

- Bunching on highways is automatically reduced as drivers accelerate and decelerate
- Queues move off much more rapidly as each vehicle moves off virtually simultaneously
- Driver fatigue is reduced
- Road congestion is improved
- Traffic flow is enhanced
- Fuel economy is improved
- Pollution is reduced

GPS ACC SENSOR FEATURES

- Precise measurement of the distance to vehicle ahead
- Very accurate measurement of speed differential
- Scanning action follows vehicles around corners
- Unaffected by climatic conditions, reflections, or electrical/ sound interference
- Fits unobtrusively onto front of vehicle
- 77GHz day and night operation

77GHz PERFORMANCE

- Approved frequency band
- Very low transmitted power needed to achieve range requirements
- Narrow bandwidth achieved with small aperture antenna
- Accurate measurement of distance and speed
- All weather operation - rain, fog, hail etc.
- No interference from roadside equipment
- Microstrip construction enables small rugged unit

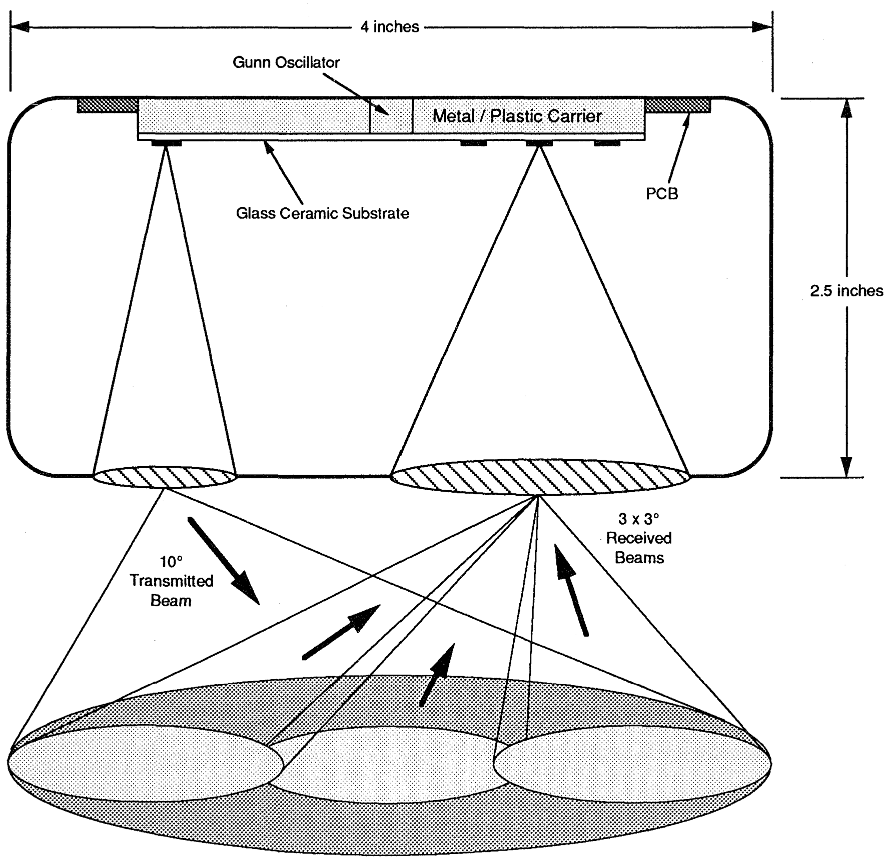
MICROSTRIP CIRCUIT TECHNOLOGY

- Very small structure
- Rugged - Proven to 20,000g shock resistance
- Operating temperature range -55°C to +125°C
- Photolithographic production ensures optimum repeatability
- Easy mounting of 'pick and place' semiconductors
- Stable electrical performance
- Direct interface to quasi-optical dielectric lens
- Switched beam antenna easily realised
- Proven readily available low cost technology

AUTOMOBILE CRUISE CONTROL SYSTEM

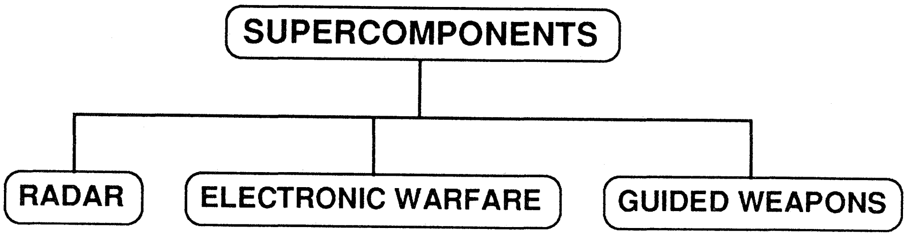
SPECIFICATION

Range	2 to 150 metres
Range Resolution	5% of Range
Differential Speed Resolution	<5km/hour
Beamwidth	3° Switchable over 3 positions to give 10° coverage
Transmit and Receive Polarisation	Circular
Size	10cm x 7.5cm x 6.5cm
Environment	Harsh (Automobile), Exposed
Interface	Input 1 - 12V Input 2 - Ground Output 1 - Range Output 2 - Rate of change of range Output 3 - Antenna Beam Position (1, 2 or 3)



Section 12

Supercomponents



GEC PLESSEY
SEMICONDUCTORS

Supercomponents

Electronic Warfare	• 0.1 to 18GHz; 26 to 40GHz • ESM • ECCM • ECCM Simulators
Guided Weapons	• Millimetre Wave • Smart Munitions
Radar	• Low Noise Airborne Radars

Section 13
GEC Plessey Semiconductors Locations

GEC PLESSEY
SEMICONDUCTORS

HEADQUARTERS OPERATIONS

UNITED KINGDOM	Cheney Manor, Swindon, Wiltshire SN2 2QW, United Kingdom. Tel: (0793) 518000 Tx: 449637 Fax: 0793 518411
NORTH AMERICA	Sequoia Research Park, 1500 Green Hills Road, Scotts Valley, California 95066, USA. Tel:(408) 438 2900 ITT Telex: 4940840 Fax: (408) 438 5576

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FRANCE & BENELUX	Z.A. Courtaboeuf, Miniparc-6, Avenue des Andes, Bat. 2-BP 142, 91944, Les Ulis Cedex A. France. Tel: (1) 64 46 23 45 Fax: (1) 64 46 06 07 Tx: 602 858 F
GERMANY, AUSTRIA and SWITZERLAND	Ungererstraße 129, 8000 Munchen 40, Germany. Tel: 089/36 0906-0. Fax: 089/360906-55 Tx: 523980
ITALY	Viale Certosa, 49 20149 Milano. Tel: (02) 33 00 10 44/45. Fax: (GR3) 31 69 04. Tx: 331347
JAPAN	Nichiyo Building 6F, 11-12, Kanda - Mitoshirocho, Chiyoda-ku, Tokyo 101. Tel: (03) 3296-0281. Fax: (03) 3296-0228
NORTH AMERICA	**Integrated Circuits** Sequoia Research Park, 1500 Green Hills Road, Scotts Valley, California 95066, USA. Tel: (408) 438 2900 ITT Tx: 4940840 Fax: (408) 438 7023 **SOS, Microwave and Hybrid Products** 160 Smith Street. Farmingdale, NY11735, USA. Tel: (516) 293 8686 Fax: (516) 293 0061.
SOUTH EAST ASIA	152 Beach Road, #04-05 Gateway East, Singapore 0718. Tel: 2919291. Fax: 2916455
SWEDEN	Ostmästargränd 4, GS-12173 Johanneshov. Tel: 46 8 7228690 Fax: 46 8 7227879
UNITED KINGDOM and SCANDINAVIA	Unit 1,Crompton Road,Groundwell Industrial Estate, Swindon, Wilts SN2 5AF, U.K. Tel: (0793) 518510. Tx: 444410 Fax: (0793) 518582.

WORLD-WIDE AGENTS

AUSTRALIA and NEW ZEALAND	**GEC George Brown Electronics,** Unit 1, 38 South Street, Rydalmere, NSW 2116, Australia. Tel: 612 638 1888. Fax: 612 638 1798.
EASTERN EUROPE	**CTL Empexion Ltd..** Falcon House, 19 Deer Park Road, London SW19 3WX, U.K. Tel: (081) 543 0911. Tx: 928472. Fax: (081) 540 0034. **FA Bernhart GmbH,** Melkstattweg 27, PO Box 1628, D 8170 Bad Toelz., Germany. Tel: 80 41 41 676 Fax: 80 41 71 504 Tx: 526246 FABD.
HONG KONG	**YES Products Ltd.,** Block E, 15/F Golden Bear Industrial Centre, 66-82 Chaiwan Kolk Street,Tsuen Wan, N.T. Hong Kong. Tel: 4144241-6. Tx: 36590. Fax: 4136078.
INDIA	**Mekaster Telecom PVT Ltd.,** 908 Ansal Bhawan, 16 Katuba Ghandi Marg, New Delhi, 100 001 India Tel: 11 3312110 Fax: 11 3712155.
JAPAN	**Cornes & Company Ltd.,** Maruzen Building, 2-3-10 Nihonbashi, Chuo-ku. Tokyo 103. Tel: 3 272 5771. Tx: 24874. Fax: 3 271 1479. **Cornes & Company Ltd.,** 1-Chome Nishihonmachi, Nishi-Ku, Osaka 550. Tel: 6 532 1012.Tx: 525-4496. Fax: 6 541-8850. **Microtek Inc.,** Itoh Bldg, 7-9-17 Nishishinijuku. Tokyo 160. Tel: 3 371 1811. Tx: 27466. Fax: 3 369 5623.
KOREA	**KML Corporation,** 3rd Floor, Bang Bae Station Building, 981-15 Bang Bae, 3-Dong Shucho-Gu, Seoul, Korea, CPO Box 7981. Tel: 2 588 2011/6. Tx: K25981. Fax: 2 588 2017.
MALAYSIA	**Adequip Enterprise Sdn Bhd,** #6-01 6th Floor, Wisjma Stephens, 88 Jalan Raya Chulan, 50200 Kualar Lumpur, Malaysia. Tel: 2423522. Fax: 2423264.
SCANDINAVIA: Denmark	**Scansupply A/S,** Gladsaxevej 356, DK-2860 Soeborg. Tel: 45 39 66 50 90. Fax: 45 39 66 50 40. **Scansupply A/S,** Marselisborg Havnevej 36, 8000 Arhus C. Tel: 45 86 12 77 88. Fax: 45 86 12 77 18.
Finland	**Oy Ferrado AB,** P.O.Box 54, SF-00381 Helsinki 38. Tel: 98 0550 002. Tx: 122214. Fax: 98 0551 117.
Norway	**Skandinavisk Elektronikk A/S,** Ostre Aker Vei 99, 0596 Oslo. Tel: 2 64 11 50. Tx: 71963 Fax: 2 643443.
TAIWAN	**Prospect Technology Corporation,** 5, Lane 55, Long-Chiang Road, Taipei, Taiwan. Tel: (886-2) 721-9533. Fax: (886-2) 773-3756. **King and King's Technology Ltd.,** 4, Alley 6, Lane 118, Sec 2, Ho Ping East Road, Taipei 106, Taiwan. Tel: (886-2) 732-6170. Fax: (886-2) 738-9146.
THAILAND	**Westech Electronics Co. Ltd,** 77/113 Moo Ban Kitikorn, Ladprao Soi 3, Ladprao Road, Ladyao, Jatujak, Bangkok 10900. Thailand. Tel: 2 5125531. Fax: 2 2365949.

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BELGIUM	**Heynen,** De Koelen 6, B-3530 Koutmalen. Tel: 011/52 57 57. Tx: 39047. Fax: 011/52 57 77. **Tekelec Airtronic NV,** Bergensesteenweg 501, B-1500 Halle. Tel: 02 362 1288 Fax: 02 360 3807
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Eprom, 185 Rue de Lyon, 13344 Marseille Cedex 15. Tel: 91 61 80 20. Fax: 91 02 97 73.
ICC:
2 bis Avenue Fontmaures, 63400 Chamalières. Tel: 73 36 71 41 Fax: 73 30 87 90.
Z.A. Artizanord II, Traversee de l'Oasis, 13015 Marseille. Tel: 91 03 12 12. Fax: 91 03 21 05.
Z.I. du Terroir, Rue de l'Industrie, 31140 Saint Alban. Tel: 61 37 44 00. Fax: 61 37 44 29.
Z.A. du Haut Vigneau, Rue de la Source, 33170 Gradignan. Tel: 56 75 17 17. Fax: 56 75 16 25.
PEP Techdis:
Z.I. Pilaterie, Rue de la Couture, 59700 Marcq en Baroeul. Tel: 20 98 92 13. Fax: 20 98 92 26.
3 Rue Berthelot, 69600 Villeurbanne. Tel: 78 53 51 16. Fax: 78 53 51 14.
6-8 Rue Ambroise Croisat, Z.I. des Glaises, 91120 Palaiseau. Tel: 64 47 29 29. Fax: 64 47 00 84.
6 Rue Abbe Henri Gregoire, 35000 Rennes. Tel: 99 32 44 33. Fax: 99 51 33 93.
1 Rue de la Faisandereie, 67380 Lingolsheim. Tel: 88 77 26 46. Fax: 88 76 13 30.
Rhonalco, 3 Rue Berthelot, 69627 Villeurbanne Cedex. Tel: 72 35 22 00. Fax: 72 34 67 72.

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Allcomp Electronic GmbH, Angerweg 20, D-8913 Schondorf. Tel: 08192/1460. Fax: 08192/1043.
AS Electronic Vertriebs GmbH, In den Garten 2, 6380 Bad Homburg 6. Tel: 06172 458931. Fax: 06172 42000.
Astronic GmbH, Gruenwalderweg 30, 8024 Deisenhofen. Tel: 089 6130303. Tx: 5216187. Fax: 089 6131668.
Micronetics GmbH, Weil de Staedter Str. 45, 7253 Renningen 1. Tel: 071 59 6019. Tx: 724708. Fax: 071 59 5119.
Weisbauer Elektronik GmbH, Heiliger Weg 1, 4600 Dortmund 1. Tel: 0231 57 95 47. Tx: 822538. Fax: 0231 57 75 1

GREECE
Impel Ltd., 30 Rodon Str, Korydallos, Piraeus, Greece. Tel: 010 30 1 49 67815. Tlx: 213835. Fax: 01 49 54041.

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Adelsy - Divisione della Generalmusic SpA, Via Novara 570, 20153 Milano. Tel: 02 3810310. Fax: 02 38002988.
Consystem Srl, Via Gramnsci 156, 20037 Paderno Dugnano (MI). Tel: 02 99041977. Fax: 02 99041981.
Eurelettronica SpA, Via E. Fermi 8, 20090 Assago (MI). Tel: 02 457841. Fax: 02 4880275.
Fanton Srl, Milano - Torino - Bologna - Firenze - Roma - Padova. Tel: 02 48912963. Fax: 02 4890902.

JAPAN
Nissho Iwai Aerospace Corp., 5-3 Akasaka & Chome, Minato-Ku, Tokyo-107. Tel: 3 588 2111 Fax: 3 588 4787.
Yamada Corporation, PO Box Tokyo Akasaka No. 120, Tokyo. Tel: 3 475 1121 Fax: 3 479 1789.

NETHERLANDS
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Tekelek Airtronic B.V., PO Box 63, Industrieweg 8A, 2712 LB Zoetermeer, Netherlands. Tel:79 310100
Fax:79 417504

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Anatronic SL, Urbanisazao Do, Infantado, Lote 18, 2° ESQ, Loures. Tel: 1 79 33 2 99.

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Anatronic SA, Bailen, 176, Estresuelo 1°, 08037 Barcelona. Tel: 93 258 1906/7. Fax: 93 258 7128.
Master Electronica SA, Angel Muñoz 18 Bis, 28043 Madrid. Tel: 91 5194342 Tx: 49085 Fax: 91 5193163.

SWEDEN
Pronesto AB (Microwave Products Only), Hemsvärnsgatan 15, Box 1358, S-17126 Solna. Tel: (08) 733 9300.
Fax: (08) 764 5009.

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Elbatex AG., Hardstr 72, CH-5430 Wettingen. Tel: 41 56 27 51 11. Tx: 826300. Fax: 41 56 27 19 24.

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Farnell Electronic Components Ltd., Canal Road, Leeds LS12 2TU.
Tel: 0532 636311. Tx: 55147. Fax: 0532 633404.
Gothic Crellon Ltd., 3 The Business Centre, Molly Millars Lane, Wokingham, Berkshire RG11 2EY.
Tel: 0734 788878, 787848. Tx: 847571. Fax: 0734 776095.
Gothic Crellon Ltd., P.O.Box 301, Elizabeth House, 22 Suffolk Street, Queensway, Birmingham B1 1LZ.
Tel: 021 643 6365. Tx: 338731. Fax: 021 633 3207.
Macro, Burnham Lane, Slough SL1 6LN. Tel: 0628 604383. Fax: 0628 66873.
Semiconductor Specialists (UK) Ltd., Carroll House, 159 High Street Yiewsley, West Drayton, Middlesex UB7 7XB
Tel: (0895) 445522. Tx: 21958. Fax: (0895) 422044.
ESD Distribution Ltd, Edinburgh Way, Harlow, Essex CM20 2DF.
Tel: 0279 626777. Tlx: 818801. Fax: 0279 441687.
2001 Electronic Components Ltd, Woolners Way, Stevenage, Herts SG1 3AJ.
Tel: 0438 742001. Tlx: 827701. Fax: 0438 742002.
Unitel Ltd., Unitel House. Fishers Green Road, Stevenage, Herts.
Tel: (0438) 312393. Tx: 825637. Fax: (0438) 318711.

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GEC Plessey Semiconductors , Unit 1, Crompton Road, Groundwell Industrial Estate, Swindon,
Wilts, UK SN2 5AF. Tel: (0793) 518510. Tx: 444410. Fax: (0793) 518582.
Whiteaway Laidlaw (Overseas) Ltd., PO Box 93, Ambassador House, Devonshire Street North,
Manchester M60 6BU Tel: 061 273 3228 Fax: 061 274 3757

AMERICAN DESIGN CENTRES

CANADA
Alberta Microelectronics Center, 3553 31st St., N.W., Calgary, Alberta T2L2K7. Tel: (403) 289-2043.
Microstar Technologies, 7050 Bramelea Rd., #27A Mississaugo, Ontario L5SITI Canada. Tel: (416) 671-8111

COLORADO
Analog Solutions, 5484 White Place, Boulder, CO 80303. Tel: (303) 442-5083.

ILLINOIS
Frederikssen & Shu Laboratories, Inc., 531 West Golf Rd., Arlington Heights, IL 60005. Tel: (312) 956-0710.

NORTH AMERICAN SALES OFFICES

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EASTERN	Two Dedham Place, Suite 1, Allied Drive, Dedham, MA 02026. Tel: (617) 320-9790. Fax: (617) 320-9383.
WESTERN	1735 Technology Drive, Suite 100, San Jose, California 95110. Tel: (408) 433-1030 Fax: (408) 433-1033
ARIZONA/NEW MEXICO	4635 South Lakeshore Drive, Tempe, AZ 85282. Tel: (602) 491-0910. Fax: (602) 491-1219.
SOUTH CENTRAL	9330 LBJ Freeway, Ste. 665, Dallas, TX 75243. Tel: (214) 690-4930. Fax: (214) 680-9753.
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DIXIE and FLORIDA	668 N. Orlando Ave., Suite 1015 B, Maitland, FL 32751. Tel: (407) 539-1700. Fax: (407) 539-0055. 385 Commerce Way, Longwood, FL 32750. Tel: (407) 339-6660. Fax: (407) 339-9355.
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ARIZONA	**Fred Board Associates,** 7353 E, 6th Avenue, Scottsdale, AZ 85251 Tel: (602) 994-9388. Fax: (602) 994-9477
CALIFORNIA	**Select Electronics,** 14730 Beach Blvd. Bldg., F #106, La Mirada, CA 90638. Tel: (714) 739-8891. Fax: (714) 739-1604. **Select Electronics,** 2106 Waterby, Westlake Village, CA 91361. Tel: (805) 496-8877. **Select Electronics,** 2109 Brookfield Drive, Thousand Oaks, CA 91362. Tel: (805) 492-2007.
FLORIDA	**DHR Marketing, Inc.,** 2300 W.Sample Road, Suite 307, Pompano, FL 33073.Tel: (305) 972-9157. Fax: (305) 972-9164. **DHR Marketing, Inc.,** 417 Whooping Loop, Suite 1747, Altamonte Springs. FL 32701. Tel: (407) 331-1199. Fax: (407) 331-1263. **DHR Marketing, Inc.,** 2907 State Road 590, STE. 11,Clearwater, FL 34619. Tel: (813) 725-5262/725-5347. Fax: (813) 725-1724.
GEORGIA	**Electramark, Inc.,** 6030-H Unity Drive, Norcross, GA 30071. Tel: (404) 446-7915. Fax: (404) 263 6389
ILLINOIS	**Micro Sales, Inc.,** 901 West Hawthorn Drive, Itasca, IL 60043. Tel: (708) 285-1000. Fax: (708) 285-1008
INDIANA	**Leslie M. DeVoe,** 4371 E. 82nd St., Suite D, IN 46250. Tel: (317) 842-3245. Fax: (317) 845-8440
IOWA	**Lorenz Sales,** 5270 N. Park Place N.E., Cedar Rapids, IA 52402. Tel: (319) 377-4666. Fax: (319) 377-2273.
KANSAS	**Lorenz Sales, Inc.,** 8645 College Blvd., Suite 220, Overland Park, KS 66210. Tel: (913) 469-1312. Fax: (913) 469-1238. **Lorenz Sales, Inc.,** 1530 Maybelle, Wichita, KS 67212. Tel: (316) 721-0500. Fax: (316) 721-0566.
MARYLAND	**Walker Associates,** 1757 Gable Hammer Road, Westminster, MD 21157. Tel: (301) 876-9399. Fax: (301) 876-9285. **Walker Associates,** 16904 Queen Anne Bridge Road, Mitchellville, MD 20716. Tel: (301) 249-7145 Fax: (301) 249-7145
MASSACHUSETTS	**Stone Components,** 2 Pierce Street. Framingham, MA 01701. Tel: (508) 875-3266. Fax: (508) 875-0537. **Stone Components,** 10 Atwood Street, Newburyport, MA 01950. Tel: (508) 875-3266. Fax: (508) 465-3544. **Stone Components,** 11 Blueberry Hill Rd., Longmeadow, MA 01106. Tel: (413) 567-9075. Fax: (413) 567-1019. **Stone Components,** P.O.Box 379, Canton, MA. Tel: (617) 828-6569 Fax: (617) 828-6734
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MINNESOTA	**High Technology Sales,** 11415 Valley View Road, Eden Prairie, MN 55344. Tel: (612) 944-7274. Fax: (612) 944-3229.
MISSOURI	**Lorenz Sales, Inc.,** 10176 Corporate Square Dr., Suite120, St. Louis, MO 63132. Tel: (314) 997-4558. Fax: (314) 997-5829.
NEBRASKA	**Lorenz Sales,** 2801 Garfield Street, Lincoln, NE 68502. Tel: (402) 475-4660. Fax: (402) 474-7094.
PENNSYLVANIA/ NEW JERSEY	**Metz-Jade Associates, Inc.,** 7 Waynnewood Rd, Suite 203, P.O.Box 276, Wynnewood, PA 19096. Tel: (215) 896-7300. Fax: (215) 642-6293. **Metz-Jade Associates, Inc.,** 1916 Fairfax Av, Cherry Hill, NJ 08003. Tel: (609) 424-0404. Fax: (609) 751-2160.
NEW YORK	**Regan Compar,** 3301 Country Club Road, Suite 2211, Endwell, NY 13760. Tel: (607) 754-2171 Fax: (607) 754-4270. **Regan Compar,** 214 Dorchester Avenue, 3-C, Syracuse, NY 13203. Tel: (315) 432-8232. Fax: (315) 432-8238. **Regan Compar,** 25C Brookhill Lane, Rochester, NY 14625. Tel: (716) 271-2230. Fax: (716) 381-2840.
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TEXAS	**Oeler & Menelaides, Inc.,** 8430 Meadow Rd., Suite 224, Dallas, TX 75231. Tel: (214) 361-8876. Fax: (214) 692-0235. **Oeler & Menelaides, Inc.,** 8705 Shoal Creek Rd., Austin, TX 78758. Tel: (512) 453-0275. Fax: (512) 453-0088.
WISCONSIN	**Micro Sales, Inc.,** 16800 W.Greenfield Ave., Suite 116, Brookfield, WI 53005. Tel: (414) 786-1403. Fax: (414) 786-1813.

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	GM Assoc. Inc., 3860 Cote-Vertu, Suite 221, St. Laurent, Quebec H4R 1N4. Tel: (514) 335-9572. Fax: (514) 335-9573.
	GM Assoc. Inc., 301 Moodie Dr., Nepean, Ontario K2H 9CR. Tel: (613) 820-3822. Fax: (613) 820-7633.

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	Hammond, 4411-B Evangel Circle NW, Huntsville, AL 35816. Tel: (205) 830-4764. Fax: (205) 830-4287.
ARIZONA	**Insight Electronics,** 1525 W. University Dr., Suite 103. Tempe, AZ 85282. Tel: (602) 829-1800. Fax: (602) 967-2658.
CALIFORNIA	**Insight Electronics (Corp.),** 6885 Flanders Dr., Unit C, San Diego, CA 92121. Tel: (619) 587-0471. Fax: (619) 587-0903.
	Insight Electronics, 28038 Dorothy Dr., Suite 2, Agoura, CA 91301. Tel: (818) 707-2100. Fax: (818) 707-0321.
	Insight Electronics, 15635 Alton Pkwy., Suite 120, Irvine, CA 92718. Tel: (714) 727-2111. Fax: (714) 727-4804
	Insight Electronics, 1295 Oakmead Parkway, Sunnyvale, CA 94086. Tel: (408) 720-9222. Fax: (408) 720-8390.
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