PHILIPS

Data handbook

PHILIPS Electronic components and materials

Electron tubes

Book T11 1986

Microwave diodes and sub-assemblies

Elcoma – Philips Electronic Components and Materials Division – embraces a world-wide group of companies operating under the following names:

IBRAPE

RTC

Miniwatt

signetics

Mullard

VALVO

PHILIPS

Elcoma offers you a technological partnership in developing your systems to the full. A partnership to which we can bring

- world-wide production and marketing
- know-how
- systems approach
- continuity
- broad product line
- fundamental research
- leading technologies
- applications support
- quality

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

ELECTRON TUBES	BLUE
SEMICONDUCTORS	RED
INTEGRATED CIRCUITS	PURPLE
COMPONENTS AND MATERIALS	GREEN

The contents of each series are listed on pages iv to viii.

The data handbooks contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application information is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Electronic Components and Materials Division is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.
Product specialists are at your service and enquiries will be answered promptly.

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks comprises:

T1	**Tubes for r.f. heating**
T2a	**Transmitting tubes for communications, glass types**
T2b	**Transmitting tubes for communications, ceramic types**
T3	**Klystrons**
T4	**Magnetrons for microwave heating**
T5	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
T6	**Geiger-Müller tubes**
T7	**Gas-filled tubes** (will not be reprinted)
T8	**Colour display systems** Colour TV picture tubes, colour data graphic display tube assemblies, deflection units
T9	**Photo and electron multipliers**
T10	**Plumbicon camera tubes and accessories**
T11	**Microwave semiconductors and components**
T12	**Vidicon and Newvicon camera tubes**
T13	**Image intensifiers**
T14	**Infrared detectors**
T15	**Dry reed switches**
T16	**Monochrome tubes and deflection units** Black and white TV picture tubes, monochrome data graphic display tubes, deflection units

(T13, T14, T15:) Data collations on these subjects are available now.
Data Handbooks will be published in 1985.

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

S1 Diodes
Small-signal silicon diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2a Power diodes

S2b Thyristors and triacs

S3 Small-signal transistors

S4a Low-frequency power transistors and hybrid modules

S4b High-voltage and switching power transistors

S5 Field-effect transistors

S6 R.F. power transistors and modules

S7 Surface mounted semiconductors

S8 Devices for optoelectronics
Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices.

S9 Power MOS transistors

S10 Wideband transistors and wideband hybrid IC modules

S11 Microwave transistors

S12 Surface acoustic wave devices

S13 Semiconductor sensors

INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of data handbooks comprises:

EXISTING SERIES		Superseded by:
IC1	**Bipolar ICs for radio and audio equipment**	IC01N
IC2	**Bipolar ICs for video equipment**	IC02Na and IC02Nb
IC3	**ICs for digital systems in radio, audio and video equipment**	IC01N, IC02Na and IC02Nb
IC4	**Digital integrated circuits** CMOS HE4000B family	
IC5	**Digital integrated circuits – ECL** ECL10 000 (GX family), ECL100 000 (HX family), dedicated designs	IC08N
IC6	**Professional analogue integrated circuits**	
IC7	**Signetics bipolar memories**	
IC8	**Signetics analogue circuits**	IC11N
IC9	**Signetics TTL logic**	IC09N and IC15N
IC10	**Signetics Integrated Fuse Logic (IFL)**	IC13N
IC11	**Microprocessors, microcomputers and peripheral circuitry**	IC14N

NEW SERIES

IC01N	**Radio, audio and associated systems** Bipolar, MOS	(published 1985)
IC02Na	**Video and associated systems** Bipolar, MOS Types MAB8031AH to TDA1524A	(published 1985)
IC02Nb	**Video and associated systems** Bipolar, MOS Types TDA2501 to TEA1002	(published 1985)
IC03N	**Integrated circuits for telephony**	(published 1985)
IC04N	**HE4000B logic family** CMOS	
IC05N	**HE4000B logic family – uncased ICs** CMOS	(published 1984)
IC06N*	**High-speed CMOS; PC74HC/HCT/HCU** Logic family	(published 1986)
IC07N	**High-speed CMOS; PC74HC/HCT/HCU – uncased ICs** Logic family	
IC08N	**ECL 10K and 100K logic families**	(published 1984)
IC09N	**TTL logic series**	(published 1984)
IC10N	**Memories** MOS, TTL, ECL	
IC11N	**Linear LSI**	(published 1985)
IC12N	**Semi-custom gate arrays & cell libraries** ISL, ECL, CMOS	
IC13N	**Semi-custom** Integrated Fuse Logic	(published 1985)
IC14N	**Microprocessors, microcontrollers & peripherals** Bipolar, MOS	(published 1985)
IC15N	**FAST TTL logic series**	(published 1984)

Note

Books available in the new series are shown with their date of publication.

* Supersedes the IC06N 1985 edition and the Supplement to IC06N issued Autumn 1985.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

C1 **Programmable controller modules**
PLC modules, PC20 modules

C2 **Television tuners, coaxial aerial input assemblies, surface acoustic wave filters**

C3 **Loudspeakers**

C4 **Ferroxcube potcores, square cores and cross cores**

C5 **Ferroxcube for power, audio/video and accelerators**

C6 **Synchronous motors and gearboxes**

C7 **Variable capacitors**

C8 **Variable mains transformers**

C9 **Piezoelectric quartz devices**

C10 **Connectors**

C11 **Varistors, thermistors and sensors**

C12 **Potentiometers, encoders and switches**

C13 **Fixed resistors**

C14 **Electrolytic and solid capacitors**

C15 **Ceramic capacitors**

C16 **Permanent magnet materials**

C17 **Stepping motors and associated electronics**

C18 **Direct current motors**

C19 **Piezoelectric ceramics**

C20 **Wire-wound components for TVs and monitors**

C21* **Assemblies for industrial use**
HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices

C22 **Film capacitors**

* To be issued shortly.

GENERAL

MICROWAVE SEMICONDUCTORS
GENERAL EXPLANATORY NOTES

TYPE NOMENCLATURE

Microwave semiconductor devices are registered with Pro-Electron.
The type nomenclature of a discrete device or, in certain cases, of a range of devices, consists of three letters followed by a serial number. The serial number normally consists of two figures, but a suffix letter is added where variants or a series occur.

The first letter indicates the semiconductor material used:

A – germanium

B – silicon

C – compound materials, such as gallium arsenide

The second letter indicates the general function of the device:

A – detection diode, mixer diode

E – backward diode

F – r.f. transistor

L – power r.f. transistor

X – multiplier diode such as varactor or step recovery diode

The third letter forms part of the serial number.

A suffix letter R after the complete type number denotes the reverse polarity version of a diode (body cathode) where applicable. A normal polarity version (body anode) has no suffix letter.

Subscripts for quantity symbols

A, a anode terminal

BR breakdown

F, f forward

I, i input

J, j junction

K, k cathode

O, o open-circuit, output

R, r resistive, reverse, repetitive

S, s series, source

Z, z impedance

ELECTRICAL PARAMETERS

	Device	Associated circuit
Resistance	r	R
Reactance	x	X
Impedance	z	Z
Admittance	y	Y
Conductance	g	G
Susceptance	b	B
Mututal inductance	m	M
Inductance	l	L
Capacitance	c	C
Frequency limits	f max. f min.	
Bandwidth	Δf	B
Noise factor		N

Symbols for microwave semiconductor devices

η	efficiency
B	bandwidth
C_d	diode capacitance
C_j	junction capacitance
C_{min}	diode capacitance at breakdown voltage
C_o	diode capacitance at zero bias
C_p	parasitic (parallel) capacitance
C_s	stray capacitance
C_{tot}	total capacitance
f	operating frequency
f_{co}	varactor diode cut-off frequency
I	current
I_{dc}	bias current
i.f.	intermediate frequency
I_F	d.c. foward current
I_{FM}	peak forward current
I_R	continuous (d.c.) reverse leakage current
L_c	conversion loss
L_s	series inductance
M	figure of merit
N_f	flicker noise
N_{if}	noise figure at intermediate frequency

N_o	overall noise figure
N_r	noise temperature ratio
P_{in}	input r.f. power
P_{out}	output r.f. power
P_{tot}	total power dissipated within the device
R_L	r.f. load resistance
R_s	spreading resistance
R_{th}	thermal resistance
S_i	current sensitivity
S_{ts}	tangential sensitivity
T_{amb}	ambient temperature
T_{case}	case temperature
T_{hs}	heatsink temperature at device interface with device
T_j	junction temperature
T_{stg}	storage temperature
t_p	pulse duration
t_s	storage time
t_{tr}	transition time
V	voltage
V_{BR}	breakdown voltage
$V_{(BR)R}$	reverse breakdown voltage
V_F	d.c. forward voltage
V_R	d.c. reverse voltage
v.s.w.r.	voltage standing wave ratio
Z_{if}	intermediate frequency impedance
Z_{rf}	radio frequency impedance
Z_v	video impedance
$1/f$	flicker noise

RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note
This definition excludes inductors, capacitors, resistors and similar components.

Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note
Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note
The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

GUNN, IMPATT AND NOISE DIODES

SILICON AVALANCHE NOISE DIODE

Epitaxial, silicon planar, broadband noise generator. This is a current controlled device operated at avalanche breakdown and is effective from less than 10 Hz to above J-band. Applications include built-in test equipment (BITE) for surveillance, tracking and weather radars, microwave links, direction finding, p.c.m. systems and noise modulators for electronic countermeasures.
It conforms to the environmental requirements of BS9300 where applicable and can be supplied to NATO stock No. 5691-99-038-3893.

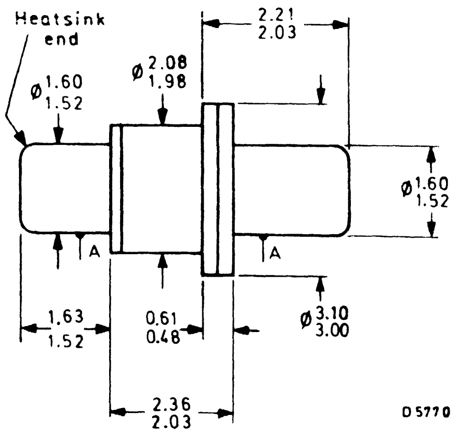
QUICK REFERENCE DATA

Frequency range		$<$10 Hz to $>$18	GHz
Avalanche voltage	min.	17	V
	max.	22	V
Recommended operating current range		0.5 to 40	mA
Broadband excess noise ratio (figs. 1 and 3)	typ.	34	dB

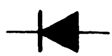
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13



Normal operation with reverse bias, i.e. heatsink end positive.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Mounting base temperature	T_{mb}	max.	80	°C
Reverse current	I_R	max.	40	mA
Total power dissipation	P_{tot}	max.	1.0	W

CHARACTERISTICS (T_{mb} = 25 °C)

Broadband excess noise ratio (figs. 1 and 3)		typ.	34	dB
Reverse breakdown voltage at I_R = 5 mA	$V_{BR(R)}$	min.	17	V
Junction capacitance at V_R = 6 V, f = 1 MHz	C_j	min.	0.4	pF
		max.	0.8	pF
Reverse current at V_R = 6 V	I_R	max.	0.1	μA
Reverse slope resistance at I_R = 40 mA, f = 1 kHz (note 1)	R_{slope}	max.	60	Ω
$\frac{R_1}{R_{40}}$ at I_R = 1 mA and 40 mA, f = 1 kHz (note 1)		max.	2.5	
Stray capacitance	C_s	typ.	0.2	pF
Series inductance	L_s	typ.	650	pH

Notes

1. R_{slope} is the reverse slope resistance and $\frac{R_1}{R_{40}}$ is the ratio of the reverse slope resistance at 1 mA and 40 mA, measured at 1 kHz. This ratio is included in the characteristics to eliminate spurious effects in the noise output/current characteristic.
   The reverse slope resistance consists of the space charge resistance R_{sc}, the spreading resistance R_{sp} and the 'thermal resistance' R_{th}, i.e.

   $$R_{slope} = R_{sc} + R_{sp} + R_{th}$$

   where: R_{sc} is approximately 10 Ω at 10 to 40 mA and 19 Ω at 1 mA

   R_{sp} is approximately 1 Ω

   R_{th} is the effective resistance due to isothermal heating in the device when operated with an infinite heatsink. Above 10 MHz, R_{th} may be neglected.

2. The location of the top cap should be a hole of diameter 1.8 to 2.2 mm, bearing on flange with a force not exceeding 10 N.

3. Other encapsulations may be made available on request.

APPLICATION INFORMATION

The device, as characterised, is operated in a 50 Ω characteristic impedance measurement system. When used as a noise source in an on-off mode, the device, when off, should appear to be 50 Ω. Since it has a large reflection coefficient when zero biased or biased just below avalanche breakdown, sufficient attenuation is required to provide a reasonable match to 50 Ω. For the broadest operating frequency range, an attenuator of approximately 14 dB with a v.s.w.r. of <1.2:1 is recommended. This will reduce the available excess noise by 14 dB. Higher excess noise may be obtained, but over a reduced operating frequency range, in a balanced configuration with low noise directional couplers (e.g. a 3 dB quadrature coupler), or fed into a broadband ferrite isolator (or terminated circulator) which would reduce the available excess noise by approximately 1 dB.

Temperature and excess noise relationship

Excess noise dB	Noise temperature °K	1 Hz bandwidth dBm	1 MHz bandwidth dBm
+100	2.9×10^{12}	−74	−14
+90	2.9×10^{11}	−84	−24
+80	2.9×10^{10}	−94	−34
+70	2.9×10^{9}	−104	−44
+60	2.9×10^{8}	−114	−54
+50	2.9×10^{7}	−124	−64
+40	2.9×10^{6}	−134	−74
+30	2.9×10^{5}	−144	−84
+20	2.9×10^{4}	−154	−94
+10	2.9×10^{3}	−164	−104
0	2.9×10^{2}	−174	−114

The device may be pulse operated with a rise time of <<0.5 μs

The device should be operated from a constant current source, however, good results may be achieved using a 28 V supply and typically a metal film or wirewound 1.6 kΩ resistor in series with the noise diode, with suitable power supply decoupling.

In some applications, current profiling with time may be useful, i.e. linear excess noise ratio as a function of log bias current as shown in fig.1. This may be used for receiver sensitivity measurement on a P.P.I. display.

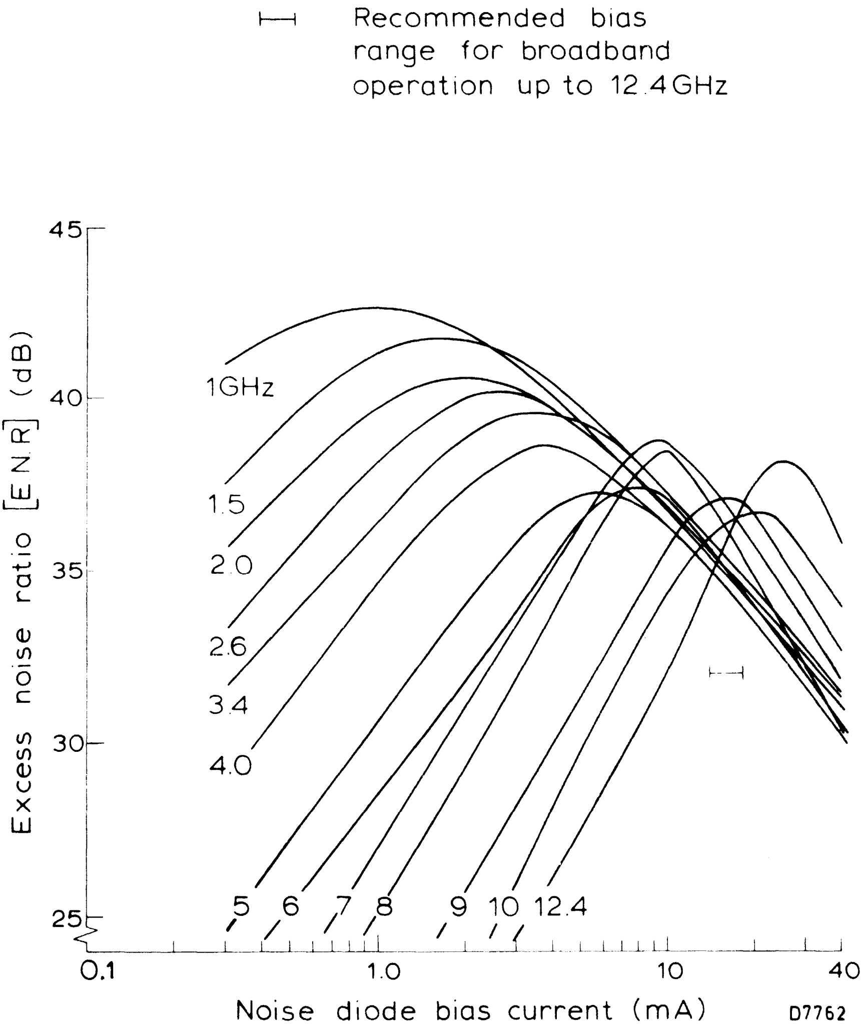


Fig.1

Typical excess noise ratio as a function of avalanche current with frequency as a parameter.
Device mounted in a 50 Ω 7 mm coaxial line as shown in Fig.2

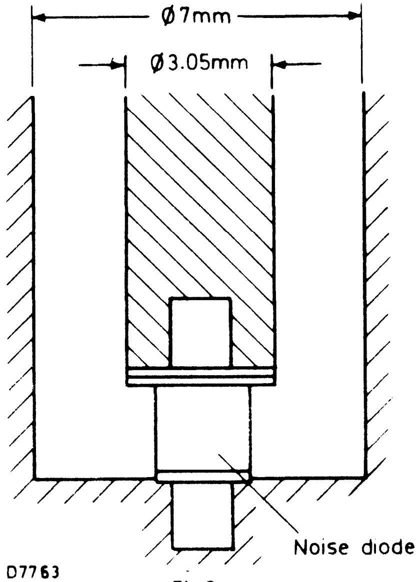


Fig.2

Device mounted in a 50 Ω 7 mm coaxial line

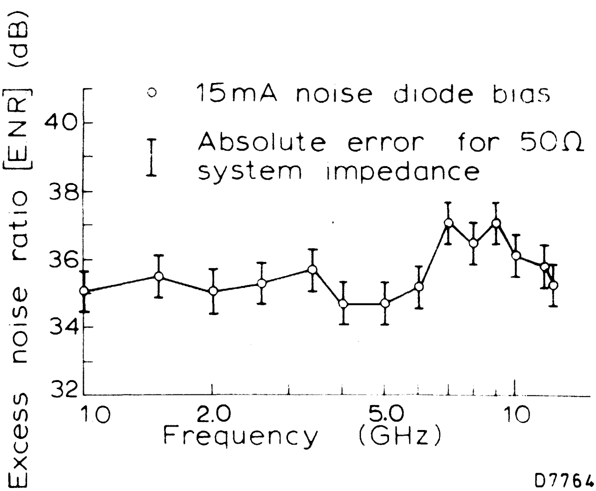


Fig.3

Typical broadband noise performance for an avalanche current of 15 mA
with device mounted as shown in Fig.2

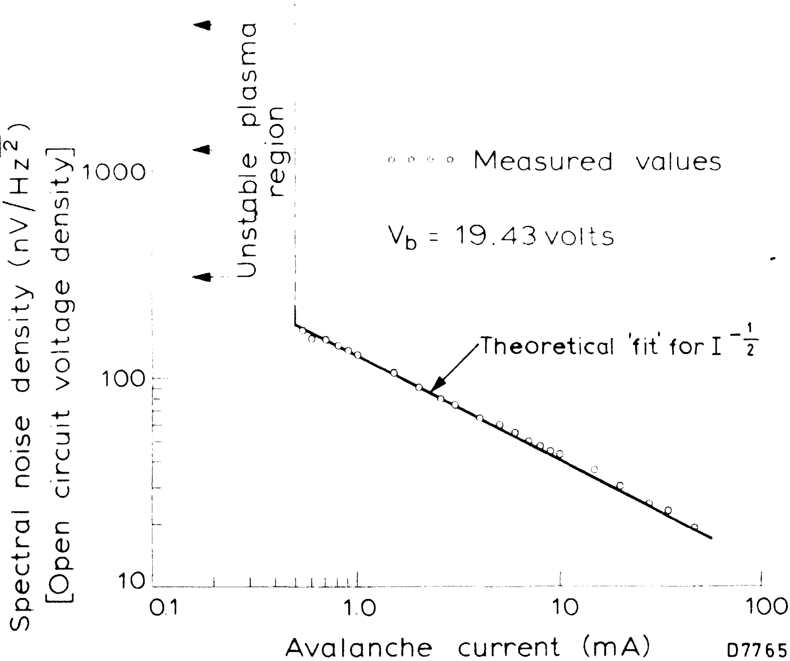


Fig.4

Typical broadband noise density measured over a 1 kHz to 10 kHz bandwidth.

SILICON IMPATT DIODE

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

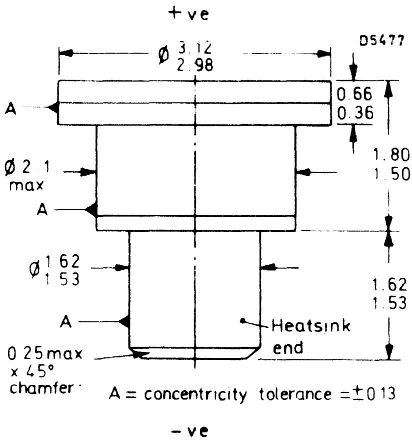
Operating frequency	f		8.0 to 10	GHz
Output power, T_{hs} = 35 °C	P_{out}	typ.	600	mW
Operating current		typ.	135	mA
Operating voltage		typ.	91	V

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Confroms to SOD-45



Devices may be selected to suit customers' specific requirements

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	°C
Junction to heatsink temperature diff.	$T_j - T_{hs}$	max.	165	°C
Total power dissipation (note 1)	P_{tot}	max.	$\frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}$	W

THERMAL RESISTANCE

Thermal resistance from junction to heatsink	$R_{th\ j\text{-}hs}$	max.	15	°C/W

CHARACTERISTICS (T_{hs} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	65	75	85	V
Reverse current V_R = 50 V	I_R	–	–	10	μA
Total capacitance $V_{(BR)R}$ = −5 V	C_T	–	0.9	–	pF

TYPICAL OSCILLATOR PERFORMANCE

		min.	typ.	max.	
Operating current (note 2)		–	135	–	mA
Operating voltage		–	91	–	V
Frequency (note 3)	f	8.0	–	10	GHz
Output power (notes 2, 4, 5 and 6)	P_{out}	500	600	–	mW
Efficiency	η	–	5.0	–	%

Notes

1. The maximum junction temperature is 200 °C, therefore care must be taken to ensure that

$$P_{tot}\ \text{max.} \leqslant \frac{200 - T_{hs}}{R_{th\ j\text{-}hs}} \quad \text{W},$$

where $P_{tot} = P_{in} - P_{out}$
T_{hs} = temperature of heatsink at interface with device
$R_{th\ j\text{-}hs}$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 115 V and 160 mA

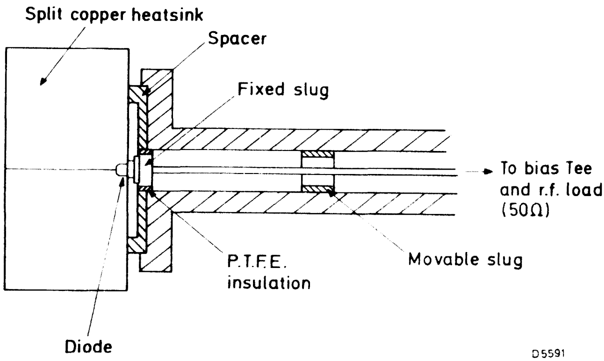
3. The frequency is governed by the choice of cavity to which the device is coupled.

4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

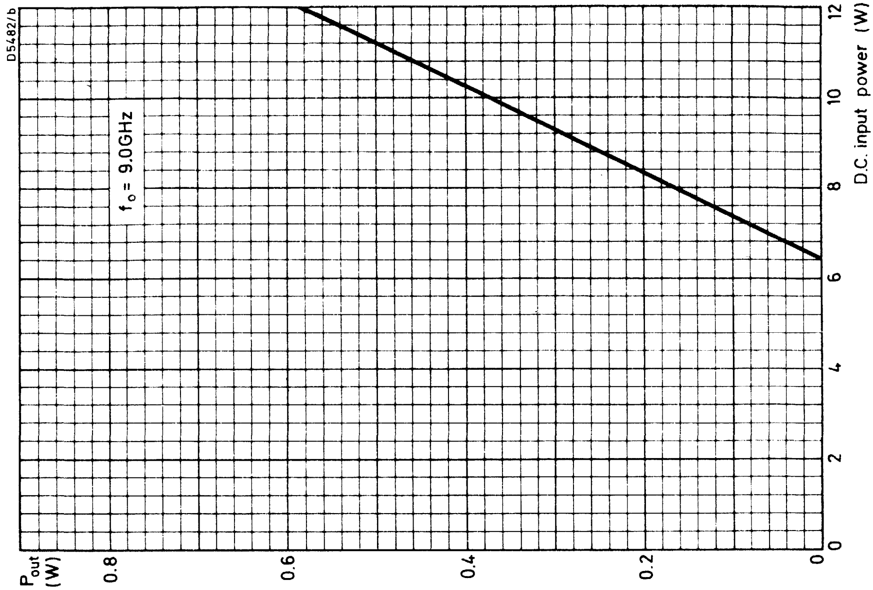
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.

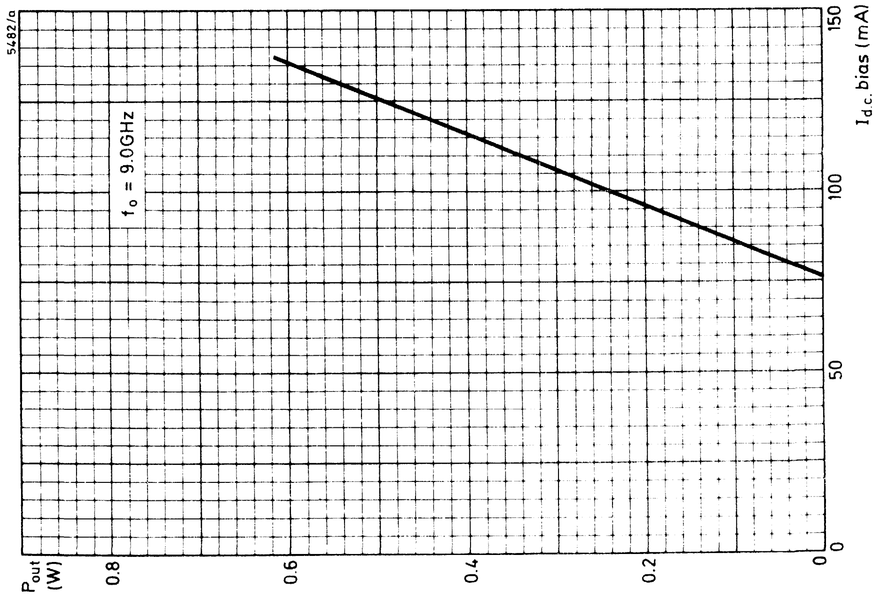
7. This device may be used as a negative resistance amplifier.



Coaxial test oscillator cavity



Typical output power as a function of d.c. input power



Typical output power as a function of bias current

SILICON IMPATT DIODE

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

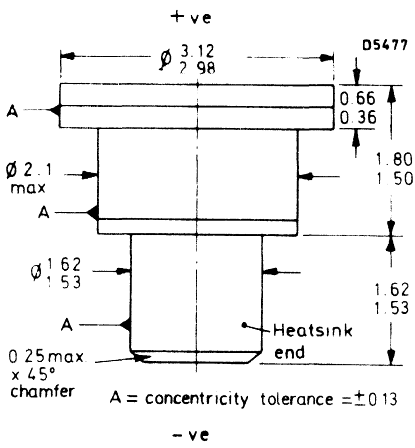
Operating frequency	f		10 to 12	GHz
Output power, T_{hs} = 35 °C	P_{out}	typ.	450	mW
Operating current		typ.	120	mA
Operating voltage		typ.	80	V

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	°C
Junction to heatsink temperature diff.	$T_j - T_{hs}$	max.	165	°C
Total power dissipation (note 1)	P_{tot}	max.	$\frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}$	W

THERMAL RESISTANCE

Thermal resistance from junction to heatsink	$R_{th\ j\text{-}hs}$	max.	19	°C/W

CHARACTERISTICS (T_{hs} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	55	65	75	V
Reverse current V_R = 45 V	I_R	–	–	10	μA
Total capacitance $V_{(BR)R}$ = −5 V	C_T	–	0.85	–	pF

TYPICAL OSCILLATOR PERFORMANCE

Operating current (note 2)		–	120	–	mA
Operating voltage		–	80	–	V
Frequency (note 3)	f	10	–	12	GHz
Output power (notes 2,4,5 and 6)	P_{out}	400	450	–	mW
Efficiency	η	–	5.0	–	%

Notes

1. The maximum junction temperature is 200 °C, therefore care must be taken to ensure that

$$P_{tot}\ \text{max.} \leqslant \frac{200 - T_{hs}}{R_{th\cdot j\text{-}hs}}\ \text{W},$$

where $P_{tot} = P_{in} - P_{out}$
T_{hs} = temperature of heatsink at interface with device
$R_{th\ j\text{-}hs}$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 105 V and 170 mA

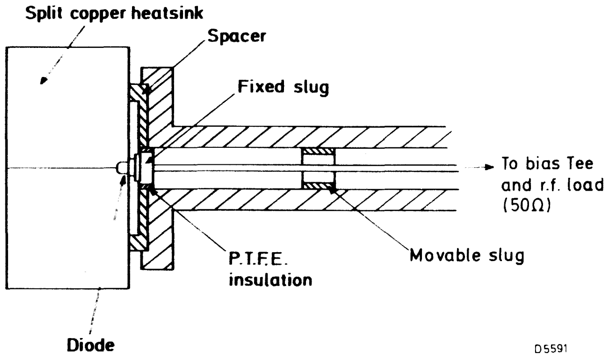
3. The frequency is governed by the choice of cavity to which the device is coupled.

4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

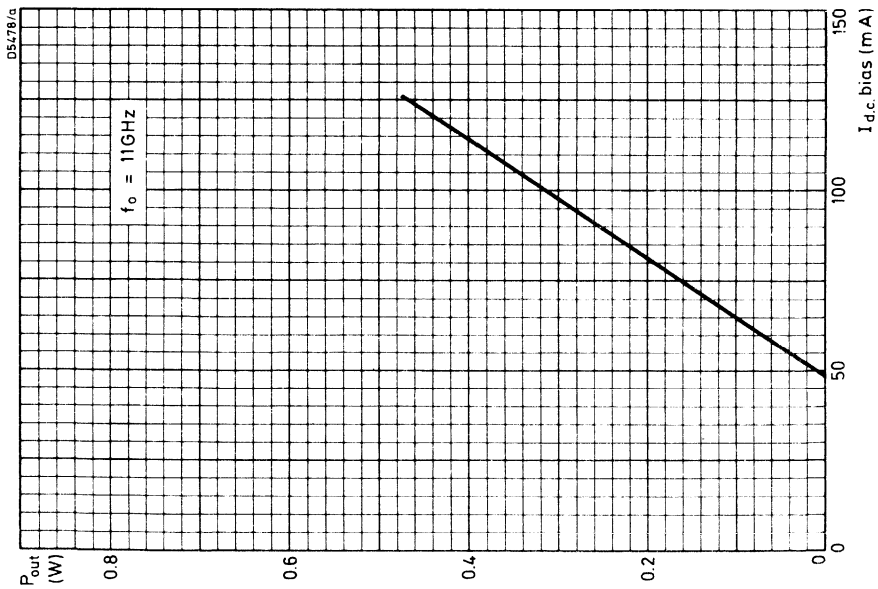
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.

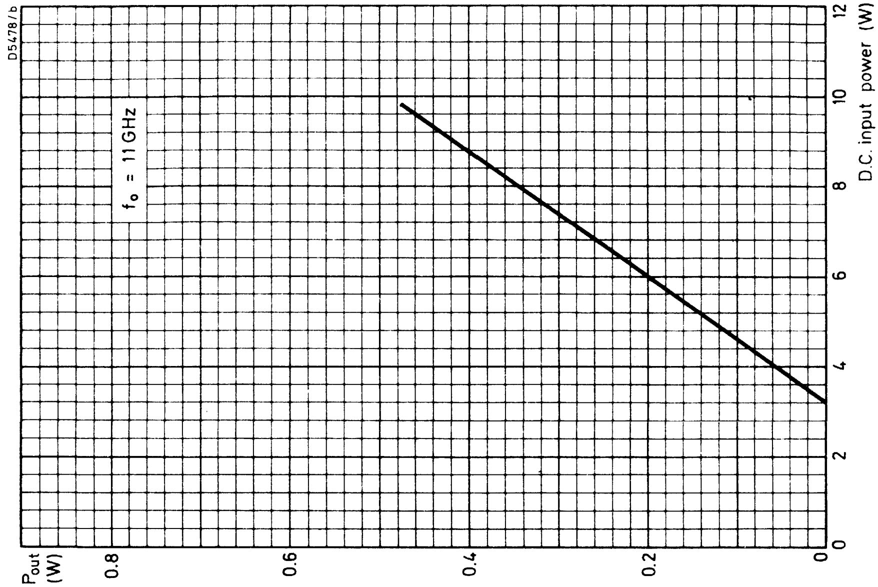
7. This device may be used as a negative resistance amplifier.



Coaxial test oscillator cavity



Typical output power as a function of bias current



Typical output power as a function of d.c. input power

SILICON IMPATT DIODE

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

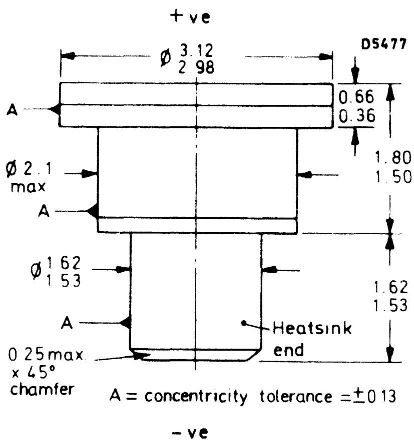
Operating frequency	f		12 to 14	GHz
Output power, T_{hs} = 35 °C	P_{out}	typ.	370	mW
Operating current		typ.	120	mA
Operating voltage		typ.	70	V

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	^oC
Junction to heatsink temperature diff.	$T_j - T_{hs}$	max.	165	^oC
Total power dissipation (note 1)	P_{tot}	max.	$\frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}$	W

THERMAL RESISTANCE

Thermal resistance from junction to heatsink	$R_{th\ j\text{-}hs}$	max.	24	$^oC/W$

CHARACTERISTICS (T_{hs} = 25 ^oC)

		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	50	55	60	V
Reverse current V_R = 40 V	I_R	–	–	10	μA
Total capacitance $V_{(BR)R}$ = −5 V	C_T	–	0.75	-	pF

TYPICAL OSCILLATOR PERFORMANCE

		min.	typ.	max.	
Operating current (note 2)		–	120	–	mA
Operating voltage		–	70	–	V
Frequency (note 3)	f	12	–	14	GHz
Output power (notes 2, 4, 5 and 6)	P_{out}	300	370	–	mW
Efficiency	η	–	4.5	–	%

Notes

1. The maximum junction temperature is 200 ^oC, therefore care must be taken to ensure that

   $$P_{tot}\ \text{max.} \leqslant \frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}\ \text{W},$$

   where $P_{tot} = P_{in} - P_{out}$

   T_{hs} = temperature of heatsink at interface with device

   $R_{th\ j\text{-}hs}$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 90 V and 150 mA

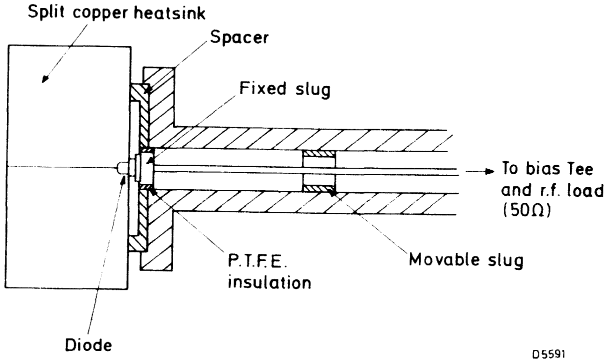
3. The frequency is governed by the choice of cavity to which the device is coupled.

4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

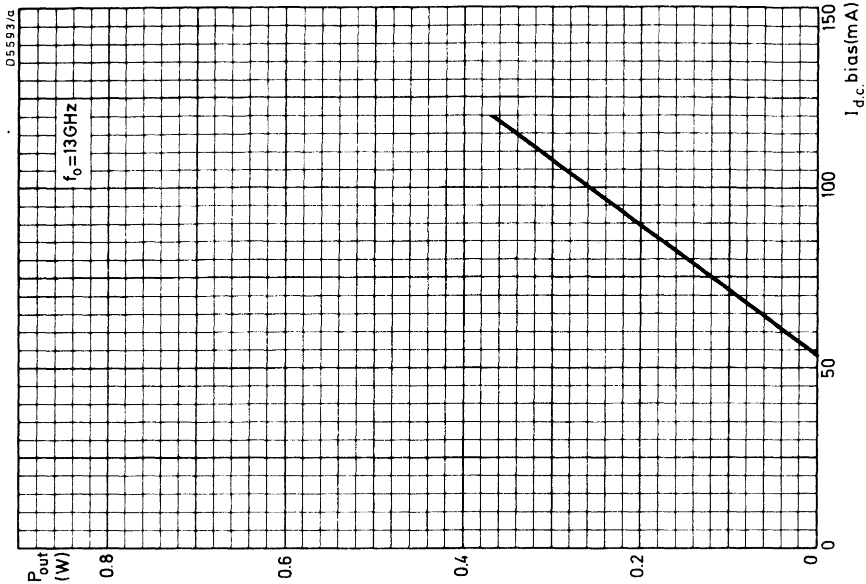
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.

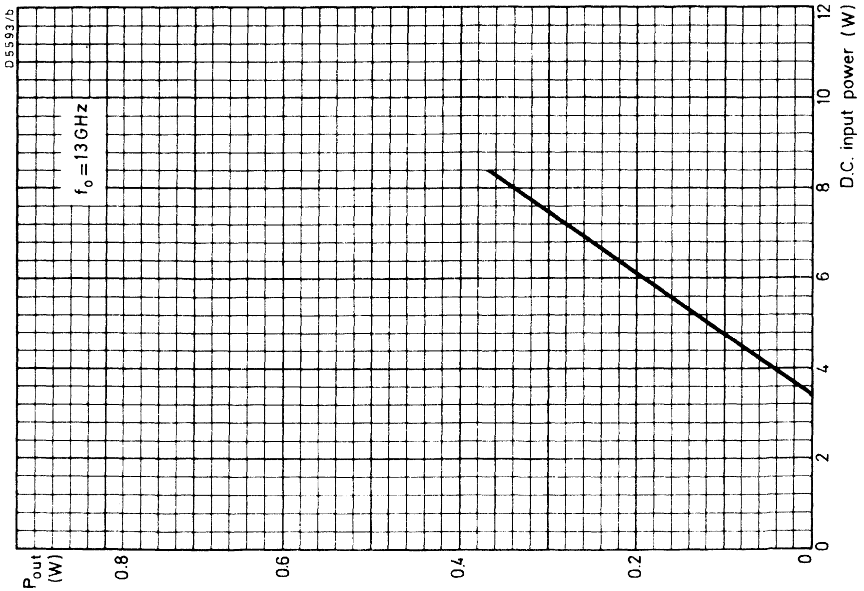
7. This device may be used as a negative resistance amplifier.



Coaxial test oscillator cavity



Typical output power as a function of d.c. input power



Typical output power as a function of bias current

SILICON IMPATT DIODE

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

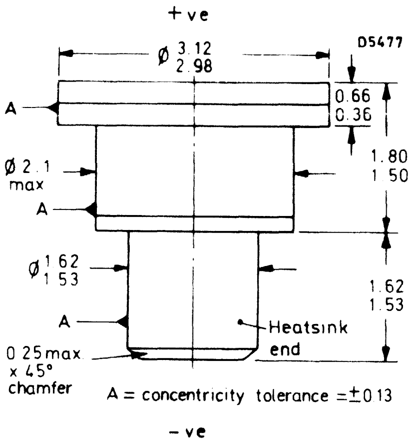
Operating frequency			6.0 to 8.0	GHz
Output power, T_{hs} = 35 °C	P_{out}	typ.	750	mW
Operating current		typ.	125	mA
Operating voltage		typ.	120	V

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	200	°C
Junction to heatsink temperature diff.	$T_j - T_{hs}$		165	°C
Total power dissipation (note 1)	P_{tot}	max.	$\frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}$	W

THERMAL RESISTANCE

Thermal resistance from junction to heatsink	$R_{th\ j\text{-}hs}$	max.	14	°C/W

CHARACTERISTICS (T_{hs} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	85	100	115	V
Reverse current V_R = 70 V	I_R	–	–	10	μA
Total capacitance $V_{(BR)R}$ = 75 V	C_T	–	0.97	–	pF

TYPICAL OSCILLATOR PERFORMANCE

Operating current (note 2)		–	125	–	mA
Operating voltage		–	120	—	V
Frequency (note 3)	f	6.0	–	8.0	GHz
Output power (notes 2, 4, 5 and 6)	P_{out}	650	750	–	mW
Efficiency	η	–	5.0	–	%

Notes

1. The maximum junction temperature is 200 °C, therefore care must be taken to ensure that

   $$P_{tot}\ \text{max.} \leqslant \frac{200 - T_{hs}}{R_{th\ j\text{-}hs}}\ \text{W},$$

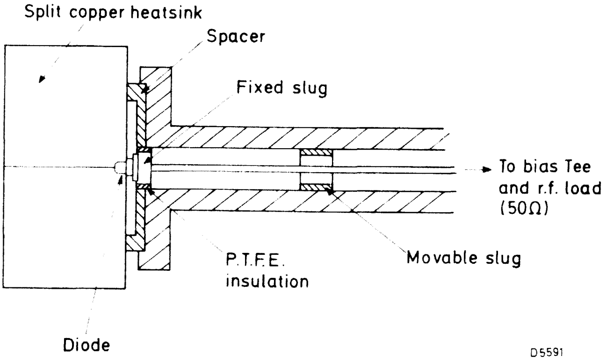
   where $P_{tot} = P_{in} - P_{out}$

   T_{hs} = temperature of heatsink at interface with device

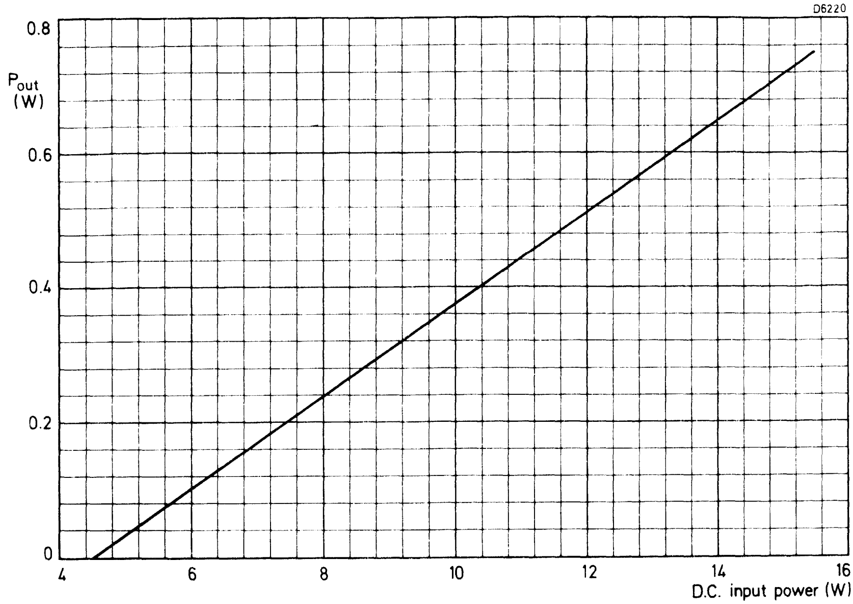
   $R_{th\ j\text{-}hs}$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 140 V and 180 mA.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

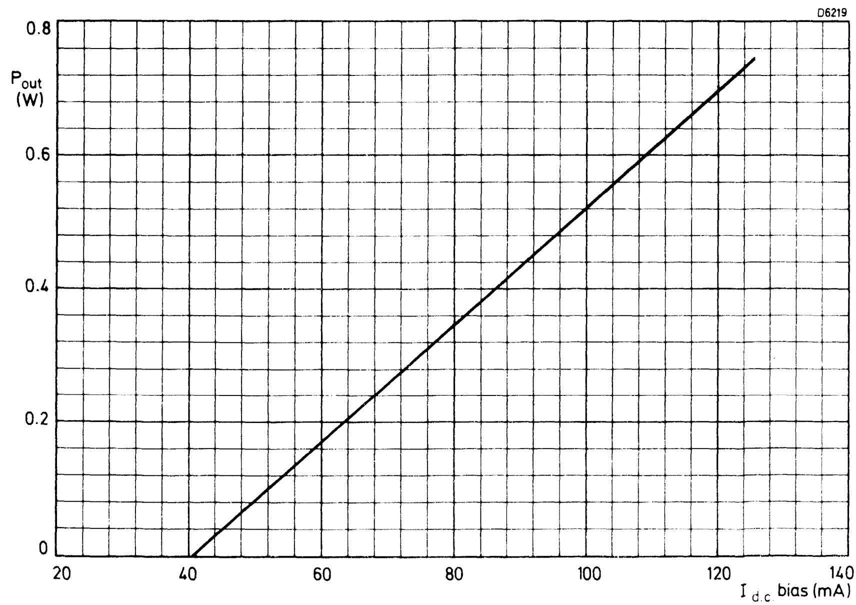
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.



Coaxial test oscillator cavity



Typical output power as a function of d.c. input power



Typical output power as a function of bias current

GUNN EFFECT DEVICES

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating frequency range		f		8.0 to 12	GHz
Operating voltage		V	typ.	7.0	V
Total power dissipation, T_{mb} = 70 °C		P_{tot}	max.	1.0	W
Output power	CXY11A	P_{out}	typ.	8.0	mW
	CXY11B			12	mW
	CXY11C			20	mW

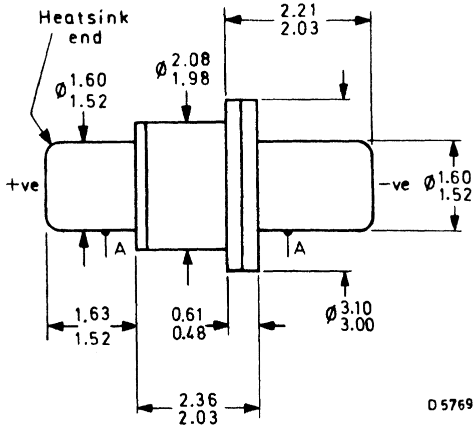
Unless otherwise stated, data is applicable to all types.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Complete oscillators using these devices are available.
Devices may be selected in customers' cavities to suit their specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Mounting base temperature range	T_{mb}		−40 to +70	°C
Operating voltage (note 1)	V	max.	7.5	V
Operating voltage for less than 1 ms	V	max.	9.0	V
Total power dissipation, T_{mb} = 70 °C	P_{tot}	max.	1.0	W

CHARACTERISTICS (T_{amb} = 25 °C)

			min.	typ.	max.	
Bias current, V = 7.0 V (note 1)		I_{dc}	–	120	150	mA
Operating frequency (note 2)		f	8.0	9.5	12	GHz
Output power, V = 7.0 V (note 3)	CXY11A	P_{out}	5.0	8.0	–	mW
	CXY11B		10	12	–	mW
	CXY11C		15	20	–	mW
A.M. noise to output power ratio (note 4)			−90	−100	–	dB

→ **Notes**

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The frequency is governed by the choice of cavity to which the device is coupled.
3. The output power is normally measured in a coaxial cavity at 9.5 GHz. Other centre frequencies may be supplied by suffixing the type number, e.g. CXY11B/10.5 specifies a diode giving 10 mW min. at 10.5 GHz. See table below. A given diode will not necessarily oscillate over the whole 8 to 12 GHz range. The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.
4. A.M. noise is measured in a 1 Hz to 1 kHz bandwidth with the diode mounted in a CL8630 oscillator.
5. It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.
6. To initiate oscillation, the power supply should be low impedance, voltage regulated and capable of supplying approximately 1.5 times the normal current .
7. The negative resistance characteristic of the device can result in parasitic oscillations in the supply leads. It is therefore recommended that a shunt capacitor is fitted close to the supply and earth terminals of the cavity. A typical value is 10 nF.

Minimum output power (mW)	Test frequency (GHz)			
	8.5	9.5	10.5	11.5
5	CXY11A/8.5	CXY11A	CXY11A/10.5	CXY11A/11.5
10	CXY11B/8.5	CXY11B	CXY11B/10.5	CXY11B/11.5
15	CXY11C/8.5	CXY11C	CXY11C/10.5	CXY11C/11.5

GUNN EFFECT DEVICES

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating frequency range		f		12 to 18	GHz
Operating voltage		V	typ.	7.0	V
Total power dissipation, T_{mb} = 70 °C		P_{tot}	max.	1.0	W
Output power	CXY14A	P_{out}	typ.	8.0	mW
	CXY14B			12	mW

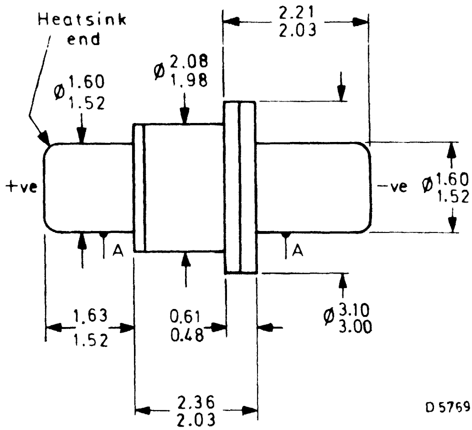
Unless otherwise stated, data is applicable to all types.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Devices may be selected in customers' cavities to suit their specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		–55 to +150	^oC
Mounting base temperature range	T_{mb}		–40 to +70	^oC
Operating voltage	V	max.	7.5	V
Operating voltage for less than 1 ms	V	max.	9.0	V
Total power dissipation, T_{mb} = 70 ^oC	P_{tot}	max.	1.0	W

CHARACTERISTICS (T_{amb} = 25 ^oC)

			min.	typ.	max.	
Bias current, V = 7.0 V (note 1)		I_{dc}	–	120	145	mA
Operating frequency (note 2)		f	12	14	18	GHz
Output power, V = 7.0 V (note 3)	CXY14A	P_{out}	5.0	8.0	–	mW
	CXY14B		10	12	–	mW

→ **Notes**

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The frequency is governed by the choice of cavity to which the device is coupled.
3. The output power is normally measured in a coaxial cavity at approximately 14 GHz. A given diode will not necessarily oscillate over the whole 12 to 18 GHz range. The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.
4. It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.
5. To initiate oscillation the power supply should be low impedance, voltage regulated and capable of supplying approximately 1.5 times the normal current.
6. The negative resistance characteristic of the device can result in parasitic oscillations in the supply leads. It is therefore recommended that a shunt capacitor is fitted close to the supply and earth terminals of the cavity. A typical value is 10 nF.

GUNN EFFECT DEVICES

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environment requirements of BS9300 where applicable.

QUICK REFERENCE DATA

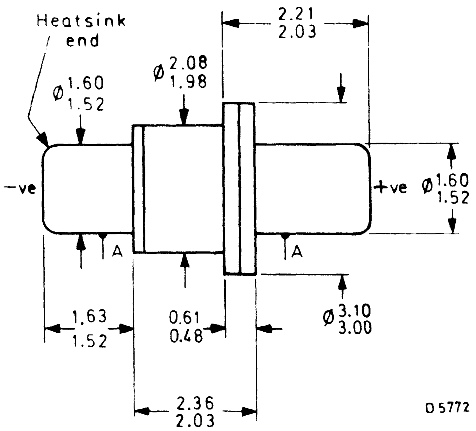
Operating frequency range		f		8.0 to 12	GHz
Operating voltage (note 2)		V		8.0 to 12	V
Total power dissipation, T_{mb} = 70 °C		P_{tot}	max.	6.0	W
Output power, f = 9.5 GHz	CXY19	P_{out}	typ.	150	mW
	CXY19A	P_{out}	typ.	250	mW
	CXY19B	P_{out}	typ.	325	mW

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

All dimensions in mm

Devices may be selected in customers' cavities to suit their specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range		T_{stg}		−55 to +150	°C
Mounting base temperature range		T_{mb}		−40 to +70	°C
Operating voltage (note 1)		V	max.	12	V
Operating voltage for less than 1 ms		V	max.	14	V
Total power dissipation, T_{mb} = 70 °C	CXY19	P_{tot}	max.	6.0	W
	CXY19A	P_{tot}	max.	6.0	W
	CXY19B	P_{tot}	max.	7.5	W

CHARACTERISTICS (T_{amb} = 25 °C)

			min.	typ.	max.	
Bias current (notes 1 and 2)	CXY19	I_{dc}	–	450	750	mA
	CXY19A	I_{dc}	–	450	750	mA
	CXY19B	I_{dc}	–	650	950	mA
Threshold current	CXY19		–	–	1.0	A
	CXY19A		–	–	1.0	A
	CXY19B		–	–	1.2	A
Operating frequency (note 3)		f	8.0	9.5	12	GHz
Output power (note 2)	CXY19	P_{out}	100	150	–	mW
	CXY19A	P_{out}	200	250	–	mW
	CXY19B	P_{out}	300	325	–	mW

Notes

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. Each device is measured for maximum output power at 9.5 GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.
3. The frequency is governed by the choice of cavity to which the device is coupled. A given diode will not necessarily oscillate over the whole 8 to 12 GHz range.
4. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.
5. To initiate oscillation, the power supply should be low impedance, voltage regulated and capable of supplying approximately 1.5 times the normal current.
6. The negative resistance characteristic of the device can result in parasitic oscillations in the supply leads. It is therefore recommended that a shunt capacitor is fitted close to the supply and earth terminals of the cavity. A typical value is 10 nF.

GUNN EFFECT DEVICES

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

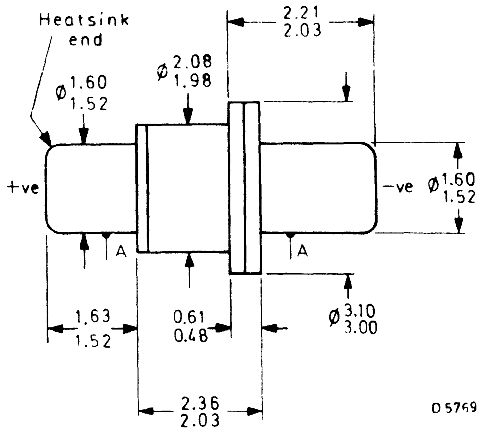
Operating frequency range		f		8.0 to 12	GHz
Operating voltage		V	typ.	8.0	V
Total power dissipation, T_{mb} = 70 °C		P_{tot}	max.	2.5	W
Output power, f = 9.5 GHz	CXY21	P_{out}	typ.	50	mW
	CXY21A	P_{out}	typ.	35	mW

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Devices may be selected in customers' cavities to suit their specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Mounting base temperature range	T_{mb}		−40 to +70	°C
Operating voltage (note 1)	V	max.	10	V
Operating voltage for less than 1 ms	V	max.	12	V
Total power dissipation, T_{mb} = 70 °C	P_{tot}	max.	2.5	W

CHARACTERISTICS (T_{amb} = 25 °C)

			min.	typ.	max.	
Bias current, V = 9.5 V		I_{dc}	–	210	265	mA
Operating frequency (note 2)		f	8.0	–	12	GHz
Output power (note 3)	CXY21	P_{out}	40	50	–	mW
	CXY21A	P_{out}	25	35	–	mW

→ **Notes**

1. The heatsink end is positive. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversal of the polarity will cause permanent damage. Care should be taken to protect the device from transients.
2. The frequency is governed by the choice of cavity to which the device is coupled.
3. The output power is normally measured in a coaxial cavity at 9.5 GHz. A given diode will not necessarily oscillate over the whole 8 to 12 GHz range. The bias may be optimized to give maximum output power within the limits of V max. and P_{tot} max.
4. The heatsink end of the device should be held in a collet or similar clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive silver loaded epoxy, such as Epotek H40, may be used.
5. To initiate oscillation, the power supply should be low impedance, voltage regulated and be capable of supplying 1.5 times the normal current.
6. The negative resistance characteristic of the device can result in parasitic oscillations in the supply leads. It is therefore recommended that a shunt capacitor is fitted close to the supply and earth terminals of the cavity. A typical value is 10 nF.

GUNN EFFECT DEVICES

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. They are encapsulated in metal-ceramic packages suitable for mounting in various types of cavity. The device will oscillate in Q-band (Ka-band), the actual frequency being determined by the type of cavity.

QUICK REFERENCE DATA

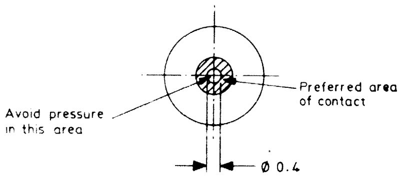
Operating frequency range		f		28 to 40	GHz
Operating voltage		V	typ.	4.0	V
Operating current		I	typ.	0.7	A
Output power, f = 34 GHz	CXY24A	P_{out}	typ.	40	mW
	CXY24B			70	mW

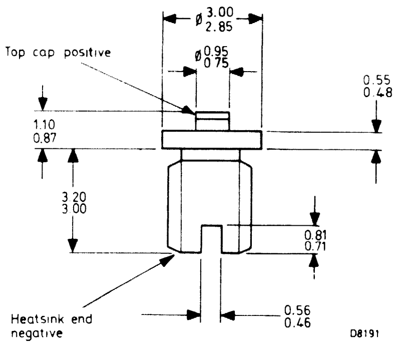
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to MO-75





Devices may be selected to suit customers' specific requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Operational stud temperature (note 1)	T_{stud}	max.	70	°C
Transient supply voltage (note 2)		max.	6.0	V
Continuous supply voltage	V	max.	note 3	
Input power (note 3)	P_{in}	max.	4.0	W

→ CHARACTERISTICS (T_{amb} = 25 °C)

			min.	typ.	max.	
Operating voltage (notes 2 and 3)		V	–	4.0	5.0	V
Operating current (note 4)		I_{dc}	–	0.7	1.1	A
Threshold current			–	–	1.6	A
Operating frequency (notes 5 and 6)		f	28	34	40	GHz
Output power (note 7)	CXY24A	P_{out}	25	40	–	mW
	CXY24B		50	70	–	mW

→ Notes

1. Good thermal conductivity is essential between the heatsink end of the device and the cavity.
2. Bias must be applied in such a way that the heatsink end of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device against transient voltages.
3. Each device is supplied with a maximum supply voltage recommendation for continuous operation, within the limits of operating voltage and input power specified above.
4. The power supply should be low impedance, voltage regulated and capable of supplying current in excess of the threshold current.
5. The frequency is governed by the choice of cavity to which the device is coupled.
6. The negative resistance characteristic of the device can result in parasitic oscillations in the supply leads. It is therefore recommended that shunt capacitors are fitted close to the supply and earth terminals of the cavity. Typical values are 10 nF in parallel with 4.7 μF.
7. Minimum output power is verified in a waveguide cavity at 34 GHz and at a voltage not exceeding the maximum recommended supply voltage (note 2) and at a stud temperature of 25 °C.

MIXER AND DETECTOR DIODES

X-BAND MIXER/DETECTOR DIODE

Silicon Schottky barrier diode in DO-23 outline specially designed for use in Doppler radar systems and intruder alarms where low 1/f noise and high sensitivity are required. May be used for both mixer and detector applications. This device is a direct replacement for the BAV46 and has an all-bonded structure capable of withstanding higher shock levels and wide temperature excursions during operation and storage.

QUICK REFERENCE DATA

Mixer mode

Voltage output for −90 dBm input power at X-band	typ.	40	μV
1/f noise in the bandwidth 1 Hz to 1 kHz from carrier	typ.	1.0	μV

Detector mode

Tangential sensitivity in bandwidth 0 to 2 MHz	typ.	−55	dBm

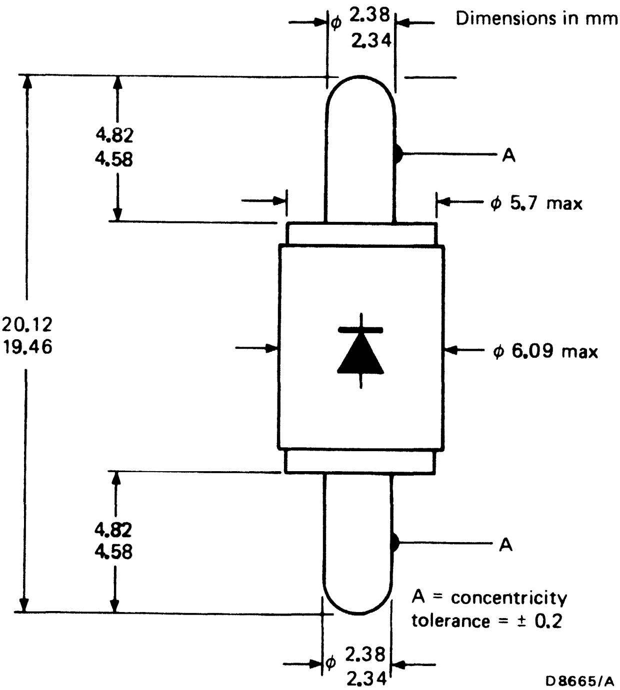
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Conforms to SOD-48

Compatible with JEDEC DO-23

Dimensions in mm



Terminal identification: diode symbol indicates polarity

Accessory: collet type 56321 (see page 4) converts BAS46 to JEDEC DO-22 outline.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Storage temperature range	T_{stg}		−55 to +125	°C
Ambient temperature range for operation	T_{amb}		−55 to +125	°C
Reverse voltage	V_R	max.	2	V
Forward current	I_F	max.	10	mA

CHARACTERISTICS (T_{amb} = 25 °C)

Forward voltage at I_F = 1 mA	V_F	typ.	0.5	V
Reverse current at V_R = 2 V	I_R	max.	2	μA
→ Total capacitance at V_R = 0 V	C_T	typ.	0.3	pF

Mixer mode

Voltage output at X-band (notes 1 and 2)	V_o	min.	15	μV
	V_o	typ.	40	μV
$1/f$ noise (note 3)	N_f	typ.	1.0	μV
	N_f	max.	2.0	μV

Detector mode

Tangential sensitivity (note 4)	S_{ts}	min.	−52	dBm
	S_{ts}	typ.	−55	dBm
Video impedance (note 5)	Z_v	typ.	850	Ω

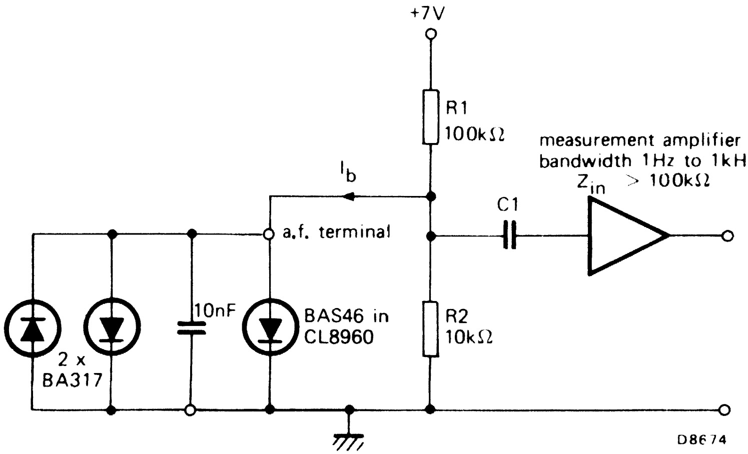
Notes

1. Mixer operated with d.c. bias of 35 μA and r.f. bias of −18 dBm, giving a total bias of 42 μA.
2. Measurement made using CL8960 doppler radar module, output power 10 mW (typ.). The input power to the mixer of −90 dBm is a signal 100 dB down on the output power from a typical CL8960 with $\frac{\text{signal + noise}}{\text{noise}}$ at 18 dB (min.)

   A return signal, 100 dB down on radiated power, is equivalent to that achieved from a man target of radar cross-section 1.0 m^2 at a range of 15 m when operating the CL8960 with a 5 dB antenna.
3. Noise measured in the bandwidth 1 Hz to 1 kHz from carrier with a d.c. bias of 50 μA.
4. Bandwidth 0 to 2 MHz and a forward bias of 50 μA.
5. Measured with a forward bias of 50 μA.

Alternative capacitance versions and packages may be made available to suit customers' specific requirements

Measurement circuit:



N.B. a) The current I_b should be approximately 35 μA with the Gunn device disconnected and approximately 42 μA with the Gunn device operational and the antenna operating into free space, using the mounting recommended in the CL8960 data.

b) The coupling capacitor C_1 should have a small impedance compared with Z_{in}. See measurement circuit above.

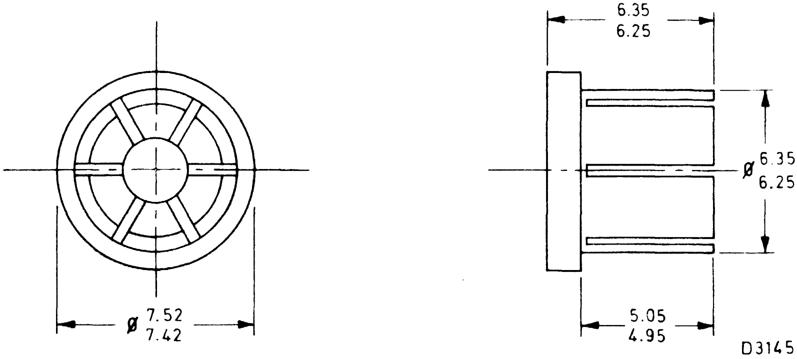
OPERATING PRECAUTIONS

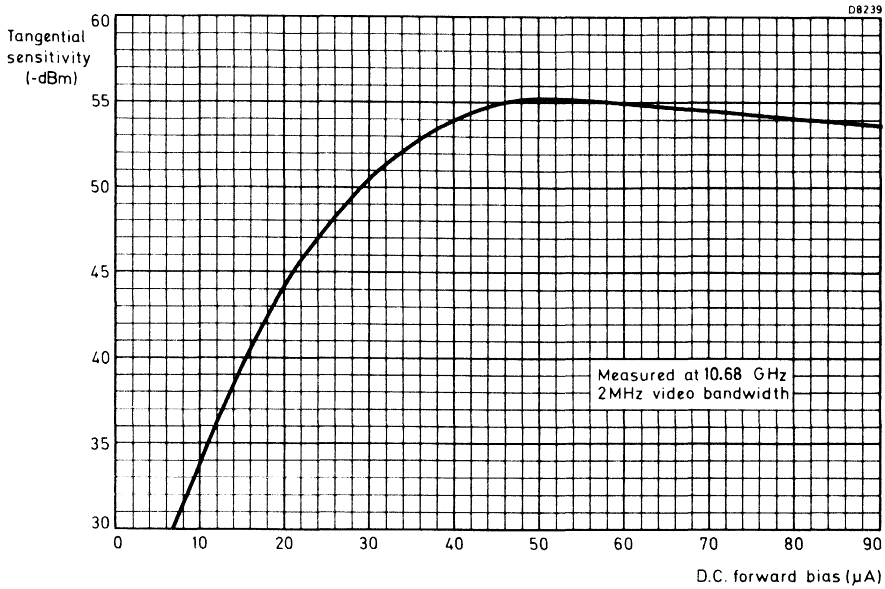
Care must be taken when making measurements that the precautions described in the operating notes are observed and that test equipment does not introduce transients.

1. The diode has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from the mains supply when making soldered connections to the diode.
2. Precautions similar to those required for CMOS devices are necessary namely:
   (a) Earthed wrist straps should be worn.
   (b) Table tops or other working surfaces should be conductive and earthed.
   (c) Anti-static clothing should be worn.
   (d) To prevent the development of damaging transient voltages, the device should not be inserted or removed from the user's circuit with the d.c. power applied.
3. It is recommended that the user incorporates a diode protection circuit. A suitable circuit consists of two BA317 diodes connected in parallel but with one diode reversed, together with a parallel 10 nF capacitor. This circuit should be connected in close proximity to the diode terminals and has been found to afford a suitable degree of protection.
4. A d.c. bias level of at least 30 μA must be maintained to ensure adequate mixer performance.

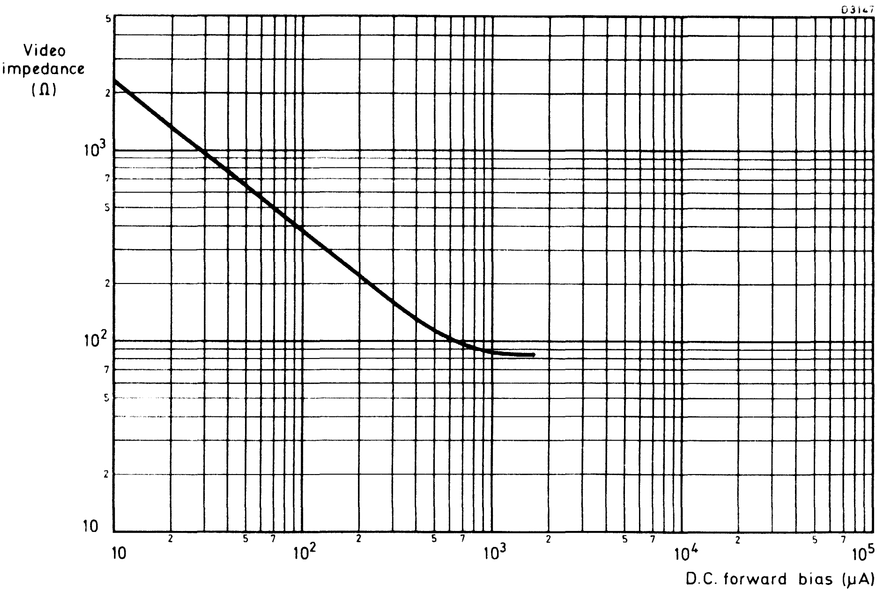
COLLET 56321

Dimensions in mm





Typical tangential sensitivity as a function of d.c. forward bias.



Typical video impedance as a function of d.c. forward bias

MICROWAVE MIXER/DETECTOR DIODE

Silicon Schottky barrier diode for use as a low level detector or as a low noise mixer at microwave frequencies. The diode is plastic encapsulated with ribbon leads suitable for mounting in stripline circuitry and conforms to the environmental requirements of BS9300 where applicable. Available as a matched pair 2/BAT10 M.

QUICK REFERENCE DATA

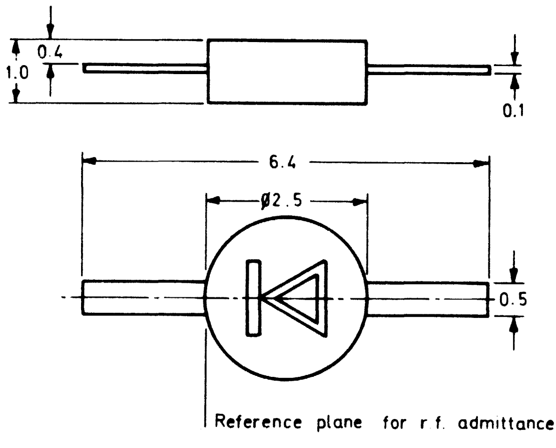
Frequency range		1 to 12	GHz
Mixer:			
Noise figure in X-band	typ.	7.0	dB
Detector:			
Tangential sensitivity in X-band with 100 μA bias	typ.	−50	dBm
Current sensitivity in X-band with 50 μA bias	typ	5.0	μA/μW

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to MO-28



D3108

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range		−55 to +150	°C
Ambient temperature range		−55 to +150	°C
Peak pulsed r.f. input power at 9.375 GHz, 0.5 μs pulse length	max.	1.0	W
Burn out (multiple r.f. spike, ΔN_O = 1 dB)	max.	20 0.2	nJ erg

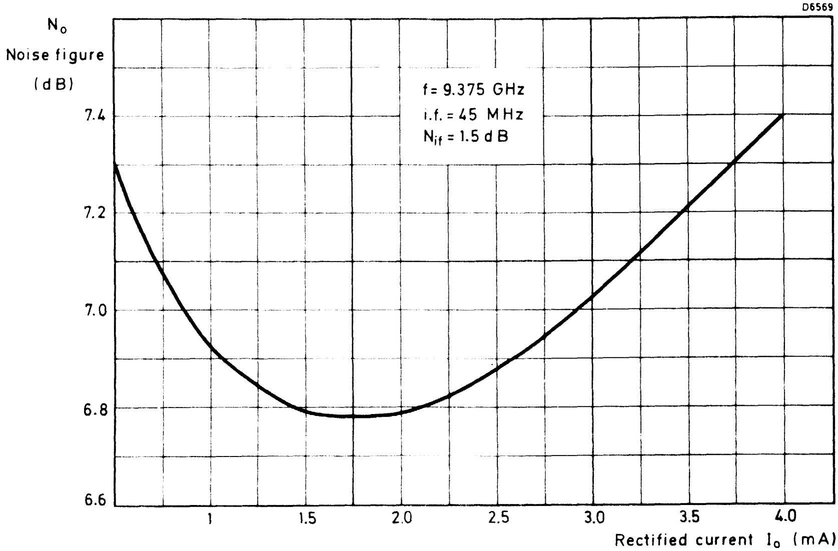
CHARACTERISTICS (T_{amb} = 25 °C)

Mixer		typ.	max.	
Noise figure (note 1)	N_O	7.0	7.5	dB
Voltage standing wave ratio (note 2)	v.s.w.r.	–	2:1	
Intermediate frequency impedance (note 3)	Z_{if}	–	500	Ω

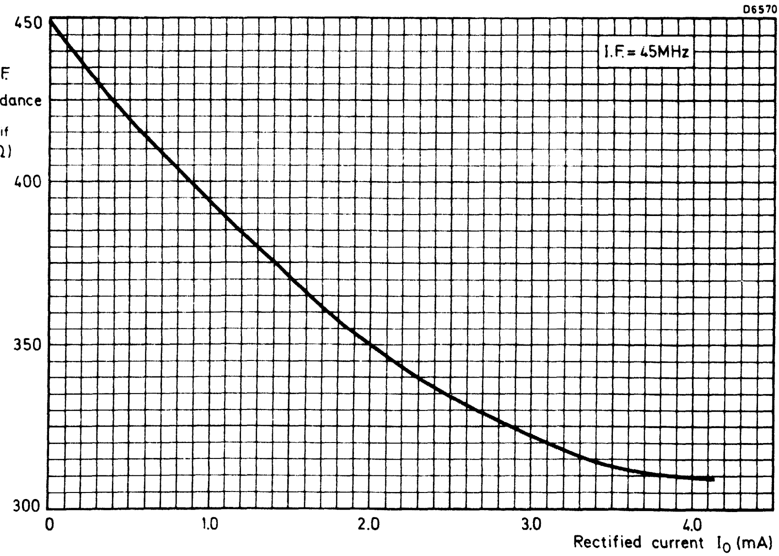
Detector				
Tangential sensitivity (note 4)	S_{ts}	−50	–	dBm
Current sensitivity (note 5)	S_i	5.0	–	μA/μW
Voltage standing wave ratio (note 6)	v.s.w.r.	–	5:1	
Video impedance (note 7)	Z_v	600	–	Ω
Noise	1/f	12	17	dB

Notes

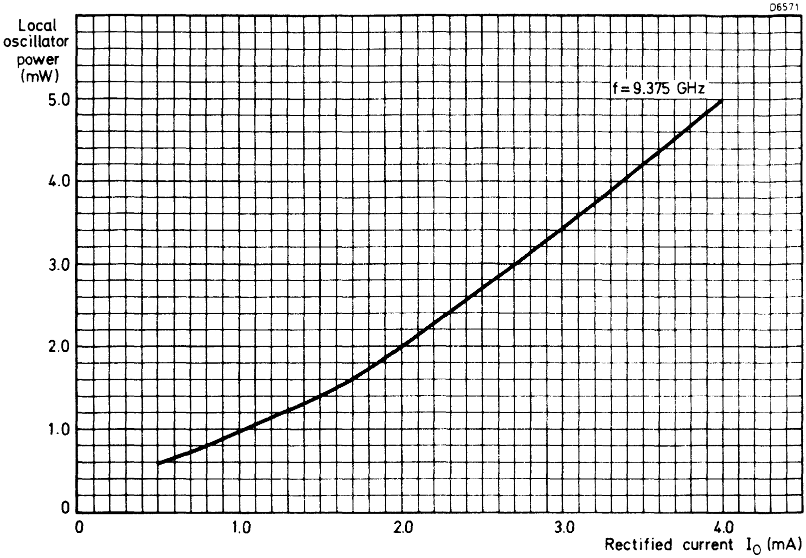
1. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω, i.f. = 45 MHz and i.f. noise figure = 1.5 dB. BS9300.
2. Measured with respect to 50 Ω at f = 9.375 GHz, rectified current = 2.0 mA and load resistance = 10 Ω. BS9300.
3. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω and i.f. = 45 MHz. BS9300.
4. Measured at f = 9.375 GHz with 2.0 MHz bandwidth and 100 μA bias.
5. Measured at f = 9.375 GHz at an input power of 1.0 μW and 50 μA bias.
6. Measured with respect to 50 Ω at f = 9.375 GHz, 100 μA bias and c.w. input less than 2.0 μW. BS9300.
7. D.C. measurement with 1.0 mV max. and 50 μA bias.
8. Other encapsulations may be made available on request.
9. Matched pairs of diodes are available to customer specifications.



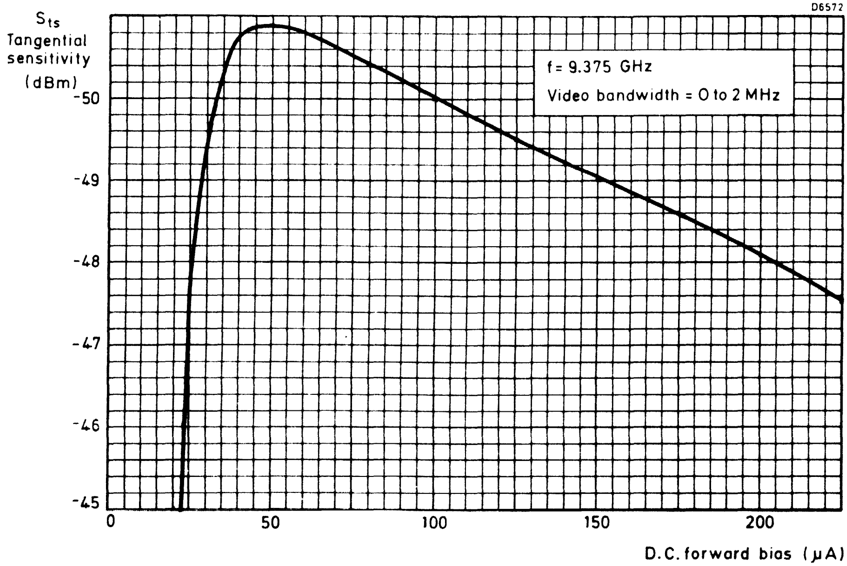
Typical noise figure as a function of rectified current (as a mixer)



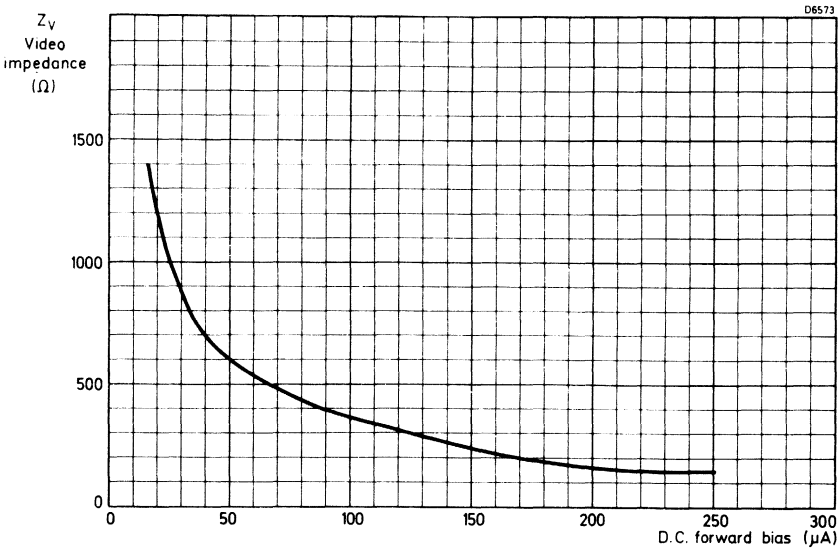
Typical i.f. impedance as a function of rectified current (as a mixer)



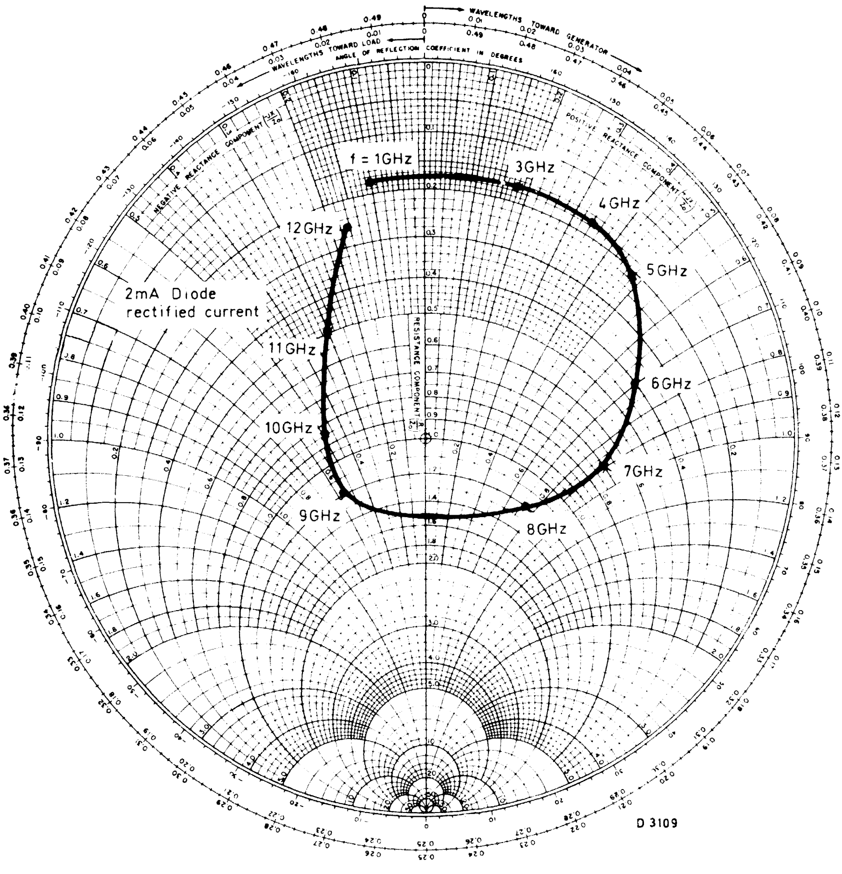
Typical local oscillator power as a function of rectified current (as a mixer)



Typical tangential sensitivity as a function of d.c. forward bias current (as a detector)



Typical video impedance as a function of d.c. forward bias current (as a detector)



Typical admittance as a function of frequency

MICROWAVE MIXER DIODE

Silicon Schottky barrier low noise mixer diode mounted in a L.I.D. type envelope. Primarily intended for hybrid integrated circuit applications in X-band. It conforms to the environmental requirements of BS9300 where applicable. Available as a matched pair 2/BAT11M.

QUICK REFERENCE DATA

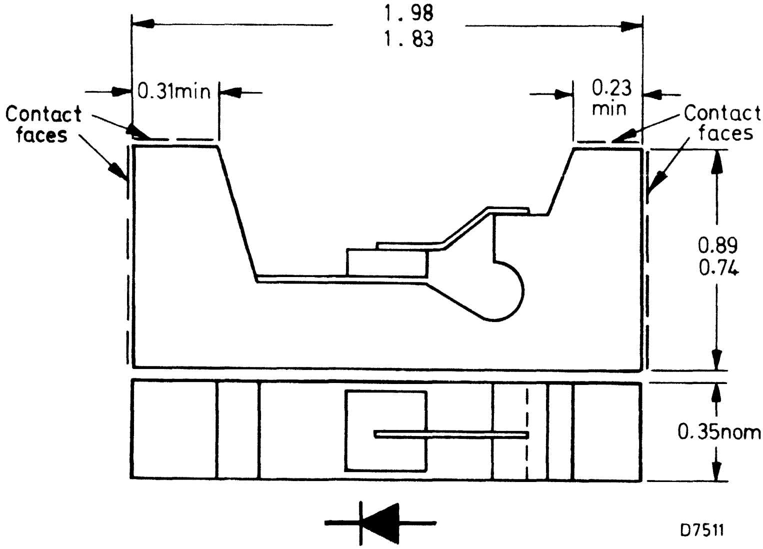
Frequency range		up to 12	GHz
Noise figure in X-band	typ.	6.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to MO-27



D7511

Contact faces are gold plated, 5 μm over 1.27 μm of nickel.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

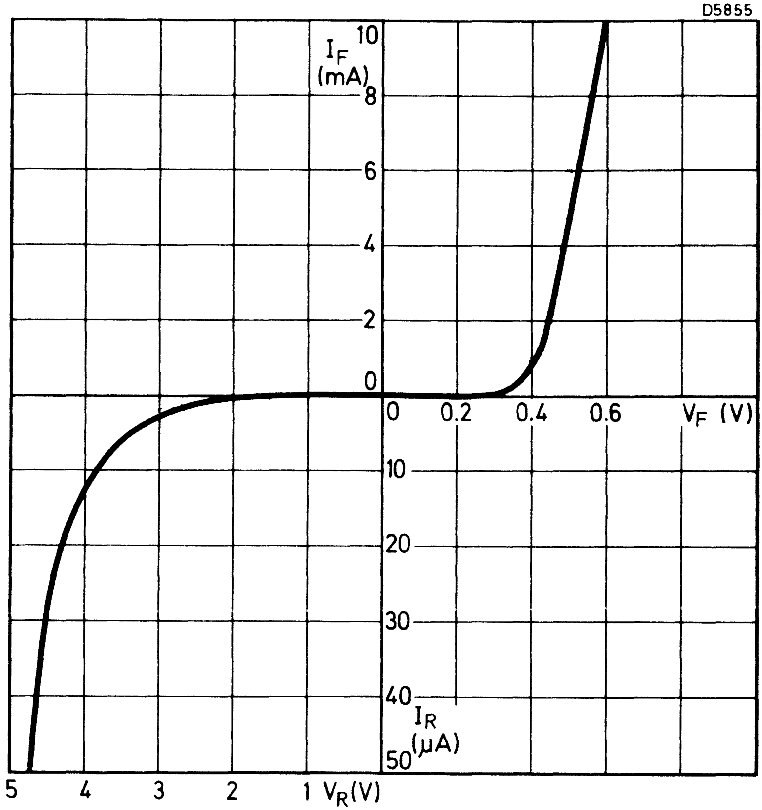
Storage temperature range	T_{stg}		−55 to +150	°C
Ambient temperature range	T_{amb}		−55 to +150	°C
Burn-out (r.f. spike)		max.	20	nJ
			0.2	erg
Burn-out (multiple d.c. spike)		max.	30	nJ

CHARACTERISTICS (T_{amb} = 25 °C)

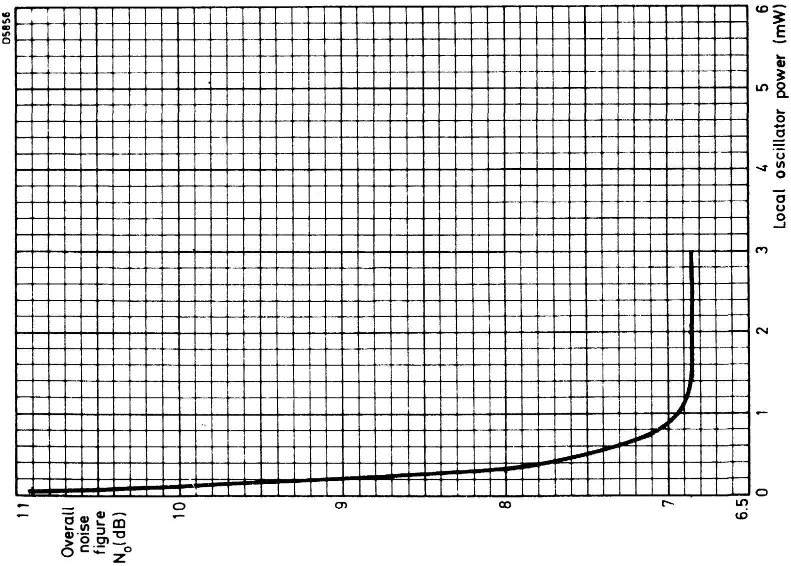
		min.	typ.	max.	
Dynamic					
Noise figure (note 1)	N_o	–	6.5	7.0	dB
Voltage standing wave ratio	v.s.w.r.	–	–	2:1	
Intermediate frequency impedance (note 3)	Z_{if}	280	320	380	Ω
Operating frequency range	f	–	–	12	GHz

Notes

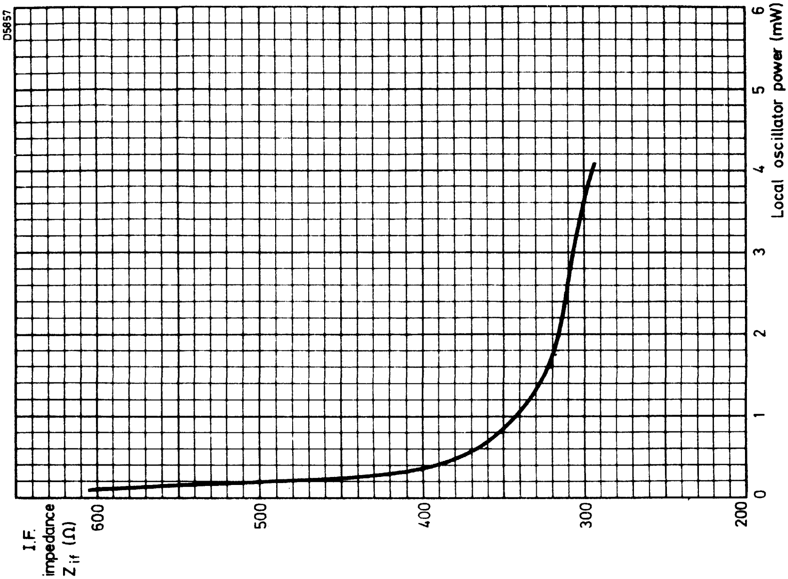
1. Measured at 9.375 GHz ± 0.1 GHz, 1.5 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9300, method 1406.
2. Measured at 9.375 GHz ± 0.1 GHz, 1.5 mA rectified current, R_L = 15 Ω. BS9300, method 1409.
3. Measured at 9.375 GHz ± 0.1 GHz, 1.5 mA rectified current, R_L = 15 Ω, intermediate frequency 45 MHz.BS9300 method 1405.
4. Maximum out of balance for a matched pair:
   a) 0.1 mA rectified current.
   b) R.F. admittance 1.5:1 with other diode normalized to 50 Ω.
5. The diode may be mounted on microstrip, using conventional thermocompression or micro-gap bonding techniques. Alternatively, the application of a silver loaded epoxy, such as Epotek H40, may be used, followed by polymerisation at 150 °C for 15 minutes. The force applied to the L.I.D. must not exceed 147 mN (15 gf).
6. Devices may be specially selected with the r.f. impedance measured at a customer's specific frequency in the range 8.4 to 12 GHz.
7. Other encapsulations may be made available on request.
8. The diode is available, on request, with a protective coating of gel around the mechanically sensitive part of the device.



Typical d.c. characteristic



Typical overall noise figure as a function of local oscillator power



Typical i.f. impedance as a function of local oscillator power

MICROWAVE MIXER DIODE

Subminiature silicon Schottky barrier mixer diode for use at Q-band (Ka-band) frequencies. Where applicable, this device conforms to the environmental requirements of BS9300. It can be supplied to NATO stock No. 5691-99-038-0540.

QUICK REFERENCE DATA

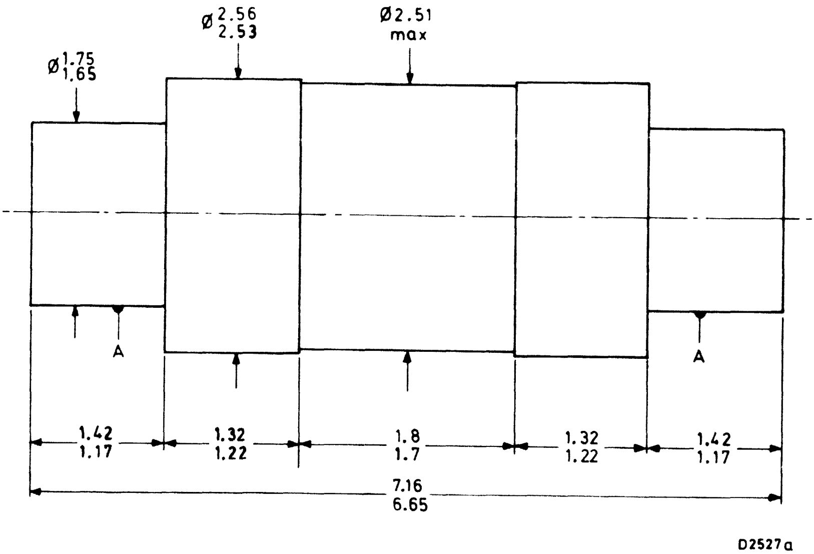
Frequency range		26 to 40	GHz
Noise figure	typ.	8.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-42



AA = concentricity tolerance = ± 0.15

The cathode (positive) is marked red.
The cathode indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Burn-out

R.F. spike		max.	0.04	erg
Peak pulse power (t_p = 0.2 μs)		max.	0.5	W

The devices are 100% burn-out screened to the above specifications at 34 GHz.

Temperature

Storage temperature	T_{stg}	−55 to +100	°C
Ambient temperature	T_{amb}	−55 to +100	°C

CHARACTERISTICS T_{amb} = 25 °C

Reverse current (V_R = 0.5 V)	I_R	max.	2.0	μA
Forward current (V_F = 0.5 V)	I_F	min.	2.0	mA
Overall noise figure f = 34.86 GHz, rectified current = 0.5 mA N_o includes N_{if} of 1.5 dB. BS9300, method 1406	N_o	typ. max.	8.5 10	dB dB
Conversion loss	L_c	typ.	5.5	dB
Noise temperature ratio I.F. = 45 MHz	N_r		1.6:1	
Voltage standing wave ratio* f = 34.86 GHz, rectified current = 0.5 mA R_L = 15 Ω. BS9300, method 1409	v.s.w.r.	typ. max.	1.4:1 2.0:1	
Intermediate frequency impedance f = 34.86 GHz, rectified current = 0.5 mA R_L = 15 Ω, i.f. = 45 MHz. BS9300, method 1405	Z_{if}	typ.	900 700 to 1100	Ω Ω
Operating frequency range	f		26 to 40	GHz

MATCHED PAIRS

The diodes can be supplied in matched pairs under the type number 2/BAT38M. The diodes are matched to ±10% on rectified current and within 150 Ω i.f. impedance.

* Standard test holder.

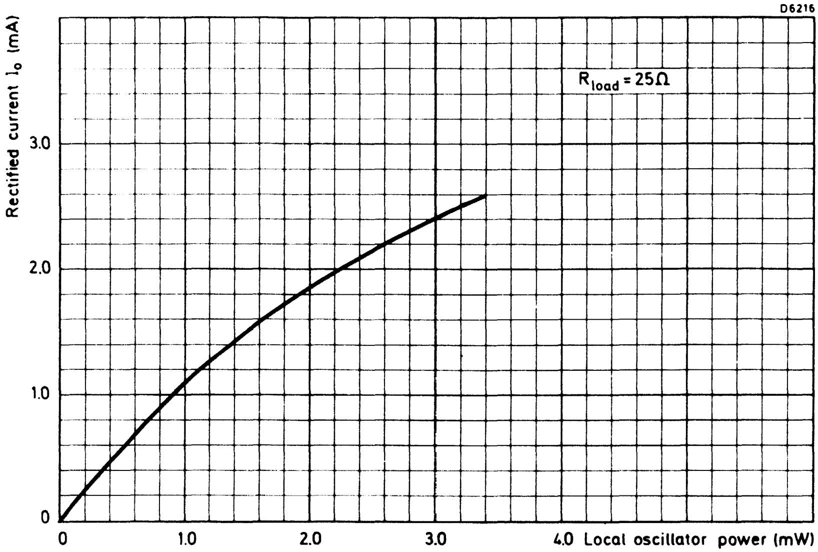


Fig.2 Typical rectified current as a function of local oscillator power at 34.86 GHz

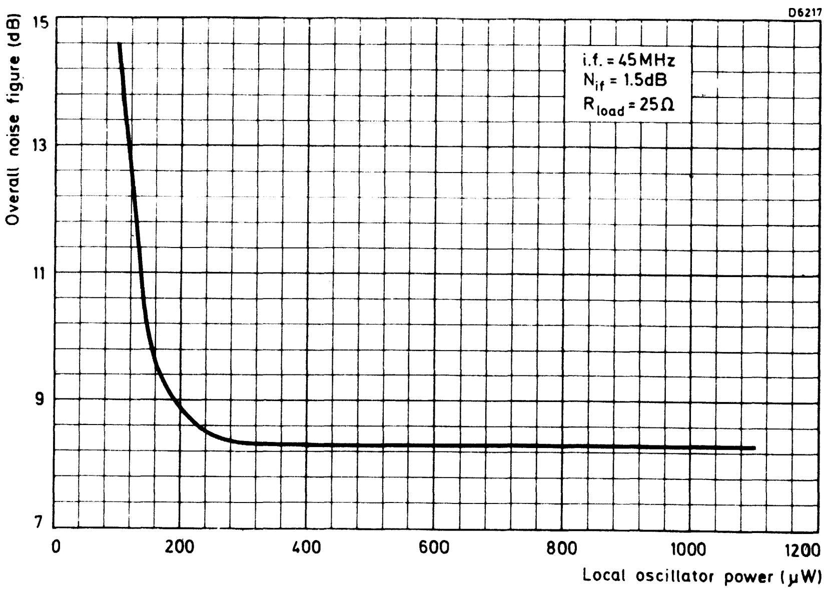


Fig.3 Typical overall noise figure as a function of local oscillator power at 34.86 GHz

MICROWAVE MIXER DIODE

Subminiature silicon reversible Schottky barrier diode primarily intended for low noise mixer applications in X-band. It is intended as a retrofit for AAY39 and CV7762. Available as a matched pair as 2/BAT39M. Can be supplied to NATO stock No. 5961-99-037-5207.

QUICK REFERENCE DATA

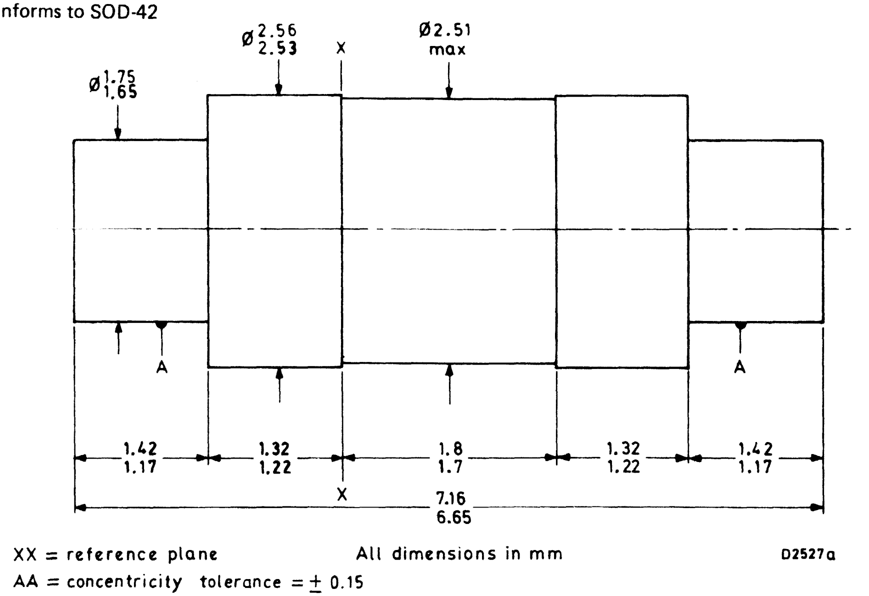
Operating frequency range		1.0 to 18	GHz
Noise figure at X-band	typ.	6.0	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-42



Terminal identification:

The BAT39 is colour coded as follows:
That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.
The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}	−55 to +100	°C
Ambient temperature range	T_{amb}	−55 to +100	°C

Burn-out (f = 9.375 GHz)

Multiple d.c. spike	max.	0.1	erg
Multiple r.f. spike (spike width at half peak power = 2 μs)	max.	0.05	erg

Peak pulse power f = 9.375 GHz, t_p = 1.0 μs	max.	0.5	W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse current V_R = 0.5 V	I_R	–	–	2.0	μA
Forward current V_F = 0.5 V	I_F	–	7.0	–	mA
Overall noise figure f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA, N_o includes N_{if} = 1.5 dB. BS9300, method 1406	N_o	5.5	6.0	6.5	dB
Conversion loss	L_c	–	4.2	–	dB
Noise temperature ratio I.F. = 45 MHz. BS9300, method 1407	N_r	–	1.1:1	–	
Voltage standing wave ratio f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA. BS9300, method 1409 Measured in standard test holder	v.s.w.r.	–	1.4:1	2.0:1	
Intermediate frequency impedance f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA. BS9300, method 1405	Z_{if}	250	–	450	Ω
Operating frequency range	f	1.0	–	18	GHz

OPERATING NOTE

Optimum performance is obtained when the local oscillator drive is adjusted to give a diode rectified current of 1.0 mA and the load resistance is restricted to 100 Ω max.

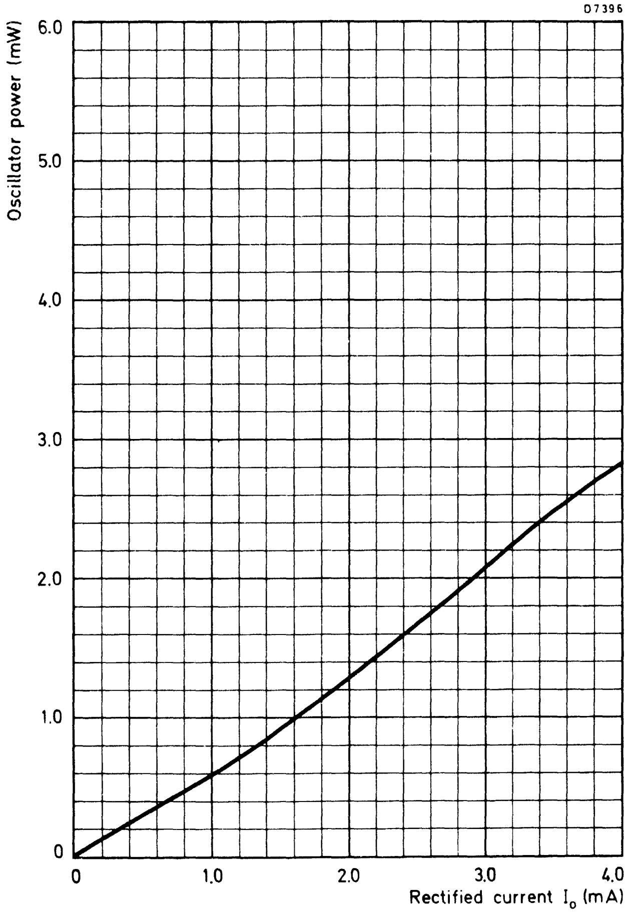
NOTE

Matched pairs of diodes are available to customer specifications.

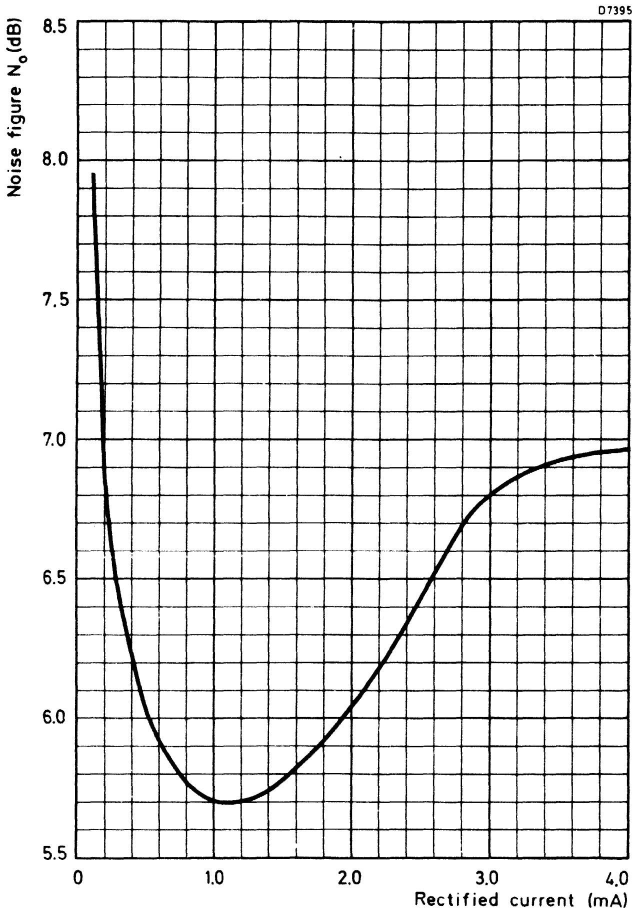
APPLICATION INFORMATION

Mixer performance at other than Test Radio Frequency

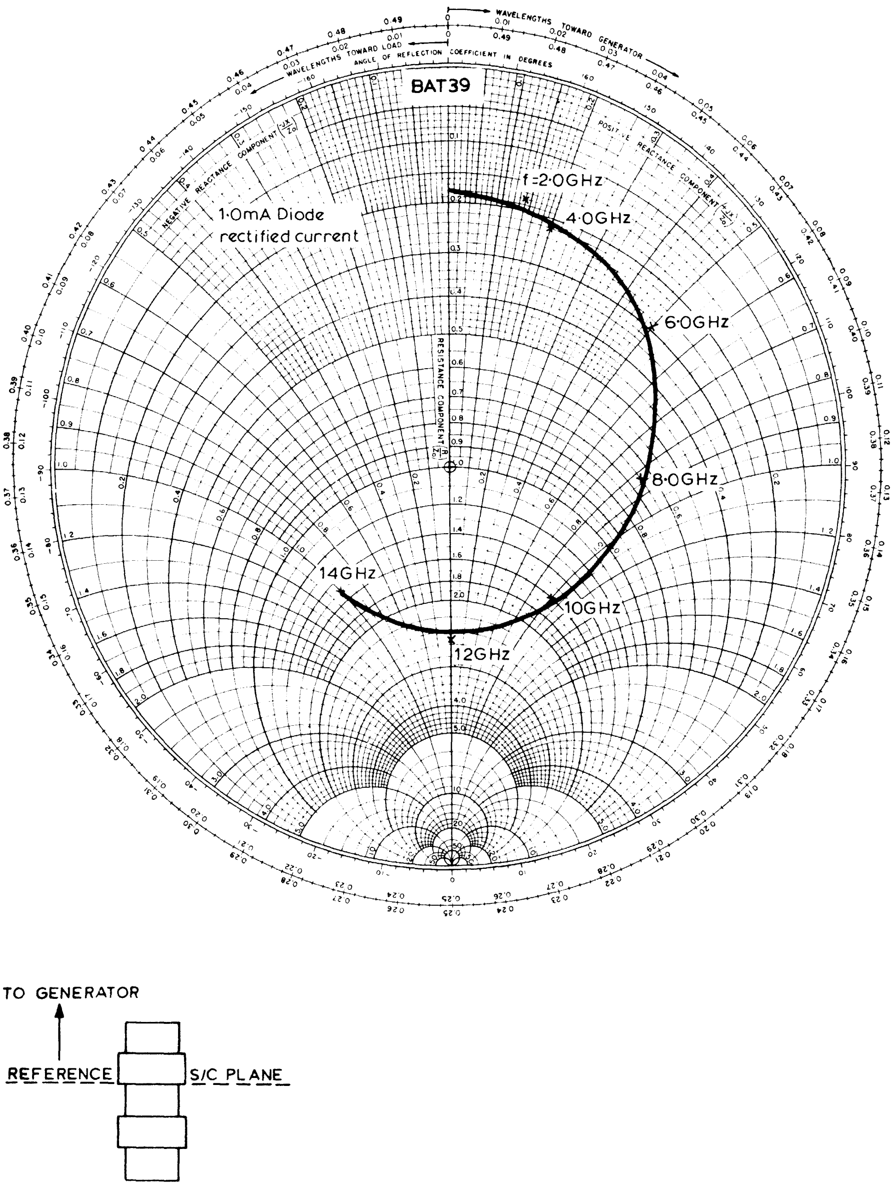
Measured overall noise figure				
f = 16.5 GHz, N_{if} = 1.5 dB, i.f. = 45 MHz	N_o	typ.	7.0	dB
f = 3.0 GHz, N_{if} = 1.5 dB, i.f. = 45 MHz	N_o	typ.	5.5	dB
f = 9.5 GHz, i.f. = 3.0 kHz	N_o	typ.	29	dB
Signal/flicker noise at 9.5 GHz				
Measured at 2.0 kHz from carrier in a 70 Hz bandwidth		typ.	131	dB
Detector performance Tangential sensitivity at 9.375 GHz, 1 kHz to 1 MHz video bandwidth, I_F (bias) = 50 μA (BS9300/1411)	S_{ts}	typ.	−52	dBm
A.C. video impedance I_F (bias) = 50 μA (BS9300/1403)	Z_r	typ.	800	Ω



Typical rectified current as a function of local oscillator power



Typical noise figure as a function of rectified current



Typical r.f. admittance as a function of radio frequency
Admittance with respect of 1/50 mho. Measured in 50Ω coaxial line.

MICROWAVE MIXER DIODES

Coaxial silicon Schottky barrier diodes for use in pre-tuned X-band low noise mixer circuits. They are intended for use as low noise retrofits at X-band frequencies for coaxial mixer diodes types AAY50, AAY50R etc. The two types have identical dimensions and characteristics but the polarity is reversed. Available as a matched pair as 2/BAT50MR. The pair are intended for use in balanced mixer circuits and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

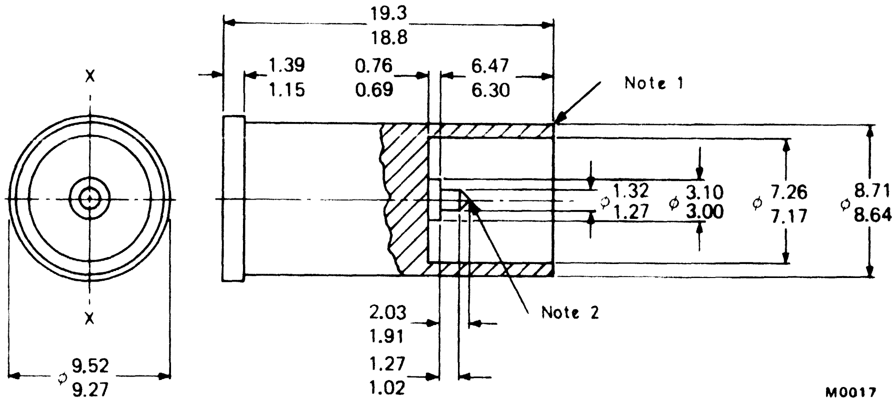
Operating frequency	max.	12	GHz
Noise figure	typ.	6.2	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to MO-74



Terminal identification

BAT50	Pin	cathode	BAT50R	Pin	anode
	Body (red spot)	anode		Body (green spot)	cathode

ACCESSORIES

Holders to fit these coaxial diodes are available in the U.K. from Marconi Instruments (Sanders Division) Gunnels Wood Rd., Stevenage, Herts.

Note 1 The device is designed to make contact on this open face.
Note 2 Cone tapers to a radius of 0.13 mm nominal.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}		−55 to +100	°C
Ambient temperature range	T_{amb}		−55 to +100	°C

Burn-out

R.F. spike		max.	0.2	erg
Peak pulse power (t_p = 0.5 μs)		max.	1.0	W

CHARACTERISTICS (T_{amb} = 25 °C)

Reverse current (V_R = 0.5 V)	I_R	max.	2.0	μA
Forward current (V_F = 0.5 V)	I_F	min.	2.0	mA
Overall noise figure (note 1) f = 9.375 GHz, rectified current = 1.0 mA, R_L = 15 Ω, N_o includes N_{if} = 1.5 dB	N_o	typ. max.	6.2 6.8	dB dB
Conversion loss	L_c		4.4	dB
Noise temperature ratio I.F. = 45 MHz	N_r		1.1:1	
Voltage standing wave ratio (notes 1 and 2) f = 9375 ± 10% MHz, rectified current 1.0 mA R_L = 15 Ω, N_o includes N_{if} = 1.5 dB	v.s.w.r.	typ. max.	1.4:1 2.0:1	
Intermediate frequency impedance	Z_{if}	min. max.	300 500	Ω Ω
Operating frequency range	f	max.	12	GHz

Notes

1. Measured in standard holder (K1007, Issue 3, Section 8B3.3.1/2).
2. The nominal rectifier admittance at a plane 7.01 mm inside the body from the open end is

$$\frac{1}{83.5} + \frac{j}{350} \text{ mho}$$

OPERATING NOTE

These devices will exhibit their inherent improved noise figure performance over the frequency range 1.0 to 12 GHz, but are not recommended for use as direct replacements in pre-tuned mounts designed for the AAY50 type coaxial diode, at other than X-band frequencies.

APPLICATION INFORMATION

Signal/Flicker noise ratio f = 9.5 GHz. Measured at 2 kHz from carrier in 70 Hz bandwidth		typ.	131	dB
Detector performance				
Tangential sensitivity, f = 9.375 GHz, video bandwidth = 1.0 MHz, I_F (bias) = 50 μA	S_t	typ.	−52	dBm
video impedance, I_F (bias) = 50 μA	Z_v	typ.	800	Ω

NOTE

Matched pairs of diodes are available to customer specifications.

MICROWAVE MIXER DIODES

The BAT51 and BAT51R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku-band). They are of silicon Schottky barrier construction and are intended as retrofits for AAY51 and AAY51R, (CV7776 and CV7777). They are packaged in the standard coaxial outline for this band, similar to 1N78 types. The encapsulation is hermetically sealed and cadmium plated. The diodes conform to the environmental requirements of BS9300 where applicable and are available as a matched pair as 2/BAT51MR, (CV7778). Can be supplied to NATO stock Nos. 5961-99-037-5472 (BAT51), 5961-99-037-5473 (BAT51R) and 5961-99-037-5474 (2/BAT51MR).

QUICK REFERENCE DATA

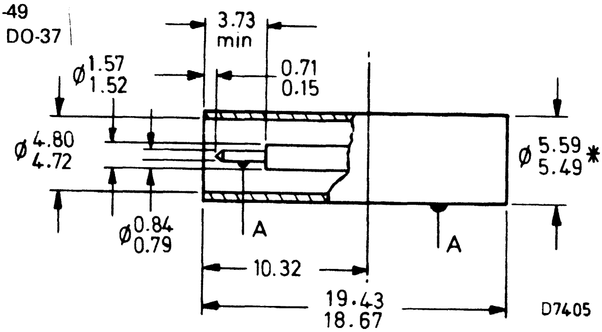
Frequency range		12 to 18	GHz
Noise figure	typ.	7.0	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-49
Similar to JEDEC DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only to the 10.32 dimension

Terminal identification

BAT51	Pin	cathode	BAT51R	Pin	anode
	Body (red)	anode		Body (green)	cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}		–55 to +100	°C
Ambient temperature range	T_{amb}		–55 to +100	°C

Burn out

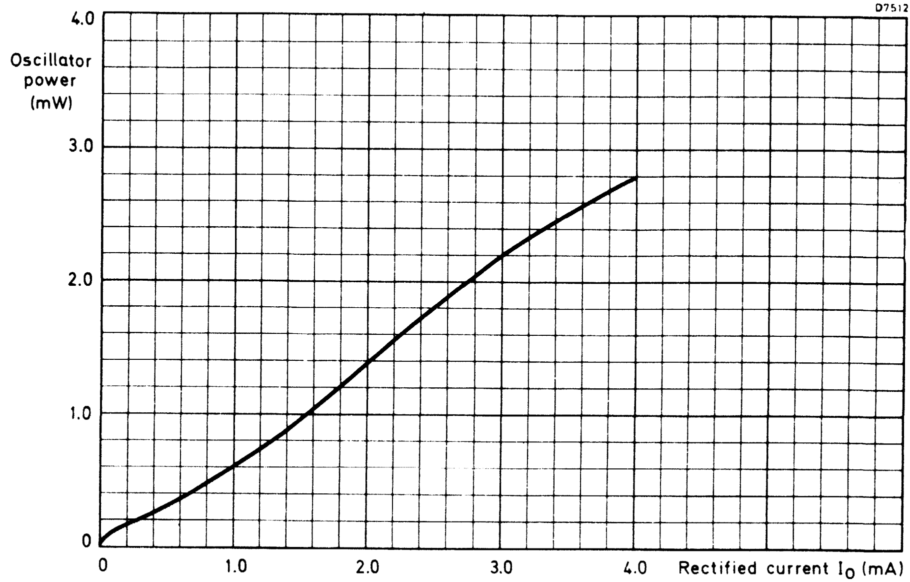
f = 9.375 GHz, multiple r.f. spike, spike width at half peak power = 2 ns		max.	0.05	erg
Peak pulse power f = 9.375 GHz, t_p = 1.0 μs		max.	0.5	W

CHARACTERISTICS (T_{amb} = 25 °C)

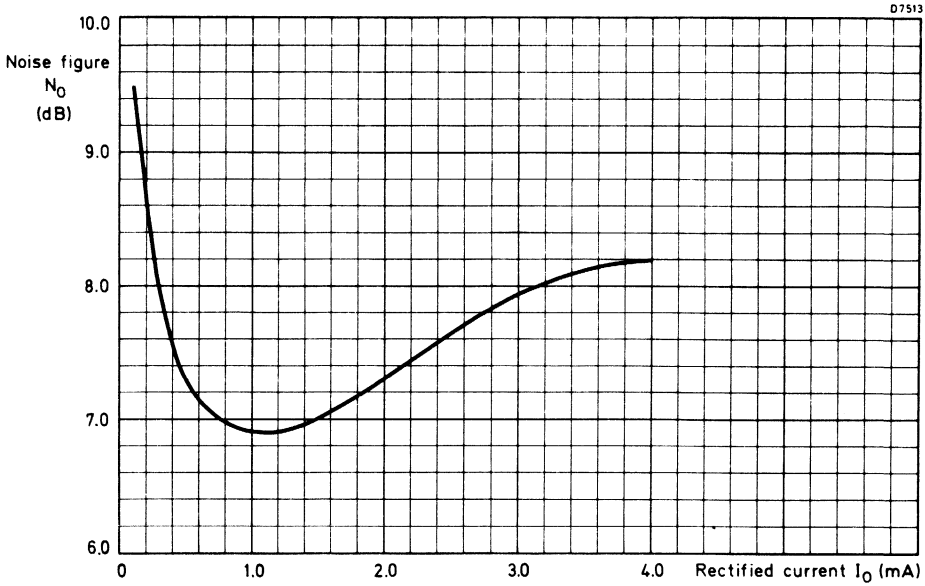
Reverse current V_R = 0.5 V	I_R	max.	2.0	μA
Forward current V_F = 0.5 V	I_F	min.	2.0	mA
Overall noise figure f = 13.5 GHz, N_o includes N_{if} = 1.5 dB Measured in JAN 201 holder. BS9300, method 1406	N_o	typ.	7.0	dB
		max.	7.5	dB
Conversion loss	L_C		5.2	dB
Noise temperature ratio I.F. = 45 MHz. BS9300, method 1407	N_r		1.1:1	
Voltage standing wave ratio f = 13.5 GHz, rectified current = 0.9 mA		typ.	1.5:1	
		max.	2.0:1	
Intermediate frequency impedance		min.	250	Ω
	Z_{if}	typ.	350	Ω
		max.	450	Ω
Operating frequency range	f		12 to 18	GHz

As a matched pair

Maximum unbalance conditions,
Z_{if} = 25 Ω, rectified current 0.1 mA.



Typical rectified current as a function of local oscillator power



Typical noise figure as a function of rectified current

MICROWAVE MIXER DIODES

The BAT52 and BAT52R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku band). The diodes are of silicon Schottky barrier construction and are intended as retrofits for AAY52 and AAY52R. They are packaged in the standard coaxial outline for this band, similar to IN78 types. The encapsulation is hermetically sealed and cadmium plated. The devices conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAT52MR.

QUICK REFERENCE DATA

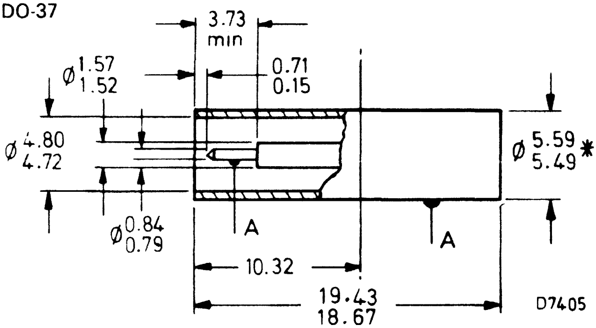
Frequency range	12 to 18	GHz
Noise figure	8.0	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-49
Similar to JEDEC DO-37



A = concentricity tolerance = ± 0.35
*These limits apply only to the 10.32 dimension

Terminal identification

BAT52	Pin	cathode	BAT52R	Pin	anode
	Body (red)	anode		Body (green)	cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}		−55 to +100	°C
Ambient temperature range	T_{amb}		−55 to +100	°C

Burn-out

f = 9.375 GHz, multiple r.f. spike, spike width at half peak power = 2 ns		max.	0.05	erg
Peak pulse power f = 9.375 GHz, t_p = 1.0 µs		max.	0.5	W

CHARACTERISTICS (T_{amb} = 25 °C)

Reverse current V_R = 0.5 V	I_R	max.	2.0	µA
Forward current V_F = 0.5 V	I_F	min.	2.0	mA
Overall noise figure f = 13.5 GHz, N_o includes N_{if} = 1.5 dB Measured in JAN 201 holder. BS9300, method 1406	N_o	typ.	8.0	dB
		max.	8.5	dB
Conversion loss	L_C		5.2	dB
Noise temperature ratio I.F. = 45 MHz. BS9300, method 1407	N_r		1.1:1	
Voltage standing wave ratio f = 13.5 GHz, rectified current = 0.9 mA		typ.	1.5:1	
		max.	2.0:1	
Intermediate frequency impedance		min.	250	Ω
	Z_{if}	typ.	350	Ω
		max.	450	Ω
Operating frequency range	f		12 to 18	GHz

As a matched pair

Maximum unbalance conditions, Z_{if} = 25 Ω, rectified current 0.1 mA.

MICROWAVE MIXER DIODE

Silicon Schottky barrier mixer diode for use in low noise mixer applications in Q-band. It conforms to the environmental requirements of BS9300 where applicable and can be supplied to NATO stock No. 5961-99-038-0541. Available as a matched pair 2/BAV72M.

QUICK REFERENCE DATA

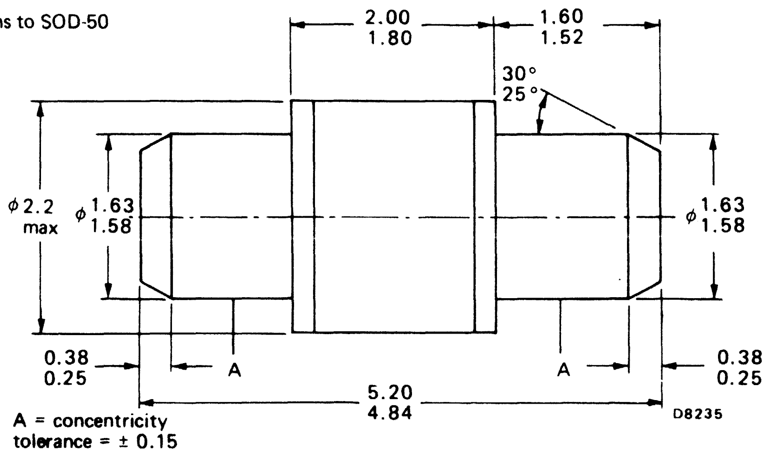
Frequency range		26 to 40	GHz
Noise figure	typ.	8.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS -- MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-50



Terminal identification: red end indicates cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Burn-out (r.f. spike) (note 1)			0.04	erg
Burn-out, peak pulse power		max.	0.5	W
Storage temperature range	T_{stg}		−55 to +100	°C
Ambient temperature range	T_{amb}		−55 to +100	°C

CHARACTERISTICS (T_{amb} = 25 °C)

Static

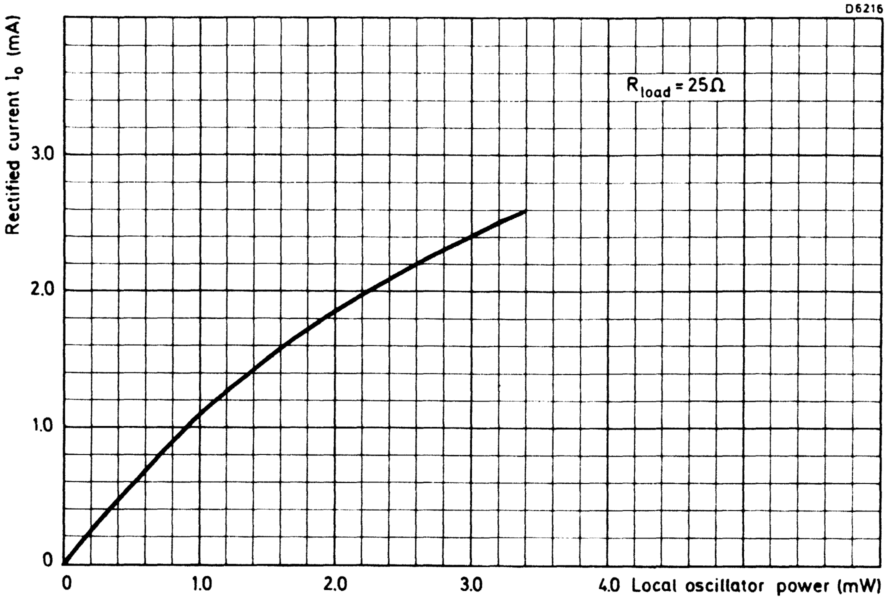
Reverse current (V_R = 0.5 V)	I_R	max.	2.0	μA
Forward current (V_F = 0.5 V)	I_F	min.	2.0	mA

Dynamic

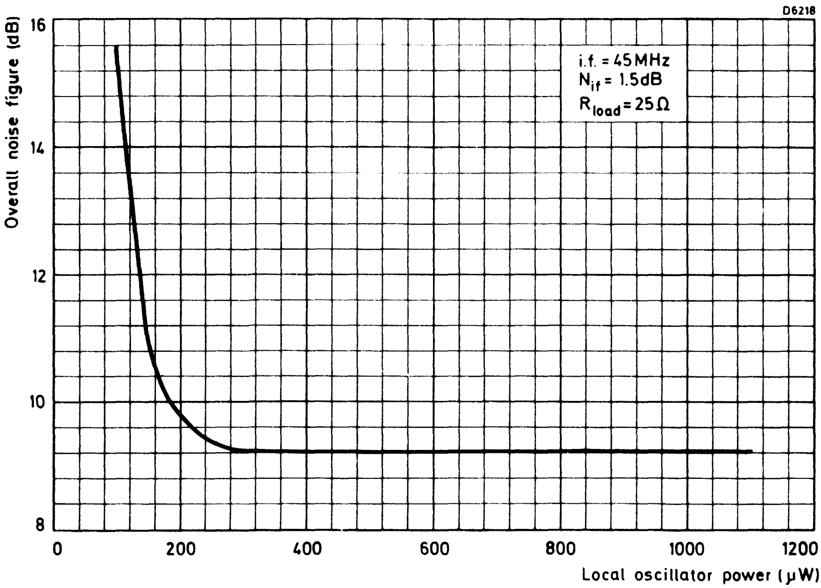
Noise figure (note 2)	N_o	typ.	8.5	dB
		max.	10	dB
Voltage standing wave ratio (note 3)	v.s.w.r.	typ.	1.8:1	
		max.	2.0:1	
Intermediate frequency impedance (note 4)	Z_{if}	min.	700	Ω
		max.	1100	Ω
Frequency range	f	min.	26	GHz
		max.	40	GHz
Conversion loss (note 5)	L_c	typ.	5.9	dB
Noise temperature ratio (note 6)	N_r	typ.	1.4:1	

Notes

1. Local oscillator frequency = 9.375 GHz, number of pulses = 6 x 10^5, pulse duration = 2 ns at half peak energy, p.r.f. = 2000 p.p.s., load resistance = 0 Ω. T_{amb} = 25 °C.
2. Measured with a local oscillator frequency of 34.86 GHz, I_o = 0.5 mA, load resistance = 15 Ω, i.f. = 45 MHz. BS9300, method 1406.
3. Measured with a local oscillator frequency of 34.86 GHz, I_o = 0.5 mA, load resistance = 15 Ω. BS9300, method 1409.
4. Measured with a local oscillator frequency of 34.86 GHz, I_o = 0.5 mA, load resistance = 15 Ω, i.f. = 45 MHz. BS9300, method 1405.
5. Measured at 34.86 GHz, 450 μW local oscillator power level and load resistance = 1 kΩ.
6. Measured at 34.86 GHz and i.f. = 45 MHz.
7. The diodes are measured in fixed tuned Q-band waveguide mounts. Details may be obtained from the manufacturer.
8. Matched pairs of diodes are available to customer specifications



Typical rectified current as a function of local oscillator power at 34.86 GHz



Typical overall noise figure as a function of local oscillator power at 34.86 GHz

MICROWAVE DETECTOR DIODE

Silicon Schottky barrier diode specially designed for use in Doppler radars where high detector sensitivity is required. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

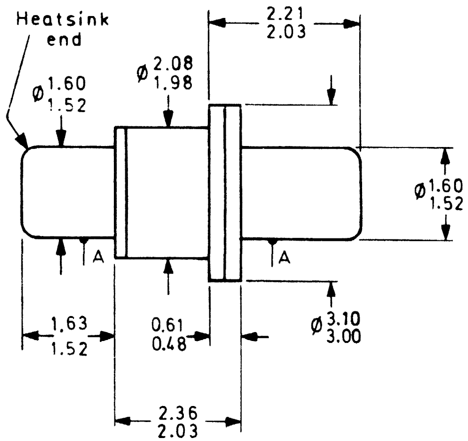
Frequency range		8 to 12	GHz
Tangential sensitivity with 100 μA bias	typ.	−50	dBm

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

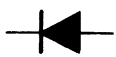
Dimensions in mm

Conforms to BS 3934 SO–86 and to SOD–31



A = concentricity tolerance = ± 0.13

C_S = 0.25pF typ.
L_S = 0.65nH typ.



RATINGS

Limiting values in accordance with the Absolute Maximum Rating System (IEC134)

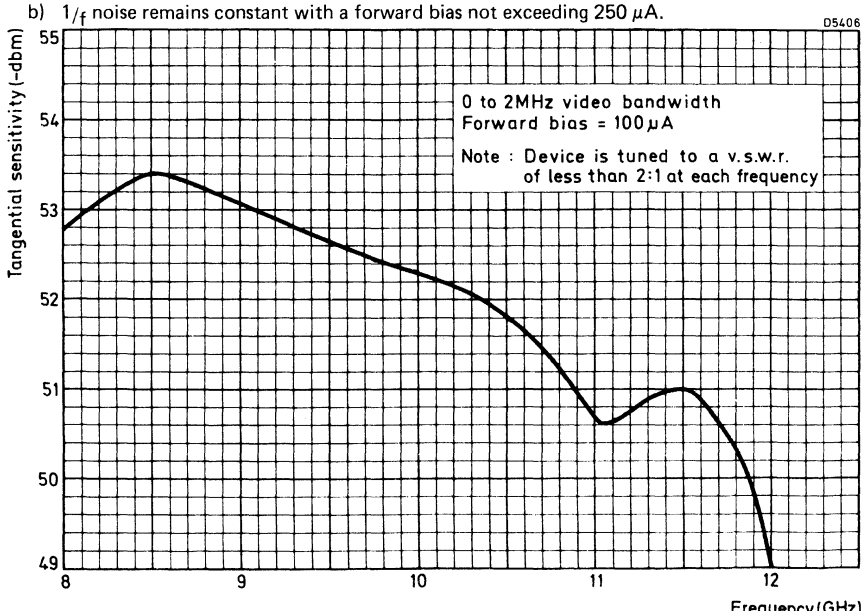
Storage temperature range		−55 to +150	°C
Ambient temperature range		−55 to +150	°C
Peak pulsed r.f. input power at 9.375 GHz, 0.5 μs pulse length	max.	0.75	W

CHARACTERISTICS (T_{amb} = 25 °C)

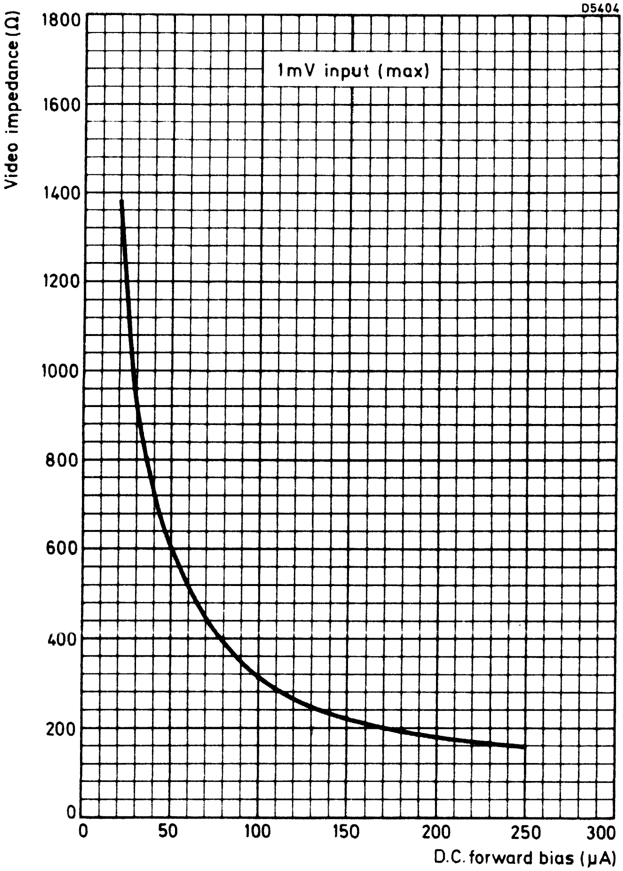
		min.	typ.	max.	
Voltage standing wave ratio (notes 1, 2 and 3)	v.s.w.r.	−	1:4:1	2:1	
Video impedance (notes 4 and 5)	Z_v	−	310	−	Ω
Tangential sensitivity (notes 1 and 2)	S_{ts}	−49	−50	−	dBm

Notes

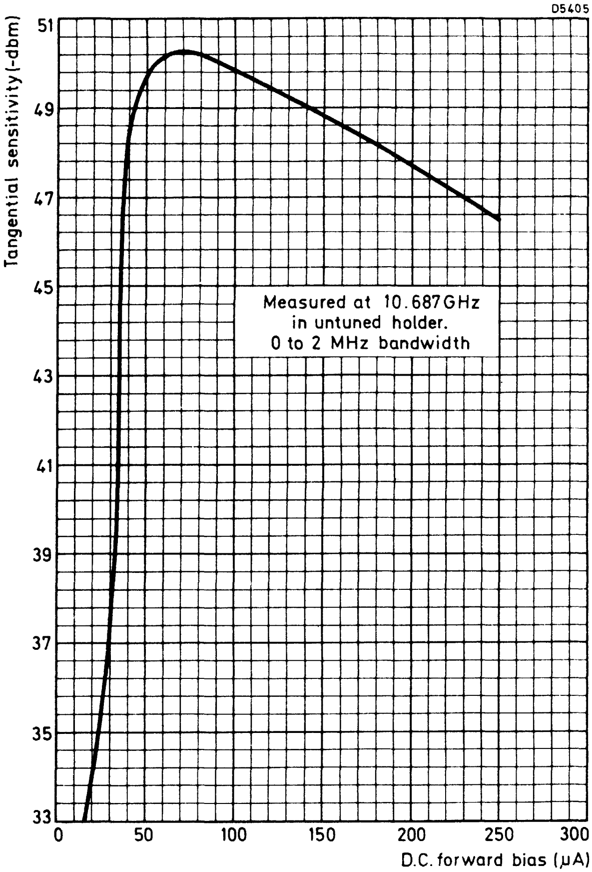
1. Measured at 10.687 GHz with 100 μA forward bias.
2. Measured in a reduced height waveguide mount.
3. R.F. input power less than 5 μW.
4. Measured with 100 μA forward bias.
5. Maximum d.c. input voltage = 1 mV.
6. a) Measured at an i.f. of 1 kHz with 50 Hz bandwidth.
   b) $1/_f$ noise remains constant with a forward bias not exceeding 250 μA.



Tangential sensitivity as a function of frequency



Video impedance as a function of d.c. forward bias



Tangential sensitivity as a function of d.c. forward bias

MICROWAVE MIXER DIODES

A range of sub-miniature reversible low noise Schottky barrier mixer diodes. The planar technology employed imparts a high degree of reliability and reproducability. The metal-ceramic case is hermetically sealed and the devices conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

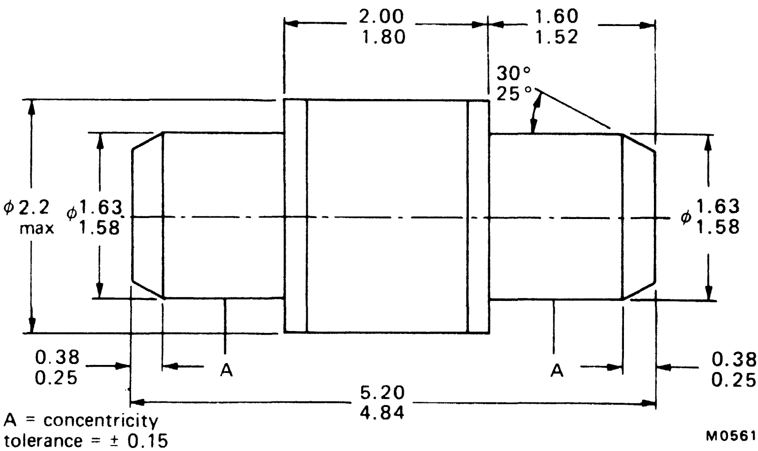
Noise figure in X-band			
BAV96A	max.	7.5	dB
BAV96B	max.	7.0	dB
BAV96C	max.	6.5	dB
BAV96D	max.	6.0	dB
Operating frequency	max.	12	GHz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-50



Terminal identification: red end indicates cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

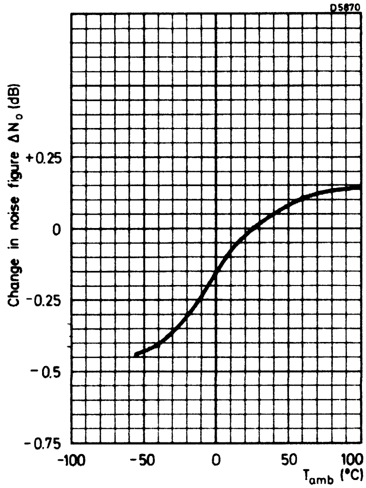
Storage temperature range	T_{stg}		−55 to +150	°C
Ambient temperature range	T_{amb}		−55 to +150	°C
Burn-out (note 1)		max.	15	nJ

CHARACTERISTICS (T_{amb} = 25 °C)

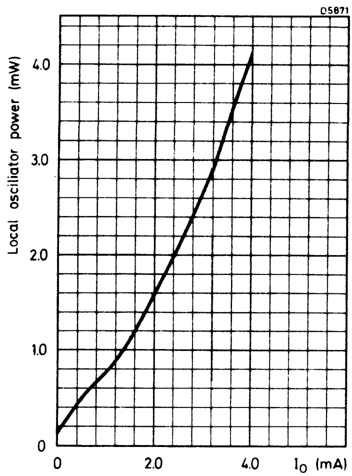
			min.	typ.	max.	
Noise figure (note 2)	BAV96A	N_O	–	7.0	7.5	dB
	BAV96B		–	6.5	7.0	dB
	BAV96C		–	6.0	6.5	dB
	BAV96D		–	5.5	6.0	dB
Voltage standing wave ratio (note 3)	BAV96A	v.s.w.r.	–	1.7:1	2.0:1	
	BAV96B		–	1.4:1	1.6:1	
	BAV96C		–	1.4:1	1.6:1	
	BAV96D		–	1.3:1	1.5:1	
I.F. impedance (note 4)		Z_{if}	250	–	450	Ω
Tangential sensitivity (note 5)		S_{ts}	–	−52	–	dBm
Tangential sensitivity (note 6)		S_{ts}	–	−54	–	dBm

NOTES

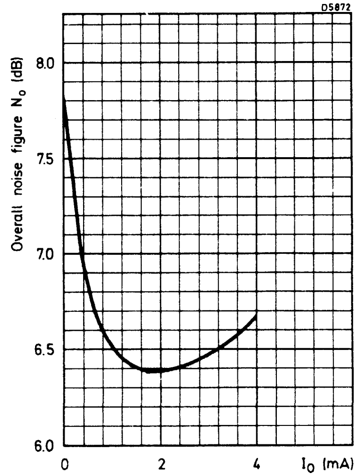
1. Burn out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2 ns width.
2. Measured at 9.375 ± 0.1 GHz. The noise figure includes i.f. amplifier contribution of 1 .5 dB, i.f. 45 MHz, d.c. return for diode 15 Ω max., rectified current 1 mA. BS9300, method 1406.
3. Measured in a reduced height waveguide mount under the same test conditions as in note 2. BS9300, method 1409.
4. I.F. = 45 MHz, R_L = 15Ω, f = 9.375 ± 0.1 GHz, I_O = 1 mA. BS9300, method 1405.
5. Video bandwidth 0 to 2 MHz, 30 μA bias. BS9300, method 1411.
6. Video bandwidth 1 kHz to 1 MHz, 30 μA bias. BS9300, method 1411.
7. A suitable holder for this diode is a modified version of Sanders type 6521.



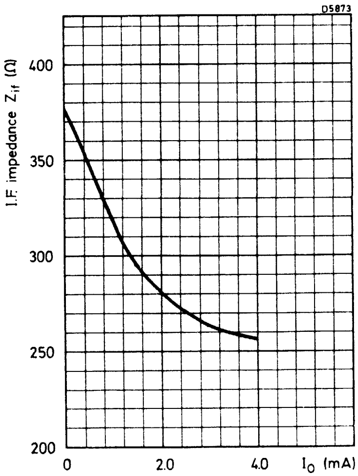
Typical change in overall noise figure as a function of temperature



Typical local oscillator power as a function of rectified current



Typical overall noise figure as a function of rectified current



Typical i.f. impedance as a function of rectified current

MICROWAVE DETECTOR DIODE

A reversible silicon Schottky barrier diode with excellent sensitivity and very low 1/f noise. It conforms to the environmental requirements of BS9300 where applicable. The metal-ceramic case is hermetically sealed.

QUICK REFERENCE DATA

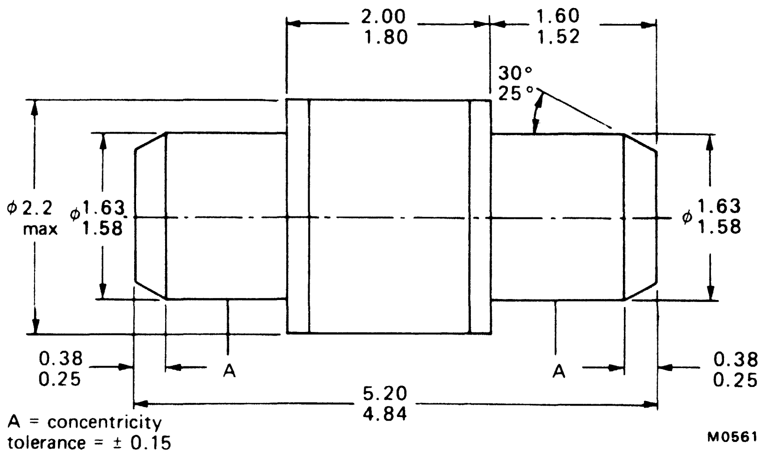
Operating frequency	f	max.	12	GHz
Tangential sensitivity	S_{ts}	typ.	−54	dBm
1/f noise	N_f	typ.	10	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-50



Terminal identification:

The positive end (cathode) is marked red.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}		−55 to +150	°C
Ambient temperature range	T_{amb}		−55 to +150	°C

Burn-out

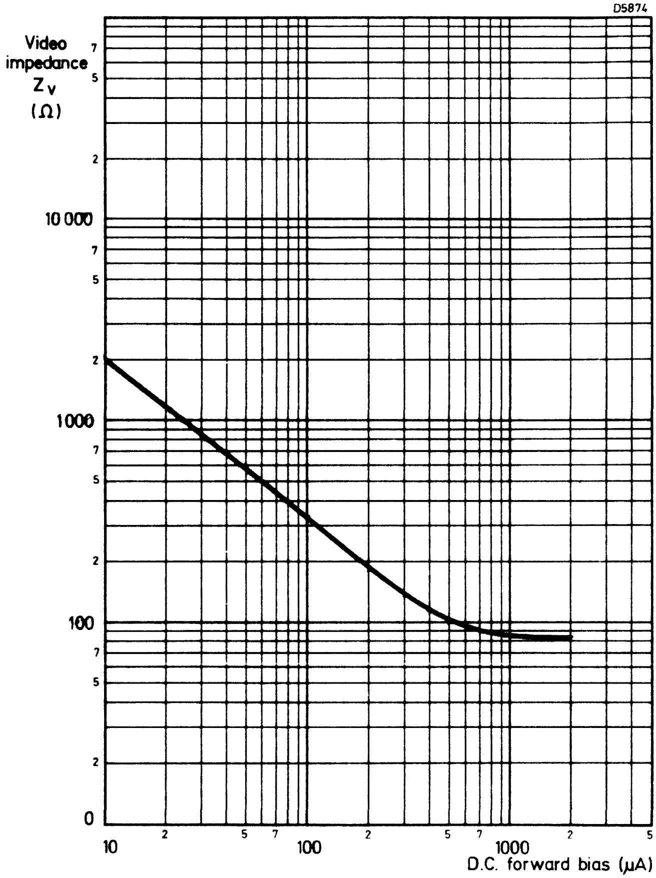
Burn-out (note 1)	max.	18	nJ
		0.18	erg

CHARACTERISTICS (T_{amb} = 25 °C)

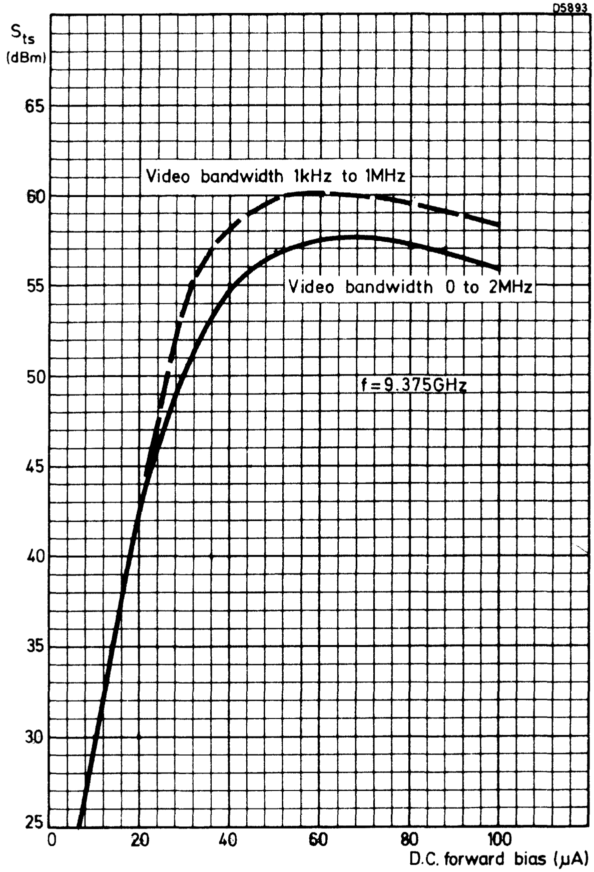
		min.	typ.	max.	
Tangential sensitivity (note 2)	S_{ts}	−52	−54	−58	dBm
$^1/_f$ noise (note 3)	N_f	–	10	15	dB
Video impedance (note 4)	Z_v	–	500	–	Ω

Notes

1. Burn-out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2 ns width.
2. Video bandwidth 0 to 2 MHz, 50 µA bias, f = 9.375 GHz. BS9300, method 1411. (A 2 dBm improvement in tangential sensitivity may be obtained by limiting the bandwidth to 1 kHz to 1 MHz).
3. Measured at 30 µA bias, f = 1 kHz, 50 Hz bandwidth. $^1/_f$ noise is unchanged with values of bias up to 150 µA.
4. Measured at 50 µA forward bias.



Video impedance as a function of d.c. forward bias



Tangential sensitivity as a function of d.c. forward bias.

MICROWAVE MIXER DIODES

A range of silicon Schottky barrier mixer diodes in reversible cartridge outline. The diodes are suitable as replacements for the 1N23 and 1N415 series and conform to environmental requirements of BS9300 where applicable.

Unless otherwise stated, data is applicable to all types.

QUICK REFERENCE DATA

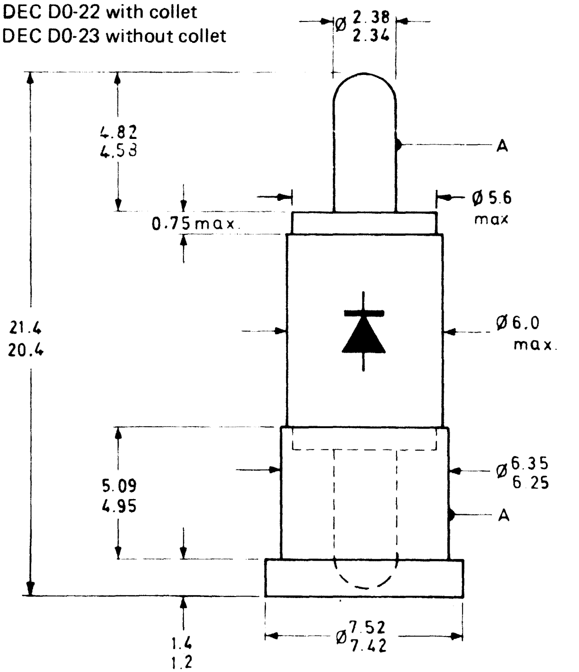
Noise figure at X-band	BAW95D	N_o	max.	8.2	dB
	BAW95E		max.	7.5	dB
	BAW95F		max.	7.0	dB
	BAW95G		max.	6.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-47
Compatible with JEDEC D0-22 with collet
Compatible with JEDEC D0-23 without collet



A = concentricity tolerance = ±0.2

Terminal identification:

Diode symbol indicates polarity

D4868

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}		−55 to +150	°C
Ambient temperature range	T_{amb}		−55 to +150	°C

Burn-out

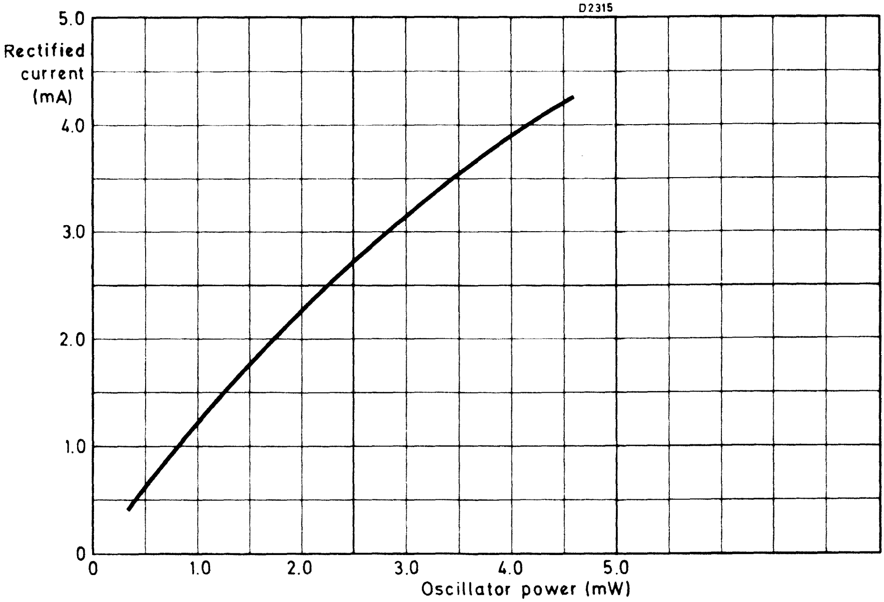
Burn-out (note 1)		max.	20	nJ
			0.2	erg
Peak pulse power $f = 9.375$ GHz, $t_p = 0.5\ \mu s$		max.	1.0	W

CHARACTERISTICS (T_{amb} = 25 °C)

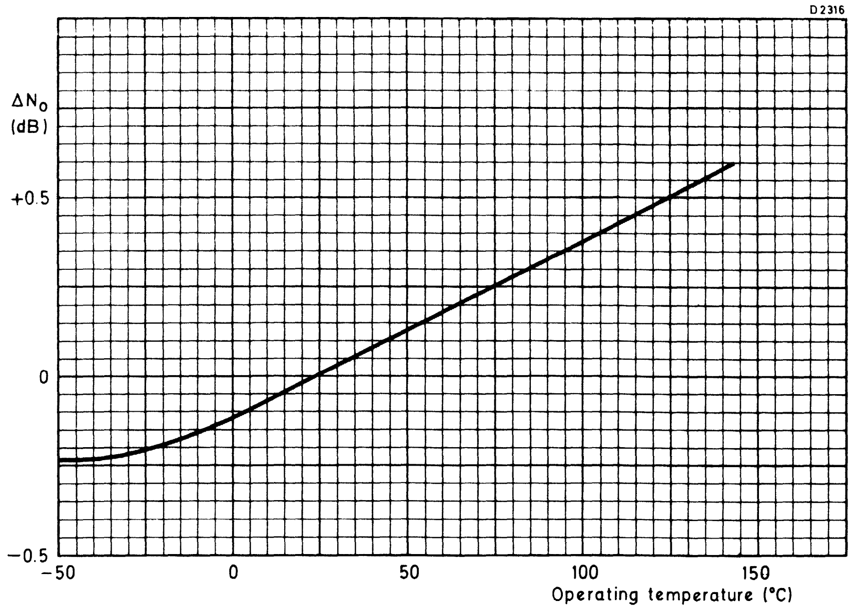
			min.	typ.	max.	
Noise figure (note 2)	BAW95D	N_o	–	7.8	8.2	dB
	BAW95E		–	7.2	7.5	dB
	BAW95F		–	6.8	7.0	dB
	BAW95G		–	6.3	6.5	dB
Voltage standing wave ratio (note 3)		v.s.w.r.	–	–	1.3:1	
Intermediate frequency impedance (note 4)		Z_{if}	250	415	500	Ω

Notes

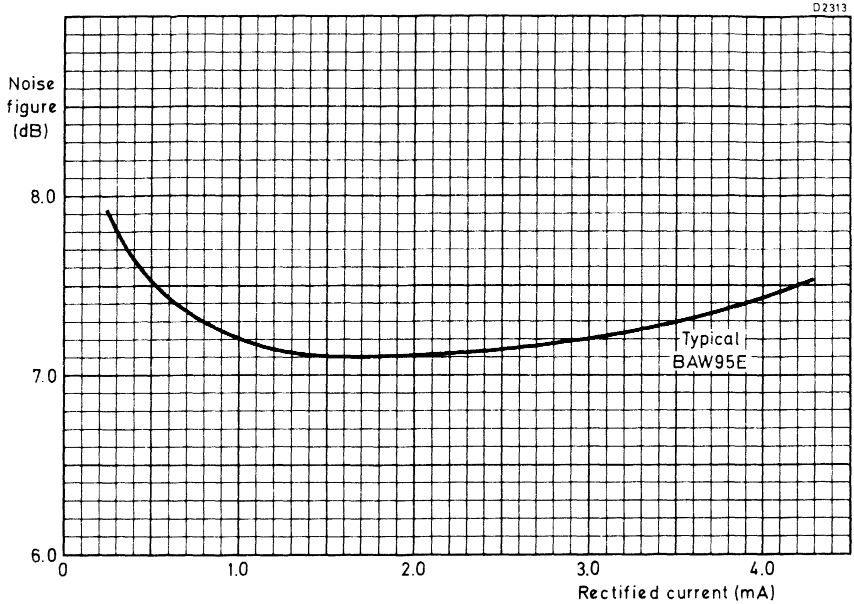
1. Burn-out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2 ns width.
2. Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9300, method 1406.
3. With respect to JAN-106 holder measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. BS9300, method 1409.
4. Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9300, method 1405.



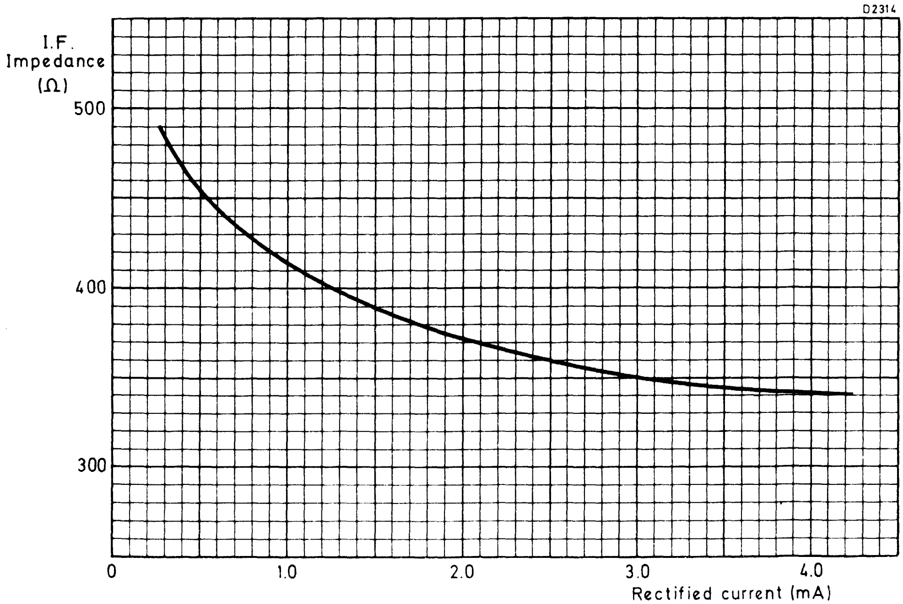
Typical rectified current as a function of local oscillator power



Typical change in noise figure as a function of temperature



Typical noise figure as a function of rectified current



I.F. impedance as a function of rectified current

MICROWAVE MIXER DIODE

Silicon Schottky barrier mixer diode in reversible cartridge outline. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

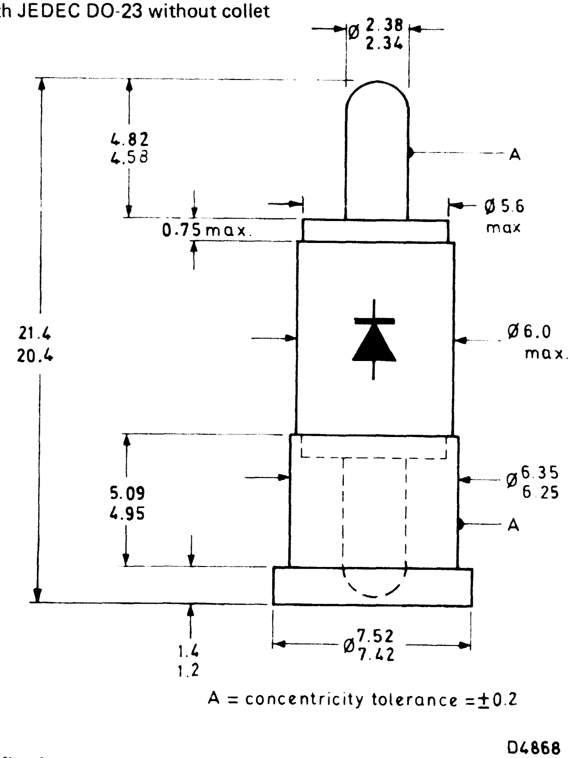
Noise figure at X-band	N_O	max.	7.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-47
Compatible with JEDEC DO-22 with collet
Compatible with JEDEC DO-23 without collet



Terminal identification:

Diode symbol indicates polarity

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Temperature

Storage temperature range	T_{stg}	−55 to +150	°C
Ambient temperature range	T_{amb}	−55 to +150	°C

Burn-out

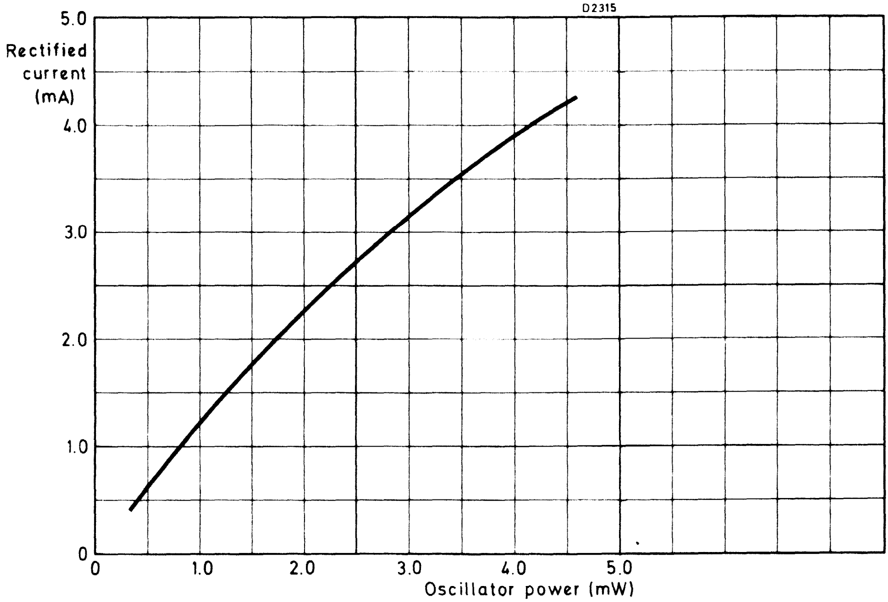
Burn-out (note 1)	max.	20	nJ
		0.2	erg
Peak pulse power f = 9.375 GHz, t_p = 0.5 μs	max.	1.0	W

CHARACTERISTICS (T_{amb} = 25 °C)

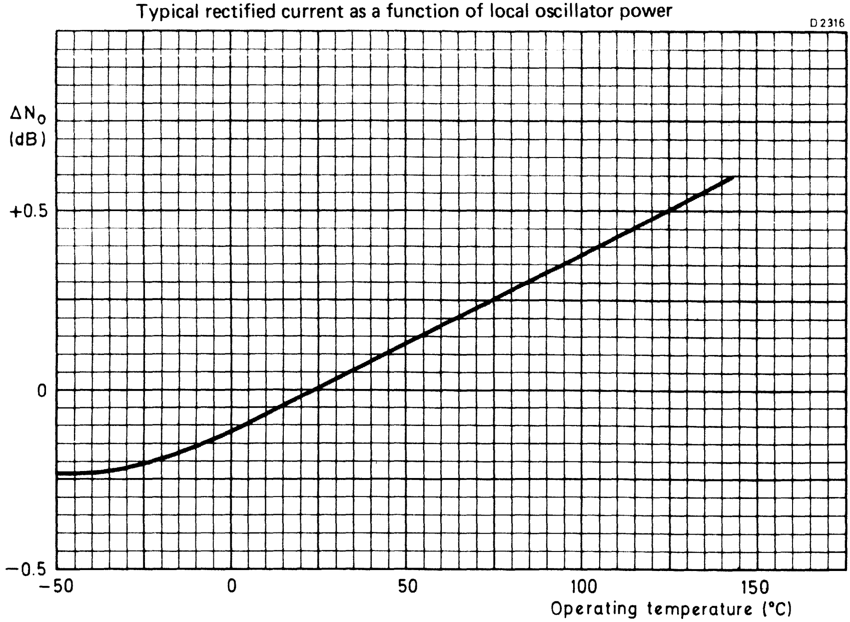
		min.	typ.	max.	
Noise figure (note 2)	N_o	–	7.2	7.5	dB
Voltage standing wave ratio (note 3)	v.s.w.r.	–	–	1.3:1	
Intermediate frequency impedance (note 4)	Z_{if}	335	400	465	Ω

Notes

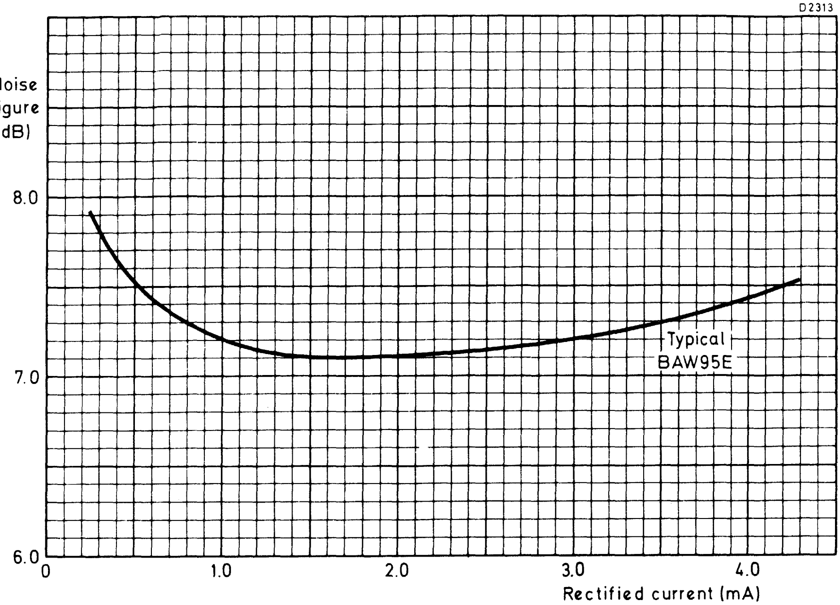
1. Burn-out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2 ns width.
2. Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9321/1406.
3. With respect to JAN-106 holder measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. BS9321/1409.
4. Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9321/1405.



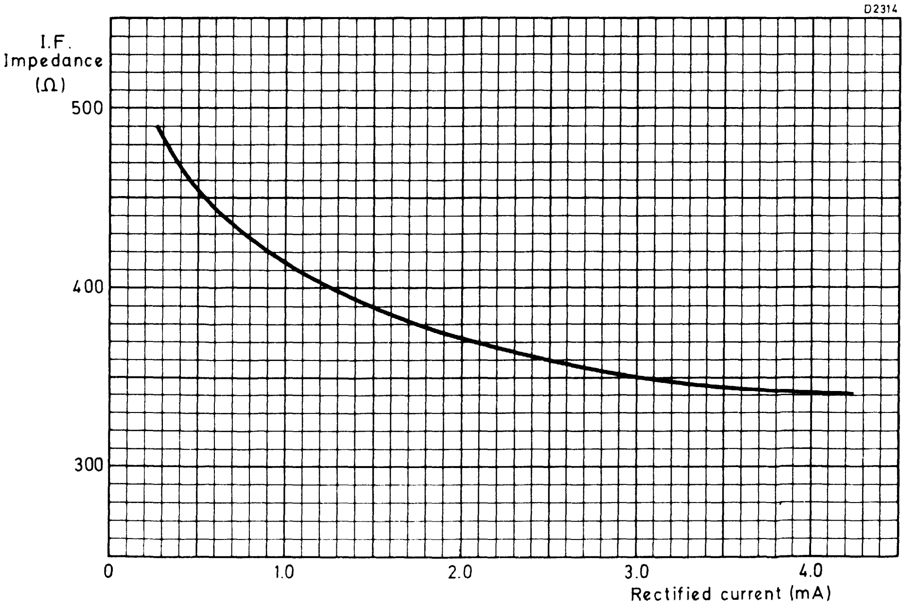
Typical rectified current as a function of local oscillator power



Typical change in noise figure as a function of temperature



Typical noise figure as a function of rectified current



I.F. impedance as a function of rectified current

Ka–BAND GaAs MOTT MIXER DIODE

This is a gallium arsenide Mott mixer diode for use at Ka-band (26.5 to 40 GHz). It embodies several entirely new concepts in millimetre-wave, low-noise mixer diode design. Advanced gallium arsenide planar technology is used to achieve a high cut-off frequency from a robust coplanar chip which has been designed to be mounted directly into planar circuits using a number of simple techniques. Fragile beam leads and the associated inductances have been eliminated. Additionally the stray capacitance associated with the gold bonding pads, which are on a thick gallium arsenide insulating substrate, is minimized.

As shown in fig.1, the variation in capacitance over a wide voltage range is much smaller than that of a conventional Schottky barrier diode. Therefore the advantage of the Mott mixer is that, since the diode capacitance remains constant, the circuit is matched to the diode impedance over a wide range of local oscillator powers and hence the variation in noise figure, especially at low powers, is also significantly less. The active area is protected by a polyimide coating.

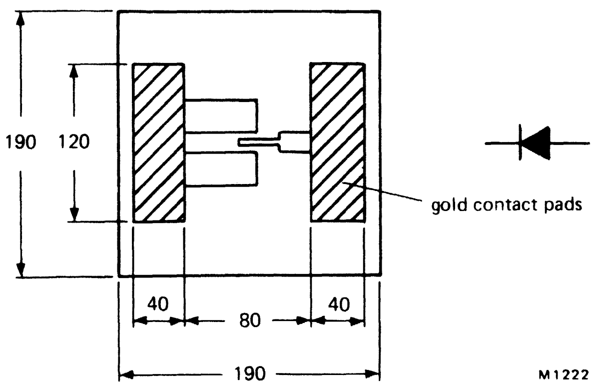
QUICK REFERENCE DATA

Frequency range		26.5 to 40	GHz
Noise figure	typ.	7.1	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in μm



M1222

Thickness 75 ± 15

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}	−55 to +125	°C
Burn-out power measured using 200 ns pulses at a p.r.f. of 4.5 kHz to produce a change in noise figure of 1 dB		2.0	W

CHARACTERISTICS

		min.	typ.	max.	
Noise figure (s.s.b.) measured at 35 GHz in a balanced mixer (Mullard type 760CLOA) with l.o. = 2 mW and 1.5 dB i.f. contribution.	N_o	6.5	7.1	7.5	dB
Total capacitance at 1 MHz with zero bias	C_T	–	0.05	–	pF
Junction capacitance at 1 MHz with zero bias	C_j	–	0.035	–	pF
Series resistance	R_s	–	4	–	Ω
Cut-off frequency $(2\pi R_s C_j)^{-1}$	f_{co}	–	1100	–	GHz
Reverse breakdown voltage (I_R = 10 μA)	$V_{(BR)R}$	2	–	–	V

CIRCUIT MOUNTING

There are a number of options depending on the application and type of circuit substrate, as follows:—

Hard Substrates (Alumina, Quartz, GaAs etc.).

Flip chip mounting by thermal compression or ultrasonic bonding or metal loaded epoxy/polyimide.

Soft Substrates (R.T. Duroid, etc.)

Flip chip mounting by ultrasonic bonding or metal loaded epoxy/polyimide.

Recess mounting, so that the chip face is flush with the circuit metallization which may then be connected to the chip by metal loaded epoxy/polyimide. Typical circuit mounting conditions are a bonding temperature of 150 °C for 1 hour.

Flip chip mounting

If flip chip mounting is required this must be stated when ordering as for this application the bonding pads are gold plated to a height of approximately 10 μm.

Other bonding schedules may be used; please discuss with the supplier.

Space models

These are available to enable customers to experiment with mounting methods for their various substrates. They are supplied as short circuit devices with the same dimensions. Samples are available on request.

MATCHED PAIRS

These are available as 2/CAY18M.

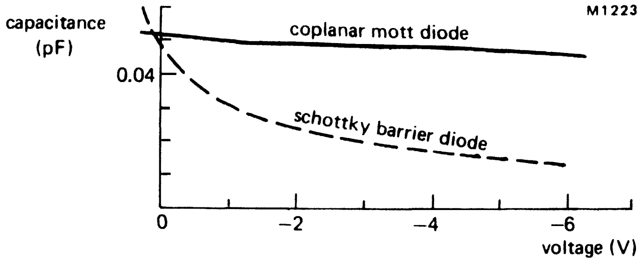


Fig.1

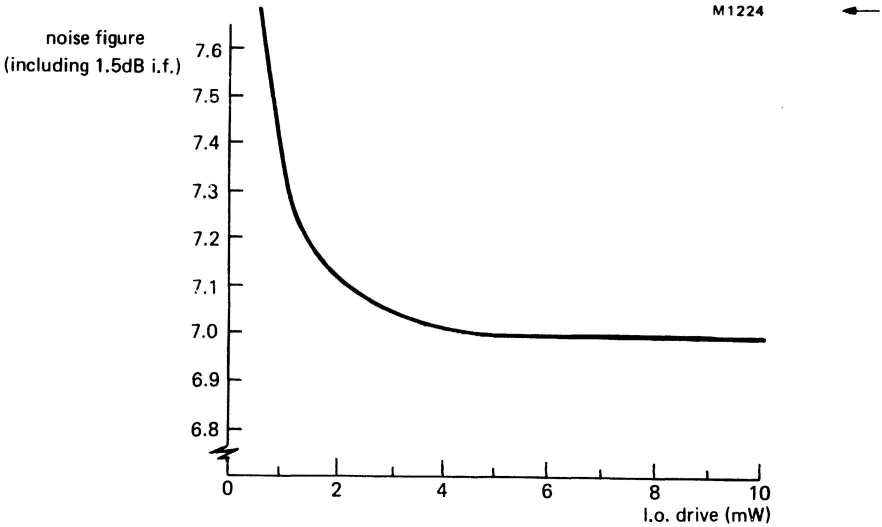


Fig.2 Typical noise figure as a function of local oscillator drive

W–BAND GaAs MOTT MIXER DIODE

This is a gallium arsenide Mott mixer diode for use at W-band (75 to 110 GHz). It embodies several enitrely new concepts in millimetre-wave, low-noise mixer diode design. Advanced gallium arsenide planar technology is used to achieve a high cut-off frequency from a robust coplanar chip which has been designed to be mounted directly into planar circuits using a number of simple techniques. Fragile beam leads and the associated inductances have been eliminated. Additionally the stray capacitance associated with the gold bonding pads, which are on a thick gallium arsenide insulating substrate, is minimized.
As shown in fig.3, the variation in capacitance over a wide voltage range is much smaller than that of a conventional Schottky barrier diode. Therefore the advantage of the Mott mixer is that, since the diode capacitance remains constant, the circuit is matched to the diode impedance over a wide range of local oscillator powers and hence the variation in noise figure, especially at low powers, is also significantly less. The active area is protected by a polyimide coating.

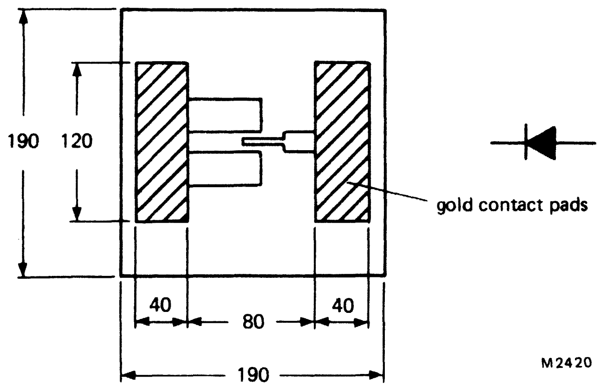
QUICK REFERENCE DATA

Frequency range		75 to 110	GHz
Noise figure	typ.	8.5	dB

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in μm



thickness 60 ± 10

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}	−55 to +100	°C

CHARACTERISTICS

		min.	typ.	max.	
Noise figure (s.s.b.) measured at 85 GHz in a balanced mixer (Mullard type 760CL5A) with l.o. = 4 mW and including 1.5 dB i.f. contribution.	N_O	7.5	8.5	9.5	dB
Total capacitance at 1 MHz with zero bias	C_T	–	0.035	–	pF
Junction capacitance at 1 MHz with zero bias	C_j	–	0.02	–	pF
Series resistance	R_s	–	6	–	Ω
Cut-off frequency $(2\pi R_s C_j)^{-1}$	f_{co}	–	1300	–	GHz
Reverse breakdown voltage (I_R = 10 μA)	$V_{(BR)R}$	2	–	–	V

CIRCUIT MOUNTING

There are a number of options depending on the application and type of circuit substrate, as follows:–

Hard Substrates (Alumina, Quartz, GaAs etc.).

Flip chip mounting by thermal compression or ultrasonic bonding or metal loaded epoxy/polyimide.

Soft Substrates (R.T. Duroid, etc.)

Flip chip mounting by ultrasonic bonding or metal loaded epoxy/polyimide.

Recess mounting, so that the chip face is flush with the circuit metallization which may then be connected to the chip by metal loaded epoxy/polyimide. Typical circuit mounting conditions are a bonding temperature of 150 °C for 1 hour.

Flip chip mounting

If flip chip mounting is required this must be stated when ordering as for this application the bonding pads are gold plated to a height of approximately 10 μm.

Other bonding schedules may be used; please discuss with the supplier.

Space models

These are available to enable customers to experiment with mounting methods for their various substrates. They are supplied as short circuit devices with the same dimensions. Their type number is ON 4054.

MATCHED PAIRS

These are available as 2/CAY19M.

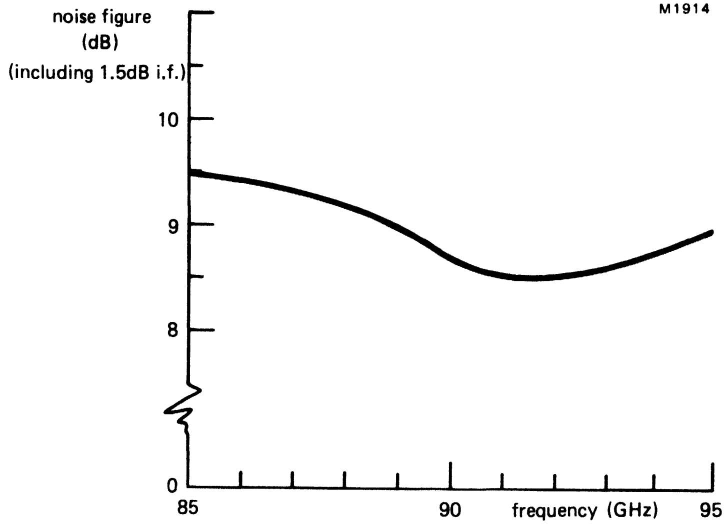


Fig.1 Typical noise figures as a function of frequency
(i.f. = 100 MHz, l.o. = 5 mW)

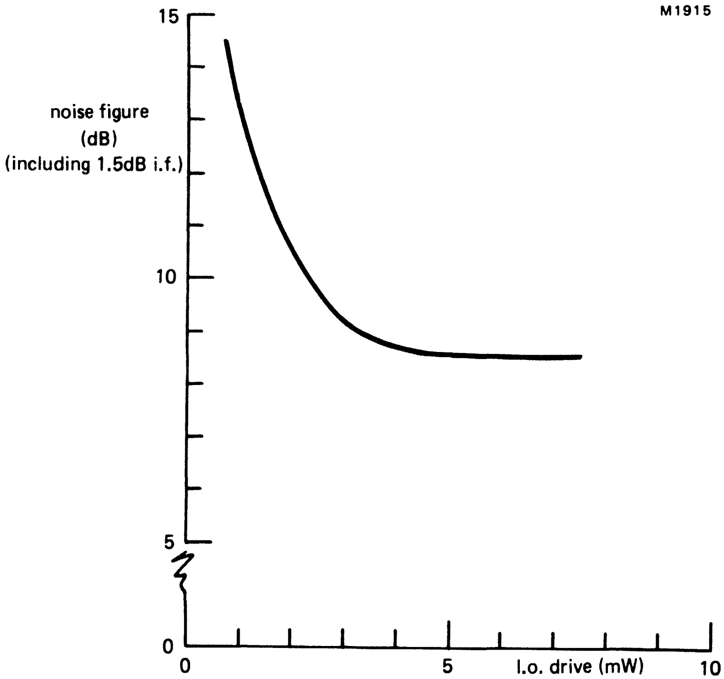


Fig.2 Typical noise figure as a function of local oscillator drive

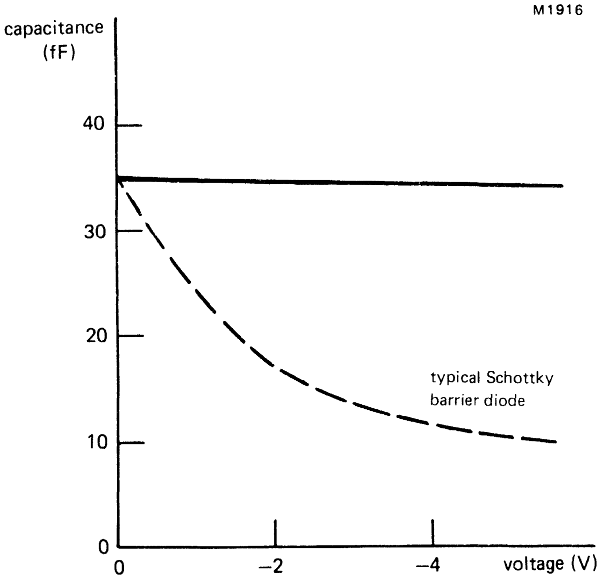


Fig.3 Typical capacitance as a function of voltage

BACKWARD DIODE

MICROWAVE DETECTOR DIODE

Germanium backward diode primarily intended for low level detector applications in J-band (Ku-band) It is packaged in the standard coaxial outline for this frequency band, similar to 1N78 types. The encapsulation is hermetically sealed and is cadmium plated. The AEY33 conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Frequency range		12 to 18	GHz
Voltage sensitivity at −20 dBm input	typ.	10	mV

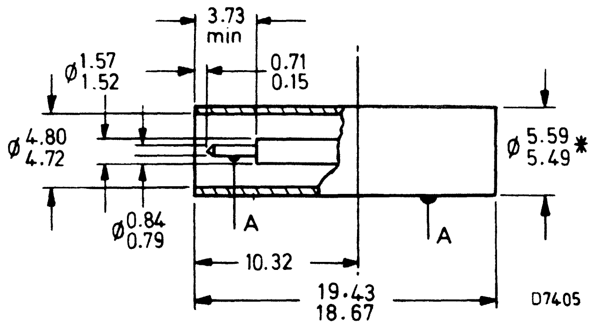
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-49

Similar to JEDEC DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only to the 10.32 dimension

Terminal identification:

Pin	cathode
Body	anode

Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}	−55 to +100	°C
Ambient temperature range	T_{amb}	−55 to +100	°C

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Static					
Reverse current V_R = 0.3 V	I_R	–	9	–	mA
Forward current V_F = 0.3 V	I_F	–	150	–	μA
Dynamic					
Voltage sensitivity at −20 dBm input*	S_v	5	10	–	mV
Video impedance (note 1)	Z_v	200	–	400	Ω
Voltage standing wave ratio (note 2)	v.s.w.r.	–	3:1	–	

Notes

1. Zero bias, input 1.0 mV. (d.c. or a.c. r.m.s.).
2. With respect to 50 Ω, measured at f = 16.5 GHz, zero bias and c.w. input power less than 1.0 μW.

*Measured in a Mid-Century 18/17A waveguide holder.

MULTIPLIER VARACTOR DIODES

SILICON MULTIPLIER VARACTOR DIODE

Silicon planar epitaxial varactor diode for use as a high efficiency frequency multiplier in the v.h.f. and u.h.f. bands. As a tripler from 150 to 450 MHz it has a typical efficiency of 64% and can handle inputs up to 40 W. The BAY96 has a very low series resistance and is packaged in a low inductance, hermetically sealed, welded ceramic-metal envelope with stud cathode. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

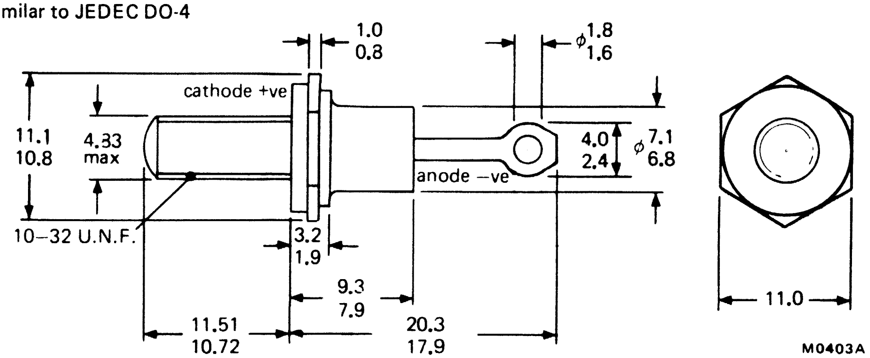
D.C. reverse voltage	V_R	max.	120	V
Total power dissipation	P_{tot}	max.	20	W
Junction temperature	T_j	max.	175	°C
Total capacitance (V_R = 6.0 V, f = 1.0 MHz)	C_T		28 to 39	pF
Series resistance (V_R = 6.0 V, f = 400 MHz)	r_s	max.	1.2	Ω
Cut-off frequency $\frac{1}{2\pi r_s C_T}$ at V_R = 120 V	f_{co}	typ.	25	GHz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-4/8
Conforms to BS3934 SO-10
Similar to JEDEC DO-4



Diameter of clearance hole: max. 5.2

Torque on nut: min. 0.9 Nm
max. 1.7 Nm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

Nut dimensions across the flats: 9.5

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−65 to +175	^oC
Junction temperature (operating)	T_j	max.	175	^oC
D.C. reverse voltage	V_R	max.	120	V
Total power dissipation (T_{mb} = 25 ^oC)	P_{tot}	max.	20	W

THERMAL RESISTANCE

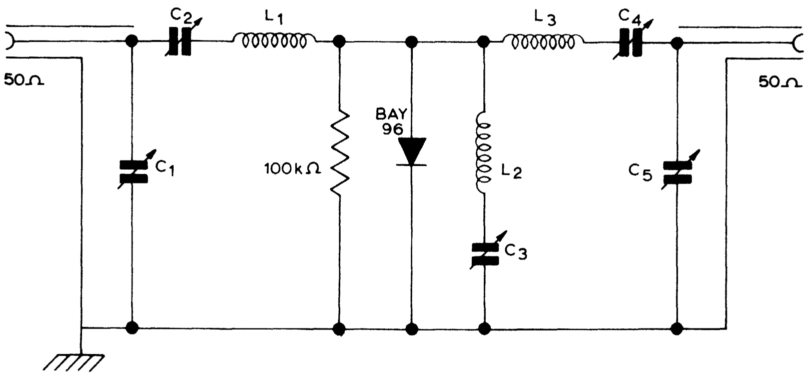
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	7.5	$^oC/W$

CHARACTERISTICS

		min.	typ.	max.	
Total capacitance V_R = 6.0 V, f = 1.0 MHz	C_T	28	–	39	pF
Series resistance V_R = 6.0 V, f = 400 MHz	r_s	–	0.9	1.2	Ω
Cut-off frequency $\frac{1}{2\pi r_s C_T}$ at V_R = 120 V	f_{co}	–	25	–	GHz

APPLICATION INFORMATION

Typical operating characteristics as a frequency tripler



Frequency tripler circuit – 150 to 450 MHz

L_1 = 6.5 turns 18 s.w.g. wire, 0.297" I.D., 0.562" long

L_2 = 2 turns 14 s.w.g. wire, 0.266" I.D., 0.312" long

L_3 = 1.0" X 0.25" X 0.020" copper strip, 0.562" from chassis

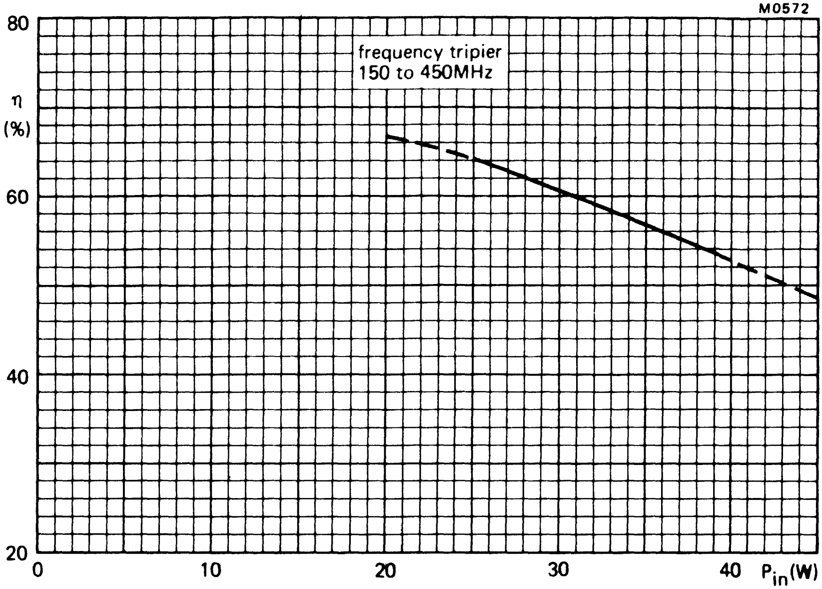
C_1 = 7.0 to 100 pF variable

C_2, C_3, C_4 = 2.0 to 13 pF variable

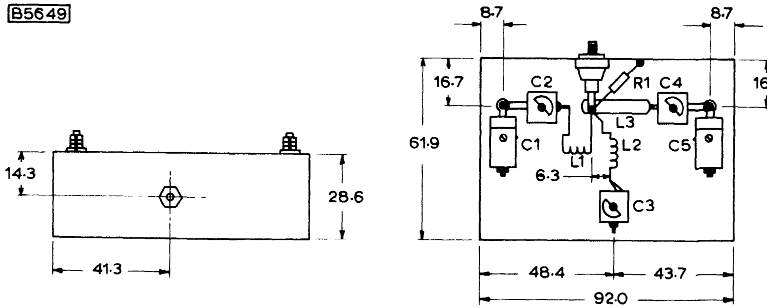
C_5 = 2.0 to 25 pF variable

Efficiency				
P_{in} = 25 W, f_{in} = 150 MHz	η	min.	60	%
		typ.	64	%

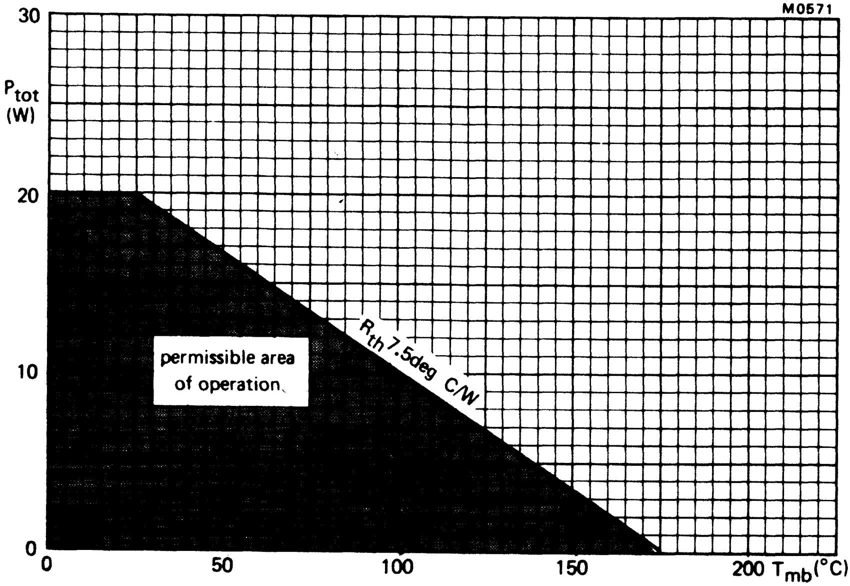
APPLICATION INFORMATION (continued)



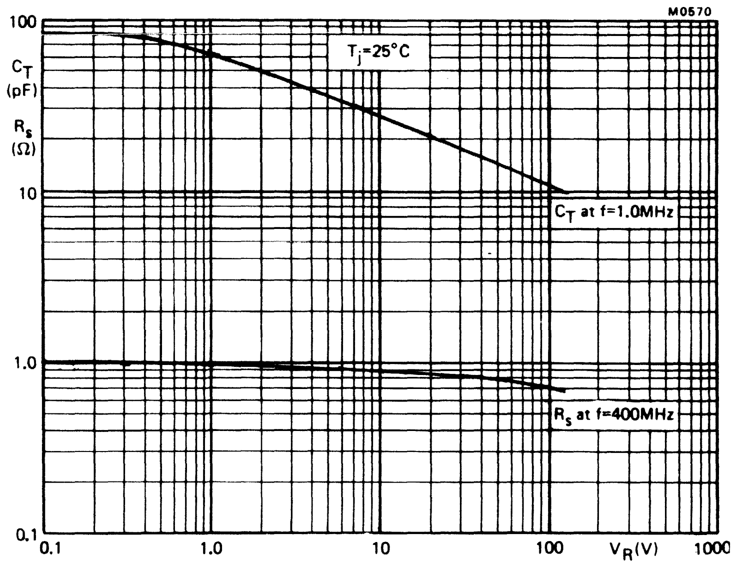
Typical tripler efficiency as a function of input power
See circuit on page 3



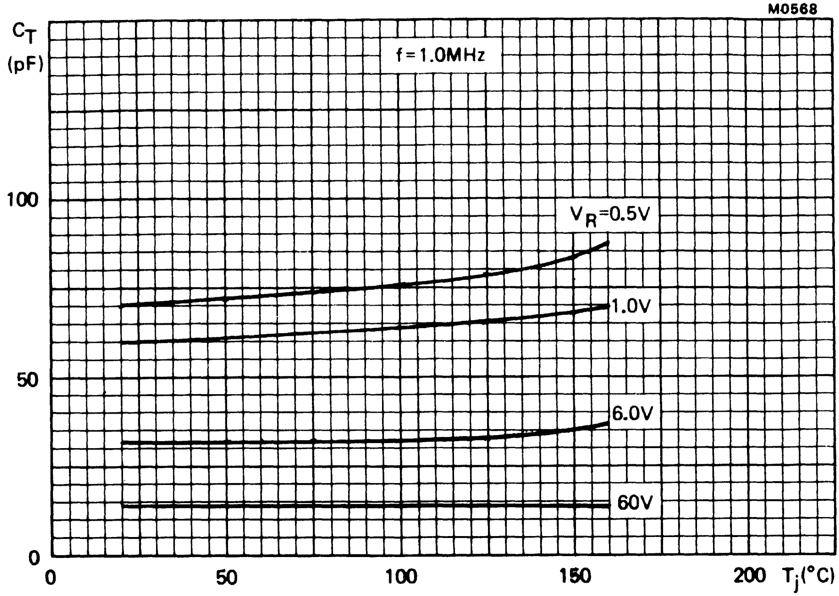
Component layout of tripler circuit

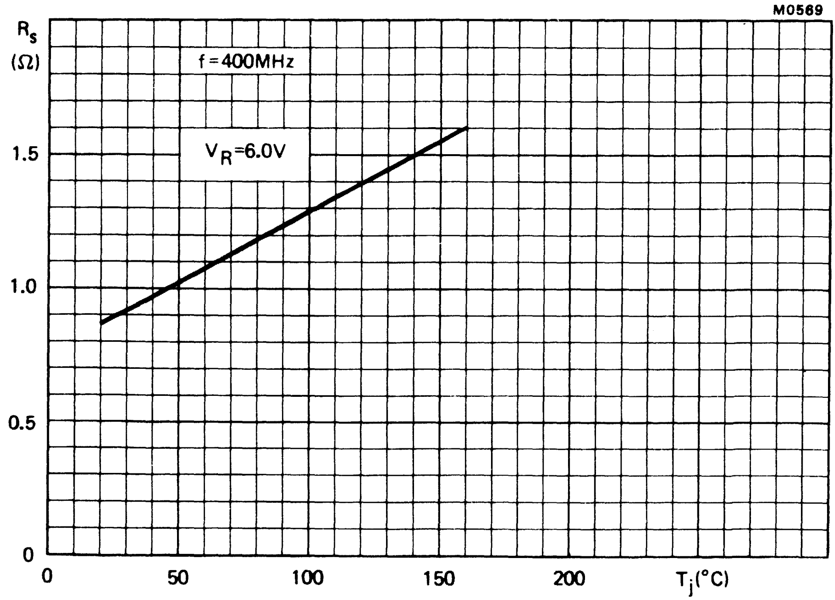


Typical dissipation as a function of mounting base temperature



Typical diode capacitance and series resistance
as a function of reverse voltage





Typical diode capacitance and series resistance
as a function of junction temperature

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to S-band output frequency. It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 1 to 2 GHz in a typical circuit,

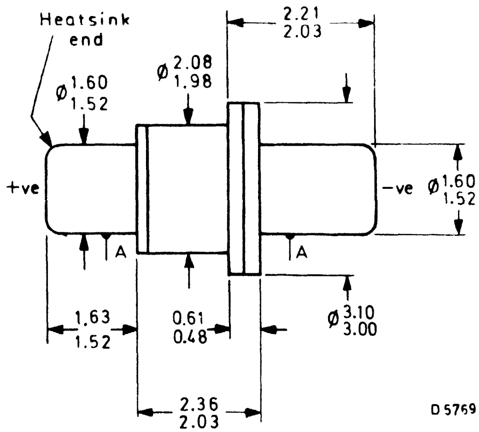
Input r.f. power	P_{in}		10	W
Output r.f. power	P_{out}		5.0	W
Resistive cut-off frequency $V_R = 6.0$ V	f_{co}	typ.	100	GHz
Total capacitance $V_R = 6.0$ V	C_T	typ.	4.5	pF
Junction temperature	T_j	max.	150	^oC

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm ←

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Chips from this range of devices may be supplied in alternative packages to customers' requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C
D.C. reverse voltage	V_R	max.	55	V
Total power dissipation R.F.				
$T_{pin} \leqslant 70$ °C	P_{tot}	max.	4.0	W
$T_{pin} > 70$ °C, derating factor			50	mW/°C

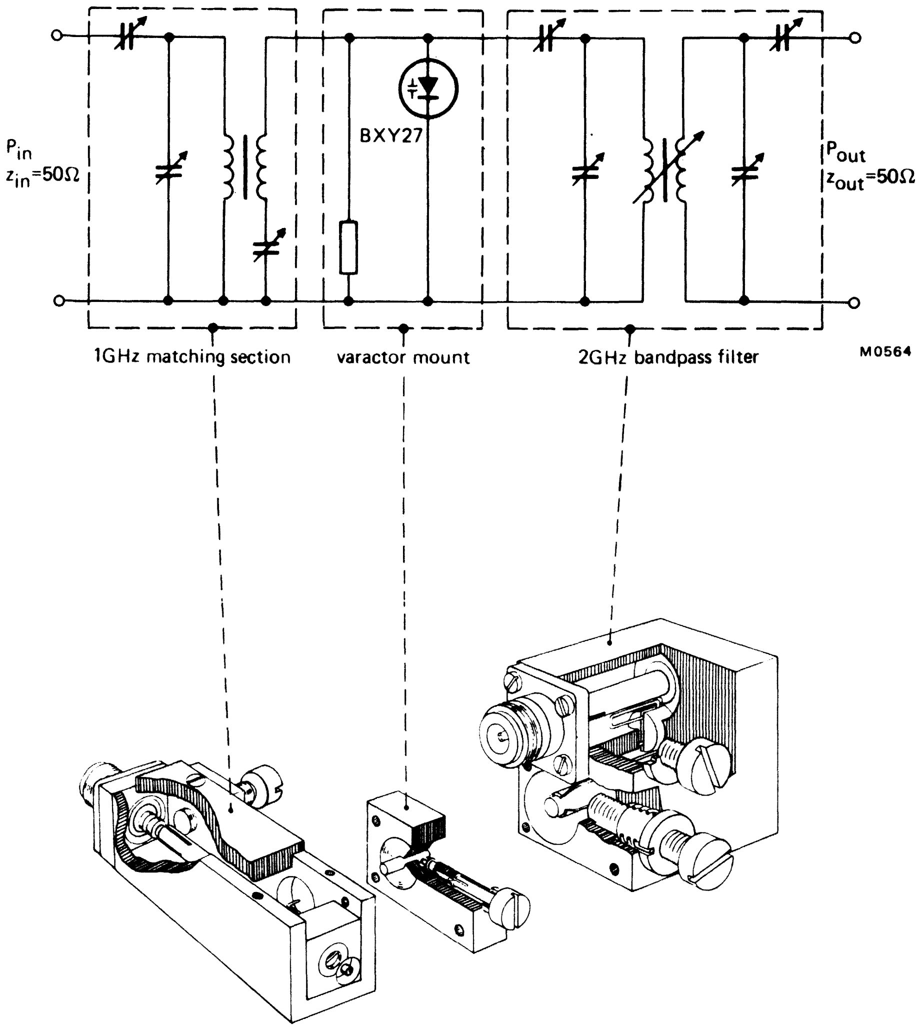
THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	20	°C/W

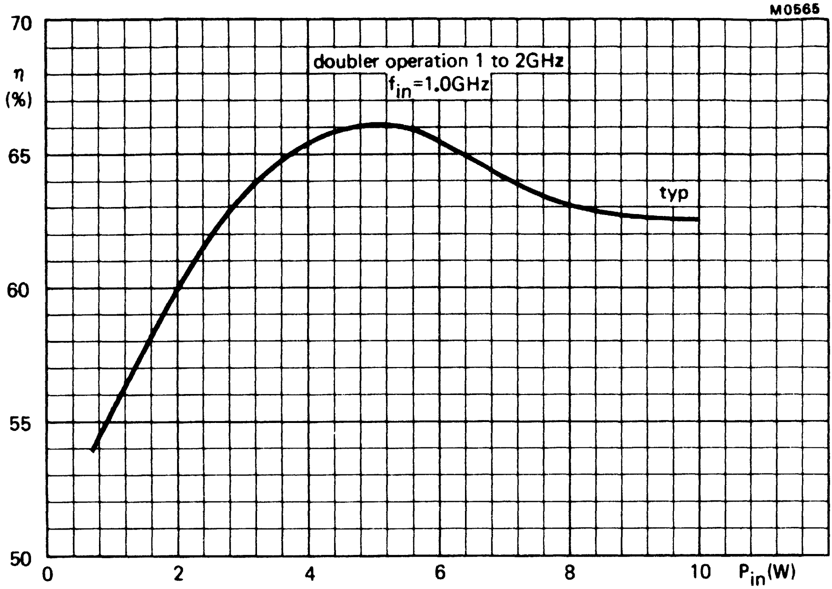
CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage	$V_{(BR)R}$	55	70	–	V
Reverse current, V_R = 6.0 V	I_R	–	0.001	1.0	μA
Cut-off frequency, V_R = 6.0 V $\frac{1}{2\pi r_s C_j}$	f_{co}	50	100	–	GHz
Total capacitance ($C_j + C_s$) V_R = 6.0 V, f = 1.0 MHz	C_T	3.0	4.5	6.0	pF
Stray capacitance	C_s	–	0.25	–	pF
Series inductance	L_s	–	650	–	pH
Series resistance, V_R = 6.0 V	r_s	–	0.4	–	Ω
Overall efficiency P_{in} = 10 W, f_{in} = 1.0 GHz					
frequency doubler	η	50	60	–	%
frequency trebler	η	–	40	–	%

APPLICATION INFORMATION



Frequency doubler circuit (1 to 2 GHz)



Overall efficiency as a function of input power
for doubler operation

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency. It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 2 to 4 GHz in a typical circuit.

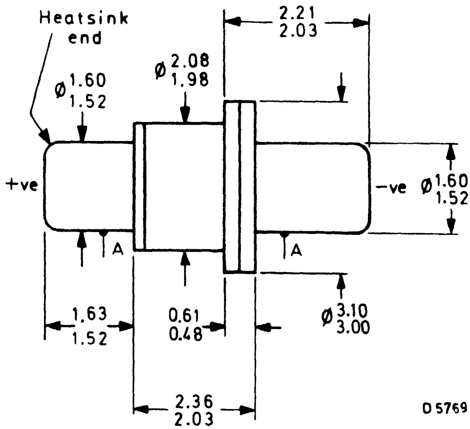
Input r.f. power	P_{in}		7.0	W
Output r.f. power	P_{out}		3.5	W
Resistive cut-off frequency, V_R = 6.0 V	f_{co}	typ.	120	GHz
Total capacitance, V_R = 6.0 V	C_T	typ.	1.5	pF
Junction temperature	T_j	max.	150	°C

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-31 and BS3934 SO-86



A = concentricity tolerance = ± 0.13

Chips from this range of devices may be supplied in alternative packages to customers' requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C
D.C. reverse voltage	V_R	max.	45	V
Total power dissipation R.F.				
$T_{pin} \leq 70$ °C	P_{tot}	max.	2.7	W
$T_{pin} > 70$ °C, derating factor			34	mW/°C

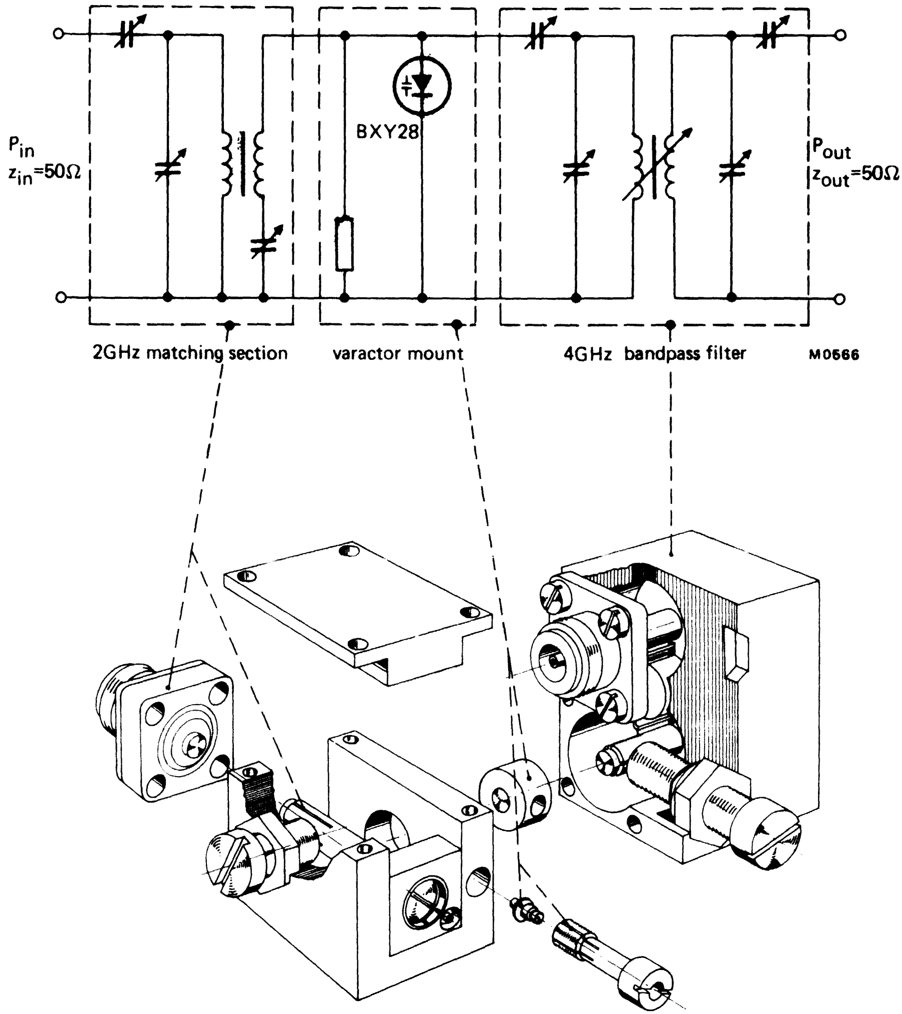
THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	30	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage	$V_{(BR)R}$	45	60	–	V
Reverse current, V_R = 6.0 V	I_R	–	0.001	1.0	μA
→ Cut-off frequency, V_R = 6.0 V $\frac{1}{2\pi r_s C_j}$	f_{co}	80	120	–	GHz
Total capacitance ($C_j + C_s$) V_R = 6.0 V, f = 1.0 MHz	C_T	1.0	1.5	2.5	pF
Stray capacitance	C_s	–	0.25	–	pF
Series inductance	L_s	–	650	–	pH
Series resistance, V_R = 6.0 V	r_s	–	1.0	–	Ω
Overall efficiency P_{in} = 7.0 W, f_{in} = 2.0 GHz frequency doubler	η	50	–	–	%

APPLICATION INFORMATION



Frequency doubler circuit (2 to 4 GHz)

Overall efficiency as a function of input power
for doubler operation

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency. It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency quadrupler 2.25 to 9.0 GHz in a typical circuit.

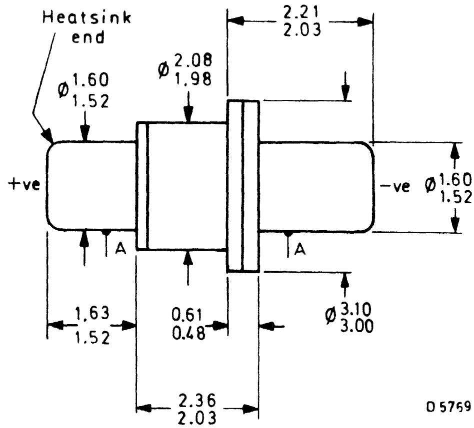
Input r.f. power	P_{in}		1.0	W
Output r.f. power	P_{out}		0.3	W
Resistive cut-off frequency $V_R = 6.0$ V	f_{co}	typ.	120	GHz
Total capacitance $V_R = 6.0$ V	C_T	typ.	1.0	pF
Junction temperature	T_j	max.	150	°C

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Chips from this range of devices may be supplied in alternative packages to customers' requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range			−55 to +150	°C
Junction temperature	T_j	max.	150	°C
D.C. reverse voltage	V_R	max.	25	V
Total power dissipation R.F. $T_{pin} \leq 70$ °C	P_{tot}	max.	2.0	W

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	40	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

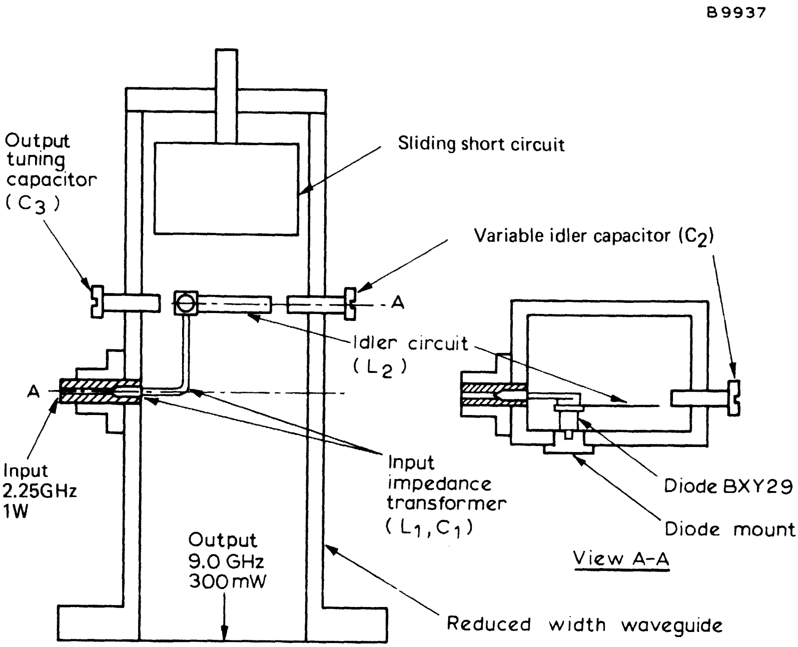
		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	25	–	–	V
Reverse current, V_R = 6.0 V	I_R	–	0.001	1.0	μA
Cut-off frequency, V_R = 6.0 V (note 1)	f_{co}	90	120	–	GHz
Total capacitance ($C_j + C_s$) V_R = 6.0 V, f = 1.0 MHz	C_T	0.8	1.0	1.5	pF
Stray capacitance	C_s	–	0.25	–	pF
Series inductance	L_s	–	650	–	pH
Overall efficiency P_{in} = 1.0 W, f_{in} = 2.25 GHz frequency quadrupler	η	30	–	–	%

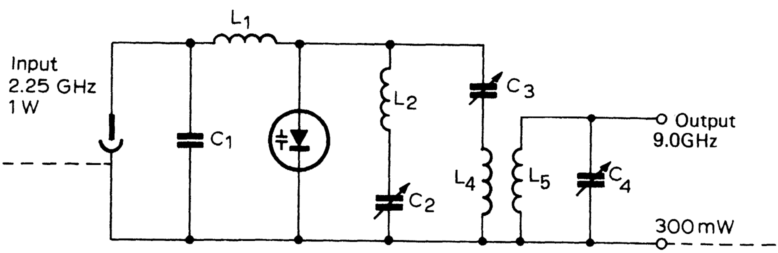
Notes

1. The cut-off frequency f_{co} is defined as: $f_{co} = \frac{1}{2\pi r_s C_j}$

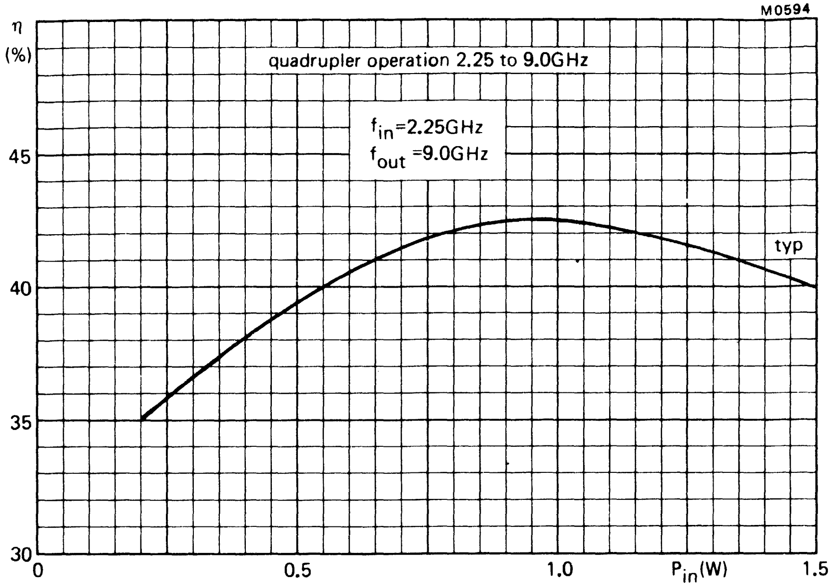
   where C_j is the junction capacitance and is measured at 1.0 MHz,
   r_s is measured on a slotted line at 2.0 GHz.

S-X band quadrupler





Approximate equivalent circuit



Overall efficiency as a function of input power
for quadrupler operation

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency. It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a high order frequency multiplier 1.0 to 10 GHz in a typical circuit.

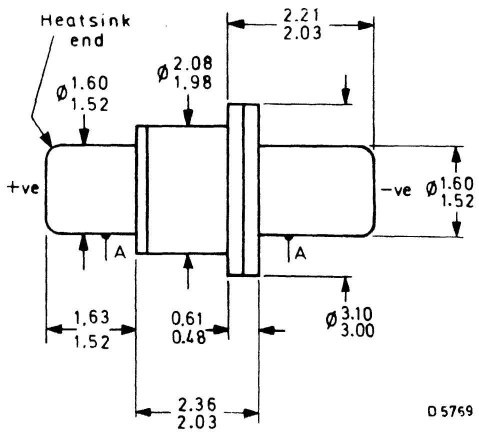
Input r.f. power	P_{in}		500	mW
Output r.f. power	P_{out}		20	mW
Resistive cut-off frequency				
V_R = 6.0 V	f_{co}	typ.	150	GHz
Total capacitance				
V_R = 6.0 V	C_T	typ.	0.75	pF
Junction temperature	T_j	max.	150	°C

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Chips from this range of devices may be supplied in alternative packages to customers' requirements.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C
D.C. reverse voltage	V_R	max.	20	V
Total power dissipation R.F. $T_{pin} \leq 70$ °C	P_{tot}	max.	1.6	W

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	50	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage I_R = 1.0 mA	$V_{(BR)R}$	20	–	–	V
Reverse current, V_R = 6.0 V	I_R	–	0.001	1.0	μA
Cut-off frequency, V_R = 6.0 V (note 1)	f_{co}	100	150	–	GHz
Total capacitance ($C_j + C_s$) V_R = 6.0 V, f = 1.0 MHz	C_T	0.5	0.75	1.0	pF
Stray capacitance	C_s	–	0.25	–	pF
Series inductance	L_s	–	625	–	pH
Transition time	t_{tr}	–	–	150	ps
Storage time	t_s	–	50	–	ns

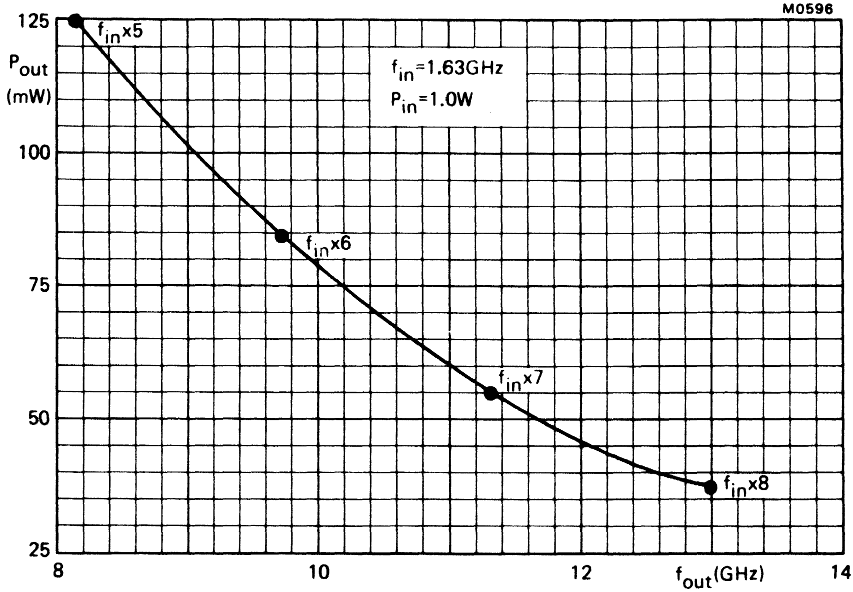
Notes

1. The cut-off frequency f_{co} is defined as: $f_{co} = \frac{1}{2\pi r_s C_j}$

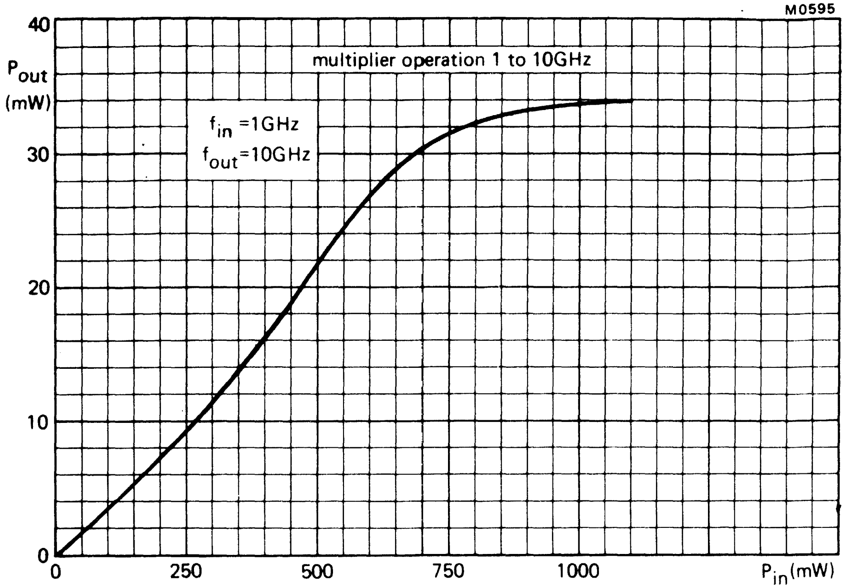
   where C_j is the junction capacitance and is measured at 1.0 MHz,
   r_s is measured on a slotted line at 8.0 GHz

MULTIPLIER PERFORMANCE

		min.	typ.	max.	
Power output, f_{in} = 1.0 GHz P_{in} = 500 mW, f_{out} = 10 GHz	P_{out}	15	20	–	mW



Typical performance in high order multipliers



Typical performance as a frequency multiplier

STEP RECOVERY DIODES

Silicon planar varactor diodes exhibiting step recovery characteristics, especially suitable for use in frequency multipliers. They conform to the environmental requirements of BS9300 where applicable.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

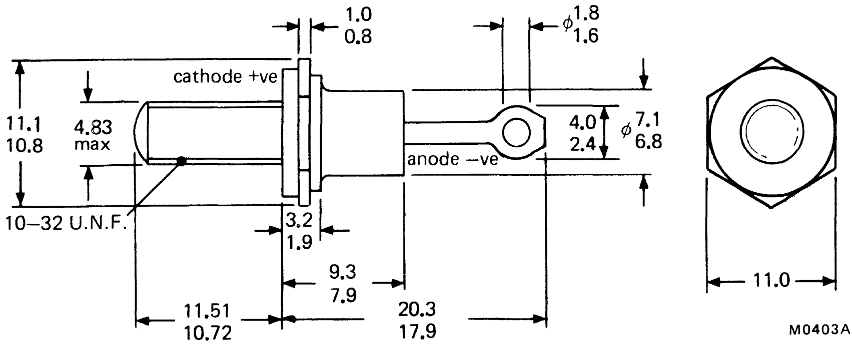
			BXY35	BXY36	BXY37	BXY38	BXY39	BXY40	BXY41	
Reverse breakdown voltage $I_R = 10\ \mu A$	$V_{(BR)R}$	min.	100	70	70	50	40	25	25	V
Cut-off frequency $V_R = 6.0$ V	f_{co}	min.	25	75	100	120	150	180	200	GHz
Diode capacitance $V_R = 6.0$ V	C_j	min.	6.0	4.0	2.0	1.2	0.8	0.4	0.25	pF
		max.	12	6.0	4.0	2.0	1.2	0.9	0.5	pF
Transition time	t_{tr}	max.	–	500	350	300	200	150	100	ps
Storage time	t_s	typ.	–	150	100	75	50	50	25	ns
Thermal resistance, junction to mounting base, types A,D,E	$R_{th\ j\text{-}mb}$		10	20	20	30	40	50	50	°C/W
Thermal resistance junction to pin, types B,C	$R_{th\ j\text{-}pin}$		10	20	20	30	40	50	50	°C/W
Multiplier performance										
Typical output frequency range		min.	0.75	2	4	6	7	8	10	GHz
		max.	2	4	6	8	9	10	14	GHz
Outlines available			A	–	–	–	–	–	–	
			–	B	B	B	B	B	B	
			–	C	C	C	C	C	C	
			–	D	D	D	D	D	D	
			–	E	E	E	E	E	E	

Devices may be selected from this range to suit customers' specific requirements, including further alternative packages.

MECHANICAL DATA

Dimensions in mm

Outline A Conforms to SOD-4/8 and BS3934 SO-10
Similar to JEDEC DO-4



Diameter of clearance hole: 5.2

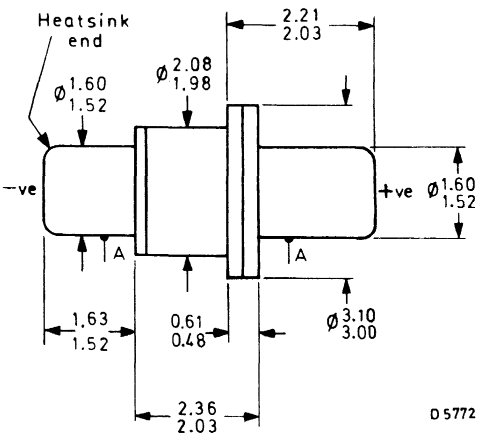
Torque on nut: min. 0.9 Nm
max. 1.7 Nm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

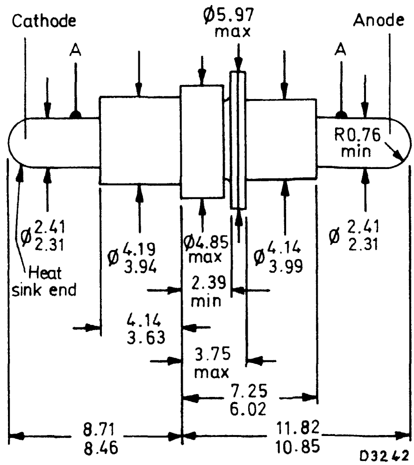
Nut dimensions across the flats: 9.5

Outline B Conforms to SOD-31 and BS3934 SO-86

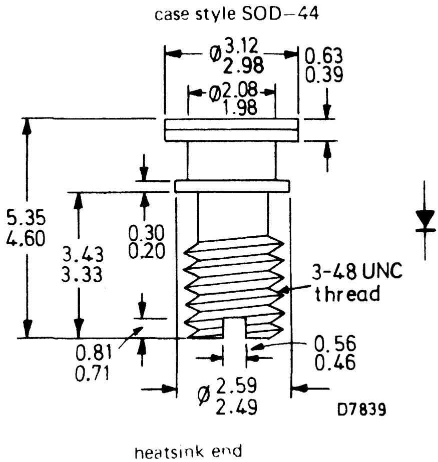


A = concentricity tolerance = ±0.13

Outline C Conforms to SOD-43

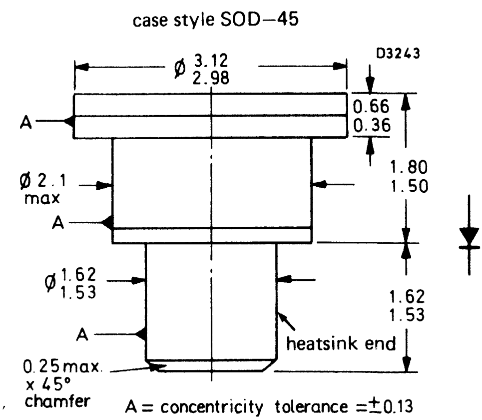


Outline D Conforms to SOD-44



C_S = 0.25pF typ.
L_S = 0.65nH typ.

Outline E Conforms to SOD-45



A = concentricity tolerance = ±0.13
C_S = 0.30pF typ.
L_S = 0.40nH typ.

HIGH EFFIENCY STEP RECOVERY DIODES

High efficiency silicon varactor diodes suitable for operation in low and high order multiplier circuits with output frequencies in the range 3 to 8 GHz. These diodes are of the diffused epitaxial type, having mesa construction for optimum performance and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

			BXY56	BXY57	
Reverse breakdown voltage					
$I_R = 10\,\mu A$	$V_{(BR)R}$	min.	60	60	V
Junction capacitance					
$V_R = 6$ V	C_j	min.	1.5	2.5	pF
		max.	2.5	3.5	pF
Cut-off frequency					
$V_R = 6$ V	f_{co}	min.	160	140	GHz

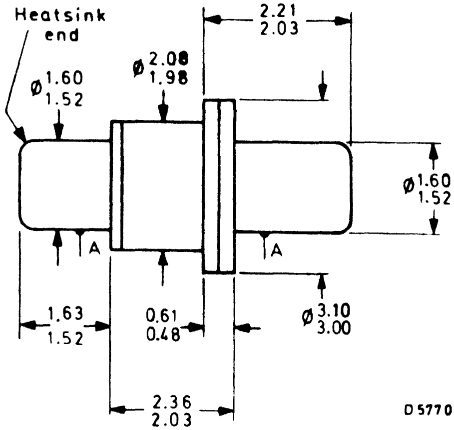
Unless otherwise shown, data is applicable to both types.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-31 and BS3934 SO-86



A = concentricity tolerance = ± 0.13

Normal operation with reverse bias, i.e. heatsink end positive.

Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

			BXY56	BXY57	
Storage temperature range	T_{stg}		−55 to +175	−55 to +175	°C
Junction temperature	T_j	max.	175	175	°C
D.C. reverse voltage	V_R	max.	60	60	V
Total power dissipation T_{hs} max. 50 °C (note 1)	P_{tot}	max.	5.2	6.6	W

THERMAL RESISTANCE

Thermal resistance from junction to heatsink	$R_{th\ j\text{-}hs}$	max.	24	19	°C/W

CHARACTERISTICS (T_{pin} = 25 °C)

Reverse breakdown voltage I_R = 10 μA	$V_{(BR)R}$	min.	60	60	V
Cut-off frequency V_R = 6 V (note 2)	f_{co}	min.	160	140	GHz
Junction capacitance V_R = 6 V, f = 1 MHz	C_j	min.	1.5	2.5	pF
		max.	2.5	3.5	pF
Stray capacitance	C_s	typ.	0.25	0.25	pF
Series inductance	L_s	typ.	650	650	pH
Transition time	t_{tr}	typ.	150	200	ps
Lifetime	τ	typ.	60	150	ns

MULTIPLIER PERFORMANCE
(note 3)

Low order multiplier efficiency in a 2.1 to 4.2 GHz doubler	η	typ.	60	60	%
High order multiplier efficiency in a 0.45 to 3.6 GHz 8x multiplier	η	typ.	20	20	%

Notes

1. $P_{tot} = P_{in} - P_{out}$. Derating curves are sued for value of T_{hs} greater than 50 °C:—

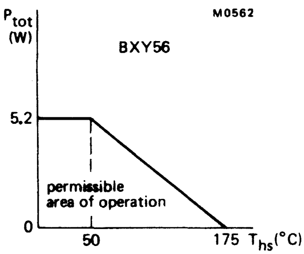


Fig. 1

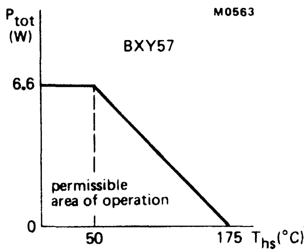


Fig. 2

Notes (continued)

2. Cut-off frequency is measured using a slotted line system at 2 GHz. $f_{co} = \frac{1}{2\pi r_s C_j}$

3. For high power applications it is essential that the heatsink end of the device is gripped by a collet or equivalent clamping system to ensure the best possible thermal conductivity. This in turn should be coupled to an adequate heatsink. Care must be taken to avoid unnecessary deformation of this diode pin, as this may cause cracking of the metal-ceramic hermetic seal. The location of the top cap should be a hold of diameter 1.8 to 2.2 mm bearing on the flange with a force not exceeding 10 N.

GALLIUM ARSENIDE PARAMETRIC AMPLIFIER VARACTOR DIODE

Gallium arsenide varactor diode with a high cut-off frequency for use in parametric amplifiers, frequency multipliers and switches. The diodes are of the diffused mesa type, are mounted in a small ceramic-metal case with a welded hermetic seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

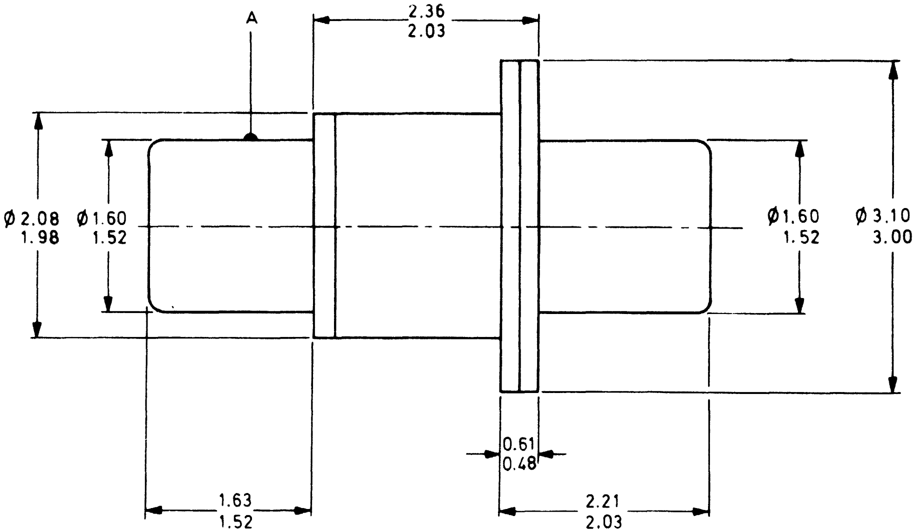
D.C. reverse voltage	V_R	max.	6.0	V
Average forward current	$I_{F(AV)}$	max.	70	mA
Total power dissipation				
$T_{stud} \leqslant 107\ ^oC$	P_{tot}	max.	50	mW
$T_{stud} > 107\ ^oC$, see derating curve				
Junction operating temperature range	T_j		−196 to +150	°C
Cut-off frequency, V_R = 6.0 V	f_{co}	typ.	240	GHz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-31 and BS3934 SO-86



A = concentricity tolerance = ±0 13

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

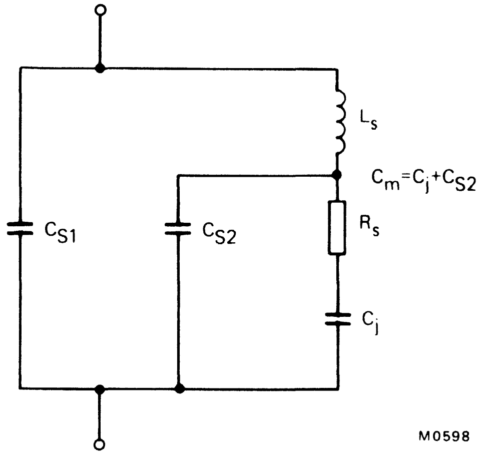
Storage temperature range	T_{stg}		−196 to +150	°C
Junction temperature operating range	T_j		−196 to +150	°C
D.C. reverse voltage	V_R	max.	6.0	V
Average forward current	$I_{F(AV)}$	max.	70	mA
Total power dissipation $T_{stud} \leqslant 107\ °C$	P_{tot}	max.	50	mW

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse current, V_R = 6.0 V	I_R	–	0.1	1.0	µA
Forward voltage drop I_F = 1.0 µA (note 3)	V_F	–	0.9	–	V
Series resonant frequency V_R = 0 (notes 1 and 2)	f_o	8.9	10	11.6	GHz
Cut-off frequency V_R = 0 (note 2)	f_{co}	125	150	–	GHz
Cut-off frequency V_R = 6.0 V (note 2)	f_{co}	–	240	–	GHz
Effective diode capacitance at X-band frequency, V_R = 0 (notes 1 and 2)	C_{mo}	0.3	0.4	0.5	pF
Capacitance variation coefficient (note 3)	γ	0.12	0.15	–	
Stray capacitance (note 1)	C_{S1}	–	0.1	–	pF
Stray capacitance (note 1)	C_{S2}	–	0.15	–	pF
Series inductance (note 1)	L_s	–	625	–	pH

Notes

1. A suitable lumped circuit equivalent for the device may be drawn as follows:



2. Measured at and about the series resonant frequency, in a suitable waveguide holder, enable the values of f_o and the diode Q factor to be determined. The effective diode capacitance and the cut-off frequency can be calculated taking L_s to be the typical value.

$f_{co} = Q_o f_o$ where f_o is the series resonant frequency
Q_o is the Q factor at zero bias

$$C_{mo} = \frac{1}{4\pi^2 f_o^2 L_s}$$

3. The capacitance variation coefficient γ is defined as

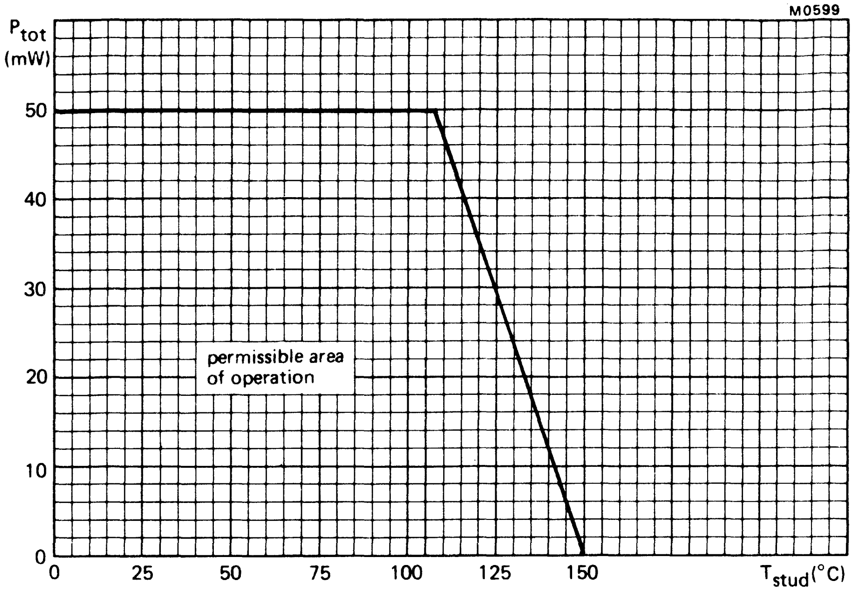
$$\gamma = \frac{C_m \text{ max.} - C_m \text{ min.}}{2(C_m \text{ max.} + C_m \text{ min.})}$$

where C_m min. = effective capacitance at V_R = 1.0 V
C_m max. = effective capacitance at I_F = 1.0 μA

This can be re-written in the form

$$\gamma = \frac{(1-V)^{-1/3} - 2^{-1/3}}{2 \quad (1-V)^{-1/3} + 2^{-1/3} \quad + \dfrac{4C_{S2}}{C_{jo}}}$$

where $V = V_F$ at 1.0 μA
$C_{jo} = C_{mo} - C_{S2}$



Total dissipation as a function of stud temperature

GALLIUM ARSENIDE PARAMETRIC AMPLIFIER VARACTOR DIODE

Gallium arsenide varactor diode with a high cut-off frequency suitable for use in parametric amplifiers and may be used in frequency multipliers and switches. The diodes are of the diffused mesa type, mounted in a small ceramic-metal case with a hermetic welded seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

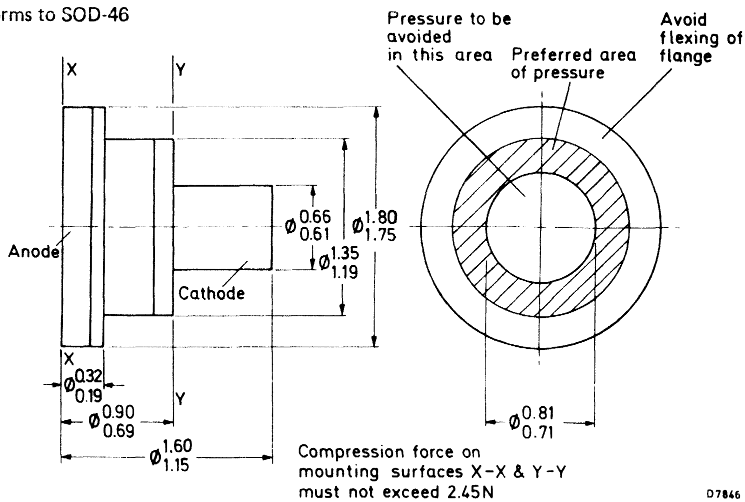
D.C. reverse voltage	V_R	max.	6.0	V
Total power dissipation $T_{pin} \leq 25\ ^oC$	P_{tot}	max.	50	mW
Typical X-band parametric amplifier performance				
Signal frequency	f		8.5	GHz
Gain			15	dB
Bandwidth (3 dB)	B		70	MHz
Noise temperature		typ.	200	^oK

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-46



Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−196 to +175	°C
Junction temperature operating range	T_j		−196 to +135	°C
D.C. reverse voltage	V_R	max.	6.0	V
Total power dissipation $T_{pin} \leqslant 25$ °C	P_{tot}	max.	50	mW

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	0.9	°C/mW

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse current, V_R = 6.0 V	I_R	–	0.1	1.0	µA
Series resonant frequency V_R = 0 (note 1)	f_{res}	27	30	34	GHz
Cut-off frequency V_R = 0 (note 1)	f_{co}	200	350	–	GHz
Product of capacitance variation coefficient and cut-off frequency V_R = 0 (note 2)	γf_{co}	35	50	–	GHz
Microwave value of effective device series resistance (notes 1 and 4)	R_m	–	2.25	–	Ω
Microwave value of effective device capacitance V_R = 0 (notes 3 and 4)	C_m	–	0.2	–	pF
Stray capacitance (L.F. measurement)	C_s	–	0.3	–	pF
Microwave value of effective device series inductance (note 3)	L_s	–	140	–	pH

Notes

1. Measured in a reduced height waveguide holder at Q-band.
2. γf_{co} is guaranteed by a functional X-band paramp test at room temperature. The capacitance variation coefficient, γ, is defined as follows:

$$\gamma = \frac{C_m \text{ max.} - C_m \text{ min.}}{2(C_m \text{ max.} + C_m \text{ min.})}$$

where C_m min. = effective capacitance at V_R = 1.0 V
C_m max. = effective capacitance at I_F = 1.0 µA

3. C_m is calculated using the frequency cut-off and the series resistance:

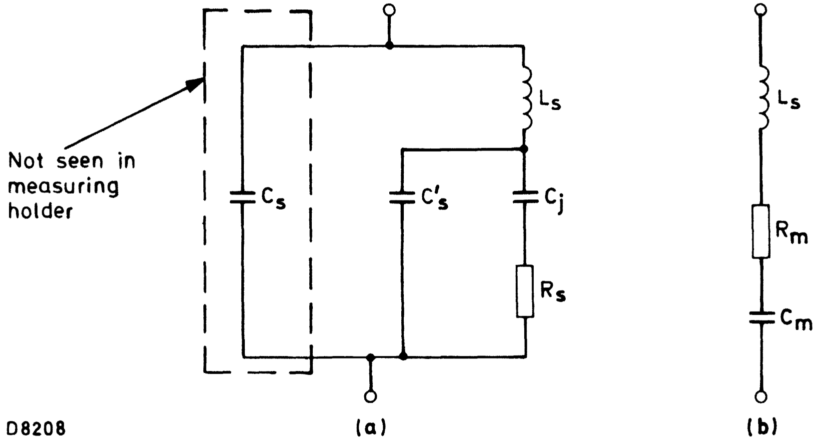
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

L_s is also calculated using f_{res} and C_m:

$$L_s = \frac{1}{4\pi^2 f_{res}^2 C_m}$$

Notes (continued)

4. (a) Diode circuit model.
   (b) Equivalent circuit in measuring holder.



Operating note

The CXY10 varactor diode will give good noise performance in a parametric amplifier of suitable design.

For example:

The effective input noise temperature of the amplifier, less the contribution due to the circulator, would be typically 200 °K and a maximum of 250 °K, with the amplifier at room temperature under the following conditions:

gain	15 dB
bandwidth	50 MHz (3 dB)
signal frequency	in X-band
overcoupled ratio	4 to 5 dB
pump frequency	in Q-band

In cooled parametric amplifiers, the device would give appropriately lower effective input noise temperatures due to its low temperature working capability.

GALLIUM ARSENIDE MULTIPLIER VARACTOR DIODE

Gallium arsenide varactor diode suitable for use in frequency multiplier circuits up to Q-band output frequency. The diodes are of the diffused mesa type, are mounted in a small ceramic-metal case with hermetic welded seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency quadrupler 9.0 to 36 GHz in a typical circuit.

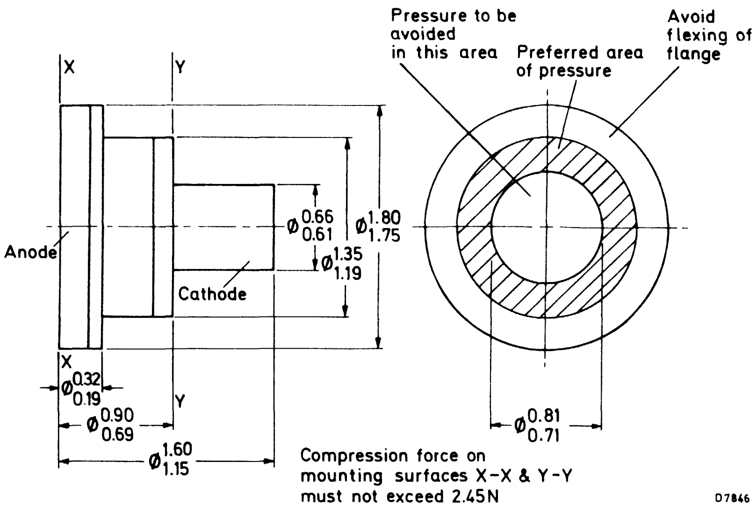
Input r.f. power	P_{in}	max.	500	mW
Output r.f. power	P_{out}	min.	50	mW
Resistive cut-off frequency, V_R = 6.0 V	f_{co}	typ.	500	GHz
Junction temperature	T_j	max.	175	°C

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-46



Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	^{o}C
Junction temperature	T_j	max.	175	^{o}C
D.C. reverse voltage	V_R	max.	10	V
Total power dissipation T_{pin} = 25 ^{o}C (note 1)	P_{tot}	max.	300	mW
Input power R.F.	P_{in}	max.	500	mW

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	0.5	$^{o}C/mW$

CHARACTERISTICS (T_{amb} = 25 ^{o}C

		min.	typ.	max.	
Reverse breakdown voltage I_R = 100 μA	$V_{(BR)R}$	10	15	–	V
Reverse current, V_R = 6.0 V	I_R	–	0.001	1.0	μA
Series resonance frequency V_R = 6.0 V (note 2)	f_{res}	27	29	35	GHz
Cut-off frequency V_R = 6.0 V (note 2)	f_{co}	300	500	–	GHz
Microwave value of effective device capacitance V_R = 6.0 V (note 3)	C_m	–	0.25	–	pF
Microwave value of effective device series resistance V_R = 6.0 V (notes 2 and 4)	R_m	–	1.3	–	Ω
Stray case capacitance (L.F. measurement)	C_s	–	0.3	–	pF
Microwave value of effective device series inductance (note 3)	L_s	–	120	–	pH

Notes

1. The maximum value of P_{tot} is based on a d.c. dissipation life test. The R.F. power may well exceed this figure in a practical circuit.

2. Measurements on semiconductor devices at microwave frequencies are very much dependent upon the kind of holder used. The dynamic parameters are quoted using a holder which takes the form of a double four section Q-band (Ka-band) 26 to 40 GHz waveguide wide band low v.s.w.r. transformer to a reduced height of 0.25 mm. The transformer is step down followed by step up in order to use standard Q-band components on either side. A d.c. isolated coaxial choke system allows the diode to be inserted across the 0.25 mm reduced height section and to be biased.
Using a swept frequency transmission loss measurement system, the series resonant frequency and the Q of the diode holder system can be measured. Hence, the resistive cut-off frequency which is defined as $Q \times f_{res}$.
Separately, by measuring the transmission loss past the diode at resonance, the effective diode series resistance can be found.

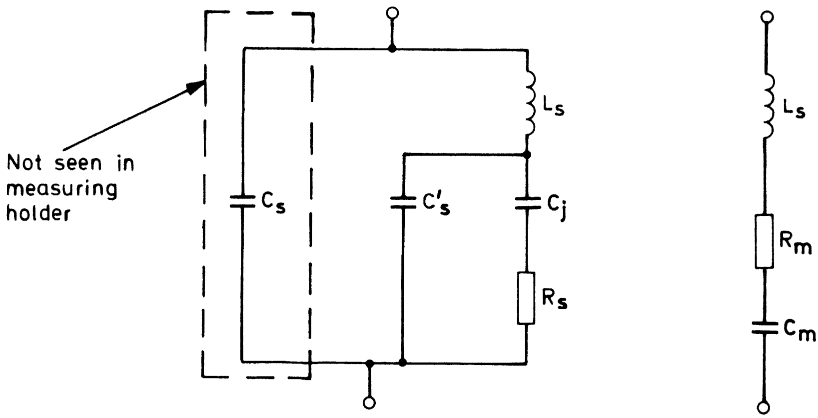
3. C_m is calculated using the frequency cut-off and the series resistance:

$$C_m = \frac{1}{2\pi R_m f_{co}}$$

L_s is also calculated using f_{res} and C_m:

$$L_s = \frac{1}{4\pi^2 f_{res}^2 C_m}$$

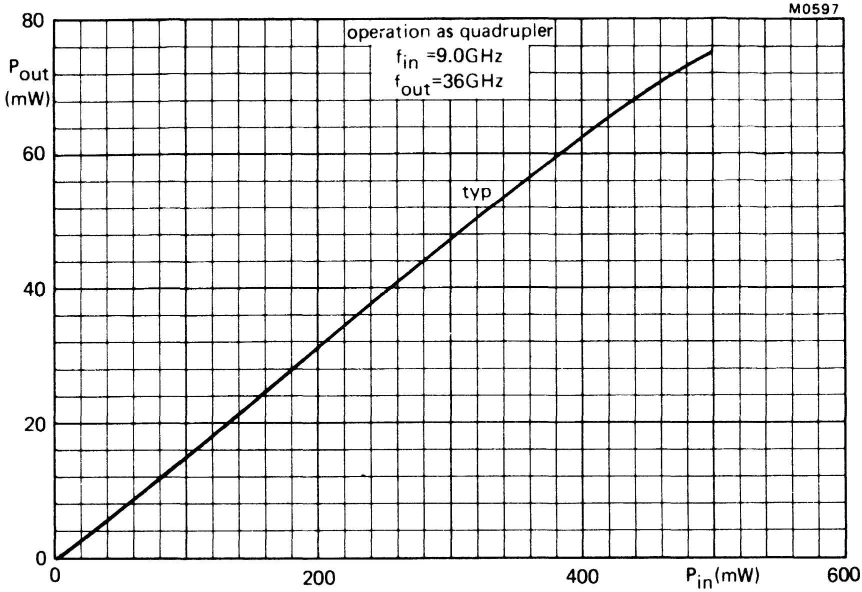
4. (a) Diode circuit model.
(b) Equivalent circuit in measuring holder.



D8208 (a) (b)

Application note

In a suitable frequency quadrupler, this device is capable of producing 50 mW at 36 GHz for an input of 400 mW at 9.0 GHz.



Output power as a function of input power
Quadrupler operation

STEP RECOVERY DIODES

Silicon planar epitaxial varactor diodes exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to S-band output frequency. They conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 1 to 2 GHz in a typical circuit.

Input r.f. power	P_{in}		12	W
Output r.f. power	P_{out}		6.0	W
Resistive cut-off frequency $V_R = 6.0$ V	f_{co}	typ.	100	GHz
Total capacitance, $V_R = 6.0$ V	C_T	typ.	6.0	pF

Unless otherwise stated, data is applicable to both types.

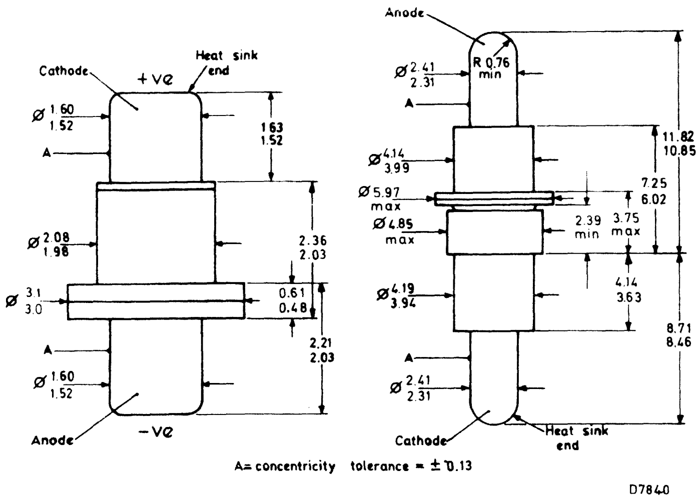
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm ←

1N5152
Conforms to BS3934 SO-86 and to SOD-31

1N5153
Conforms to SOD-43



Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C
D.C. reverse voltage	V_R	max.	75	V
Total power dissipation R.F. $T_{pin} \leq 70$ °C	P_{tot}	max.	5.0	W

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	20	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	75	–	–	V
Reverse current, V_R = 60 V	I_R	–	0.001	1.0	μA
Forward voltage, I_F = 10 mA	V_F	–	–	1.0	V
Cut-off frequency, V_R = 6.0 V, $f_{measured}$ = 2.0 GHz	f_{co}	55	100	–	GHz
Total capacitance V_R = 6.0 V, f= 1.0 MHz	C_T	5.0	–	7.5	pF
Overall efficiency P_{in} = 12 W, f_{in} = 1.0 GHz frequency doubler	η	50	60	–	%

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating as a frequency tripler 2 to 6 GHz in a typical circuit.

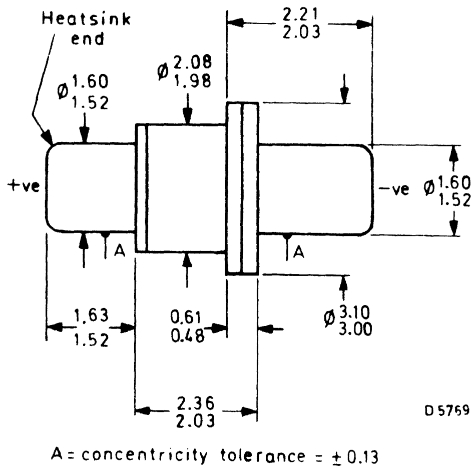
Input r.f. power	P_{in}		5.0	W
Output r.f. power	P_{out}		2.0	W
Resistive cut-off frequency, V_R = 6.0 V	f_{co}	typ.	120	GHz
Total capacitance, V_R = 6.0 V	C_T	typ.	2.0	pF

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		–55 to +175	°C
Junction temperature	T_j	max.	175	°C
D.C. reverse voltage	V_R	max.	35	V
Total power dissipation R.F. $T_{pin} \leqslant 70$ °C	P_{tot}	max.	3.0	W

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	35	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	35	--	–	V
Reverse current, V_R = 26 V	I_R	–	0.001	1.0	μA
Forward voltage, I_F = 10 mA	V_F	–	–	1.0	V
Cut-off frequency, V_R = 6.0 V, $f_{measured}$ = 2.0 GHz	f_{co}	100	120	–	GHz
Total capacitance V_R = 6.0 V, f = 1.0 MHz	C_T	1.0	–	3.0	pF
Overall efficiency P_{in} = 5.0 W, f_{in} = 2.0 GHz, frequency tripler	η	40	–	–	%

STEP RECOVERY DIODE

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to X-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating as a frequency doubler 5 to 10 GHz in a typical circuit.

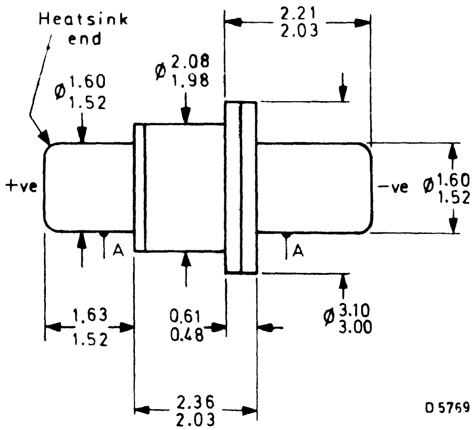
Input r.f. power	P_{in}		2.6	W
Output r.f. power	P_{out}		1.0	W
Resistive cut-off frequency, V_R = 6.0 V	f_{co}	typ.	200	GHz
Total capacitance, V_R = 6.0 V	C_T	typ.	0.8	pF

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance = ± 0.13

Devices may be selected to suit customers' specific requirements, including alternative packages.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C
D.C. reverse voltage	V_R	max.	20	V
Total power dissipation R.F. $T_{pin} \leq 70$ °C	P_{tot}	max.	2.5	W

THERMAL RESISTANCE

Thermal resistance from junction to pin	$R_{th\ j\text{-}pin}$	max.	38.5	°C/W

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	20	–	–	V
Reverse current, V_R = 16 V	I_R	–	–	0.1	μA
Forward voltage, I_F = 10 mA	V_F	–	–	1.0	V
Cut-off frequency, V_R = 6.0 V, $f_{measured}$ = 8.0 GHz	f_{co}	180	200	–	GHz
Total capacitance V_R = 6.0 V, f = 1.0 MHz	C_T	0.6	–	1.0	pF
Overall efficiency P_{in} = 2.6 W, f_{in} = 5.0 GHz frequency doubler	η	38	–	–	%

TUNING VARACTOR DIODES

SILICON PLANAR VARACTOR TUNING DIODES

This is a range of planar epitaxial varactor tuning diodes with highly reproducible abrupt junction performance. The devices are specifically designed for frequency tuning in military and professional applications where high stability is essential.
A ± 10% capacitance tolerance is supplied as standard; closer tolerances are available on request.
This series of diodes is available in a wide range of ceramic packages, including those shown here.
They conform to the environmental requirements of BS CECC 50.006–010 where applicable.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Storage temperature range		T_{stg}		−65 to +150	°C
Ambient temperature range for operation		T_{amb}		−65 to +150	°C
Reverse voltage	BXY48–20	V_R	max.	20	V
	BXY48–30	V_R	max.	30	V
	BXY48–40	V_R	max.	40	V

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
20 volt series, BXY48–20					
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	22	25	–	V
Reverse leakage current, V_R = 20 V	I_R	–	–	0.1	μA
Junction capacitance, −4 V (note 1)	C_j	0.3	–	1.6	pF
Capacitance law (note 2)					
Q at −4 V (note 3)		–	2500	–	
30 volt series, BXY48–30					
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	33	36	–	V
Reverse leakage current, V_R = 30 V	I_R	–	–	0.1	μA
Junction capacitance, −4 V (note 1)	C_j	0.4	–	1.8	pF
Capacitance law (note 2)					
Q at −4 V (note 3)		–	1500	–	
40 volt series, BXY48–40					
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	45	48	–	V
Reverse leakage current, V_R = 40 V	I_R	–	–	0.1	μA
Junction capacitance, −4 V (note 1)	C_j	0.6	–	4.5	pF
Capacitance law (note 2)					
Q at −4 V (note 3)		–	1000	–	

Notes

1. The customer should specify the required total capacitance value and measurement voltage (0 or –4 V). A ± 10% capacitance tolerance is supplied as standard; closer tolerances are available on request.
   Capacitance is measured at 1 MHz.

2. All junctions are abrupt and obey the following law:

$$C_T = C_{jo}\left(1 + \frac{V_R}{\phi}\right)^{-n} + C_s$$

where C_T is total capacitance

C_{jo} is zero bias junction capacitance

V_R is reverse voltage

ϕ is 0.65 V, typically

n is 0.46, typically

C_s is package capacitance

3. Measurements at microwave frequencies are converted to Q at 50 MHz.

4. Case parasitics C_s and L_s are shown on the outline drawings.

Ordering information

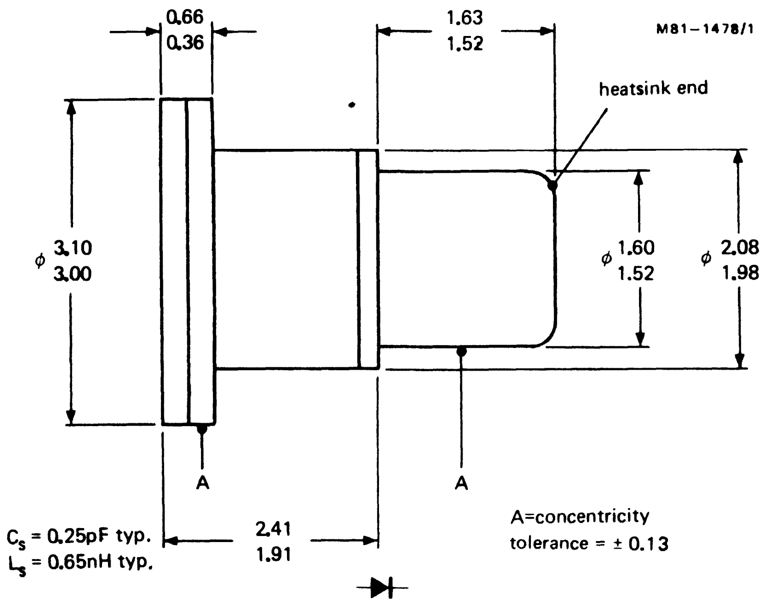
When ordering, please specify:

1. Reverse breakdown voltage.
2. Total capacitance and measurement voltage.
3. Capacitance tolerance.
4. Case style.

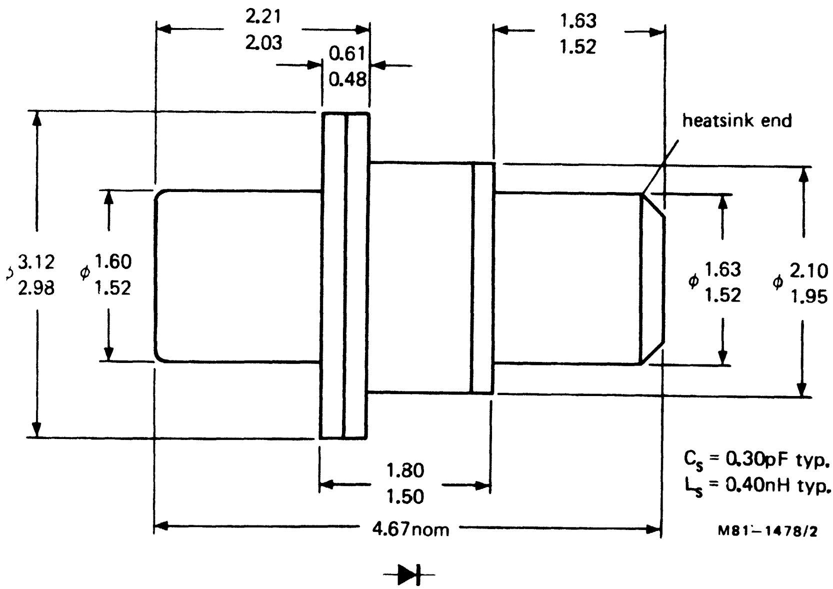
MECHANICAL DATA

Dimensions in mm

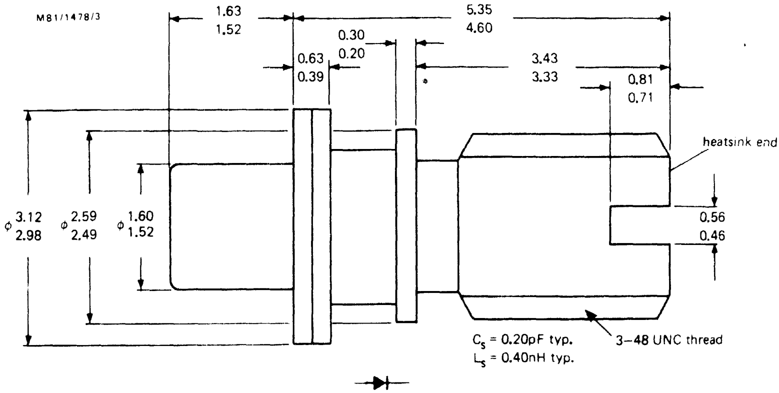
case style MO–63



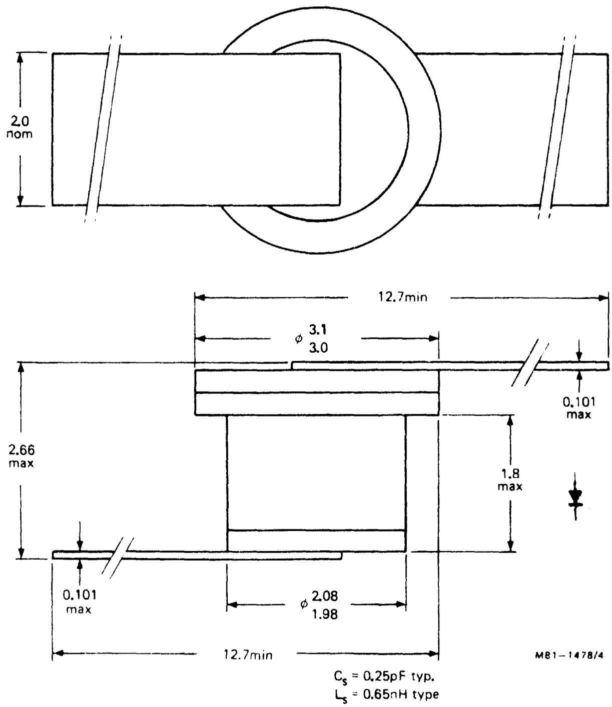
case style MO–64

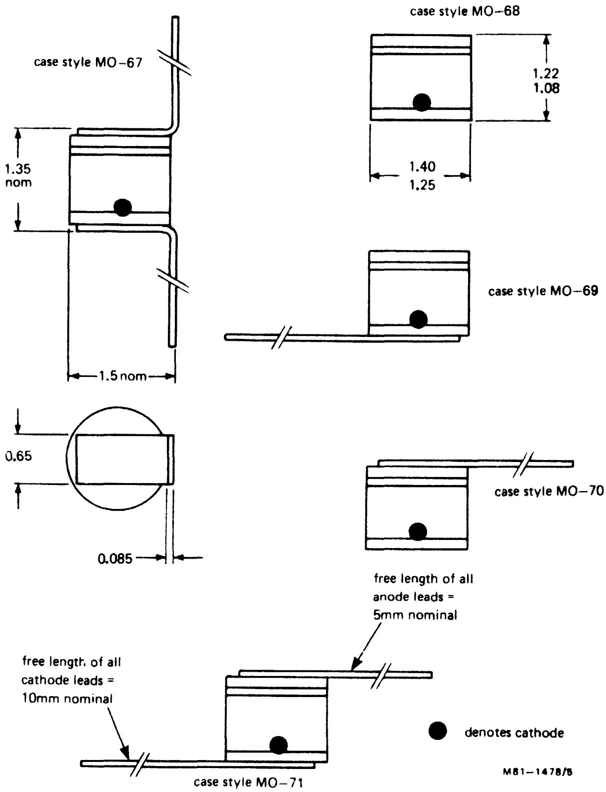


case style MO–65



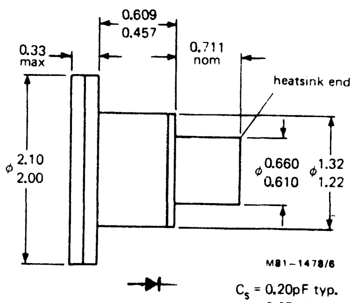
case style MO–66





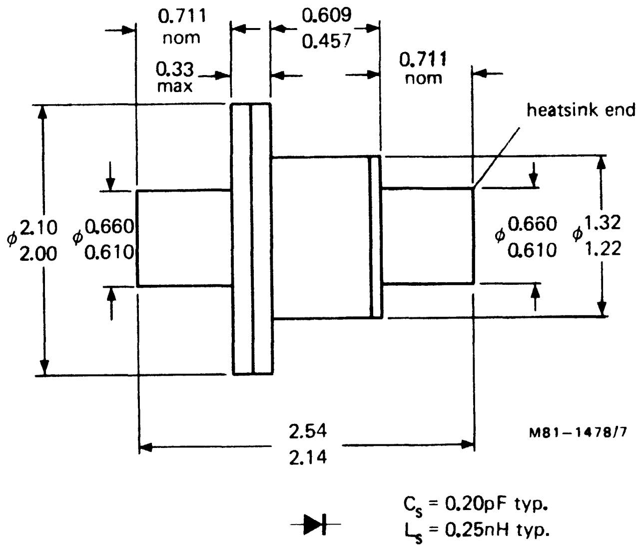
for all casestyles: C_s = 0.15pF typ.
L_s = 0.20nH typ.

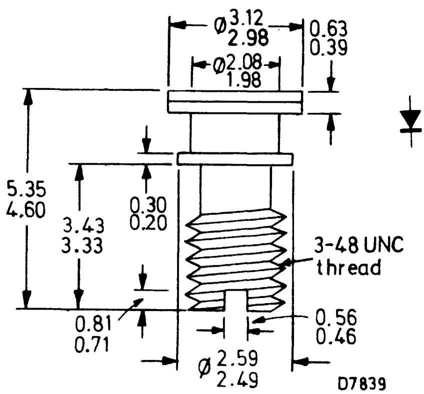
case style MO–72



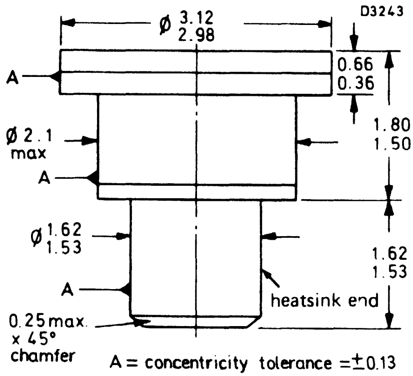
C_s = 0.20pF typ.
L_s = 0.25nH typ.

case style MO–73





case style SOD−45



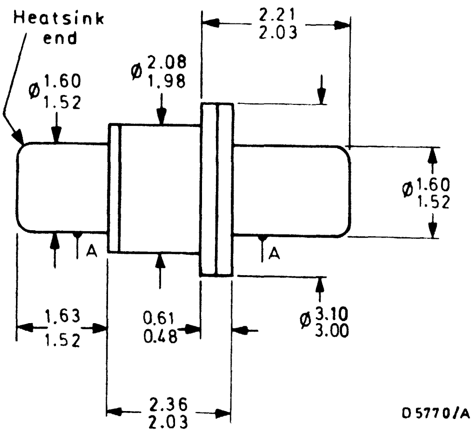
A = concentricity tolerance = ±0.13

C_S = 0.30pF typ.

L_S = 0.40nH typ.

case style SOD−31

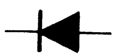
conforms to BS3934 SO−86



A = concentricity tolerance = ± 0.13

C_S = 0.25pF typ.

L_S = 0.65nH typ.



GALLIUM ARSENIDE TUNING DIODES

This is a range of high Q gallium arsenide varactor tuning diodes with highly reproducible abrupt junction performance. The devices are specifically designed for broadband tuning applications up to Q-band (Ka-band). A ± 10% capacitance tolerance is supplied as standard; closer tolerances are available on request.
This series of diodes is available in a wide range of ceramic packages.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Storage temperature range	T_{stg}	–55 to +150	^oC
Ambient temperature range for operation	T_{amb}	–55 to +150	^oC
Reverse voltage	V_R	max. 30	V

CHARACTERISTICS (T_{amb} = 25 ^oC)

		min.	typ.	max.	
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	35	–	–	V
Junction capacitance, 0 V (note 1)	C_j	0.6	–	4.8	
Junction capacitance, –4 V (note 1)	C_j	0.3	–	2.0	pF
Capacitance law (note 2)					
Q at –4 V (note 3)		–	6000	–	

Notes

1. The customer should specify the required total capacitance value and measurement voltage (0 or –4 V). A ± 10% capacitance tolerance is supplied as standard; closer tolerances are available on request.
   Capacitance is measured at 1 MHz.

2. All junctions are abrupt and obey the following law:

$$C_T = C_{jo} \left(1 + \frac{V_R}{\phi}\right)^{-n} + C_s$$

where C_T is total capacitance
C_{jo} is zero bias junction capacitance
V_R is reverse voltage
ϕ is 0.65 V typically
n is 0.46, typically
C_s is package capacitance

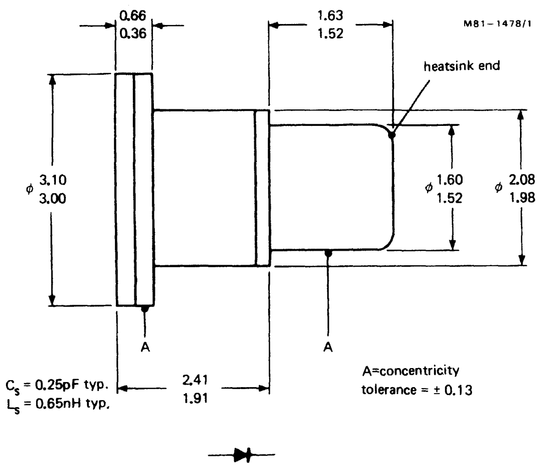
3. Measurements at microwave frequencies are converted to Q at 50 MHz.
4. Case parasitics C_s and L_s are shown on the outline drawings.

Ordering information

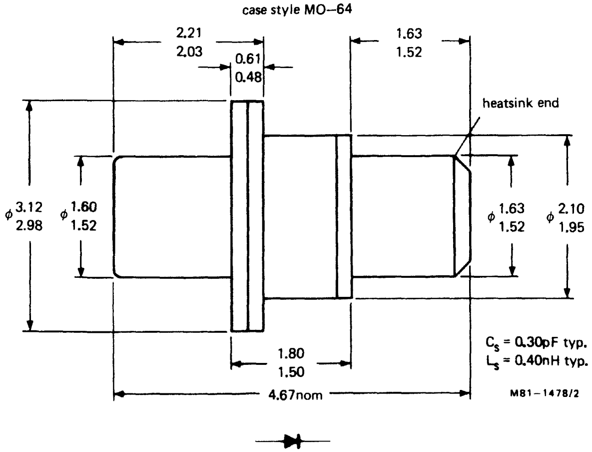
When ordering, please specify:

1. Total capacitance and measurement voltage.
2. Capacitance tolerance.
3. Case style.

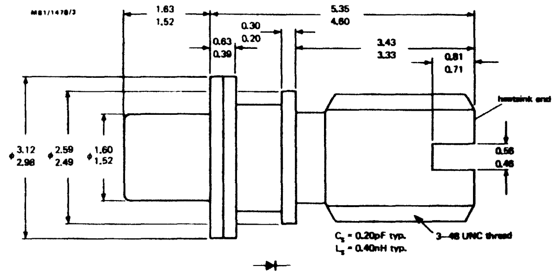
case style MO–63



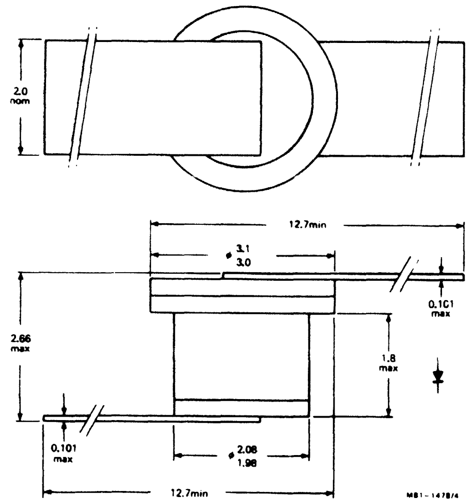
case style MO–64

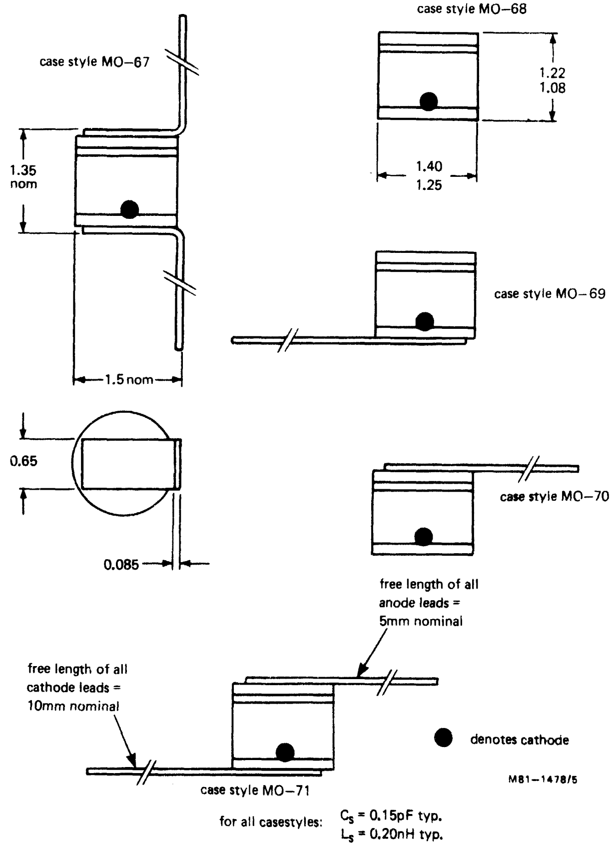


case style MO–65

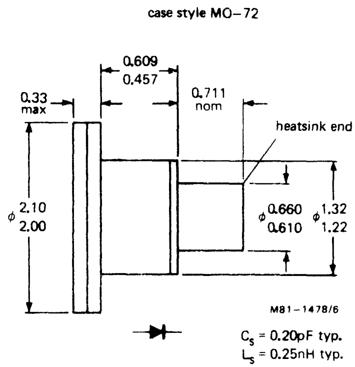


case style MO–66



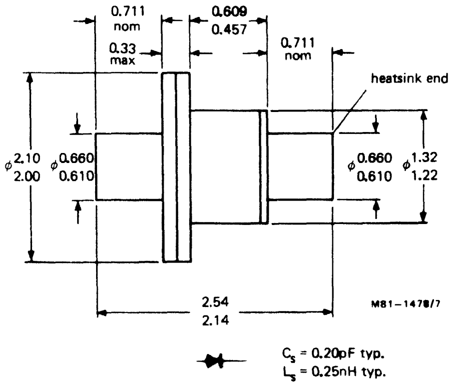


case style MO–67
1.35 nom
1.5 nom
0.65
0.085
case style MO–68
1.22
1.08
1.40
1.25
case style MO–69
case style MO–70
free length of all anode leads = 5mm nominal
free length of all cathode leads = 10mm nominal
denotes cathode
M81–1478/5
case style MO–71
for all casestyles:
C_s = 0.15pF typ.
L_s = 0.20nH typ.

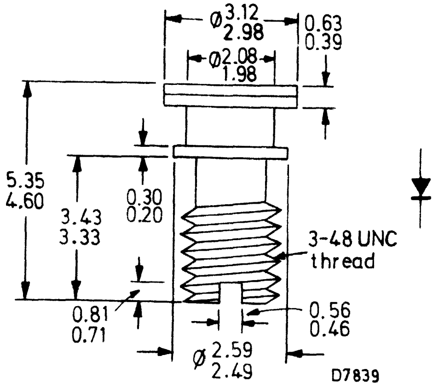


case style MO–72
0.609
0.457
0.33 max
0.711 nom
heatsink end
φ 2.10
2.00
φ 0.660
0.610
φ 1.32
1.22
M81–1478/6
C_s = 0.20pF typ.
L_s = 0.25nH typ.

case style MO–73



case style SOD–44

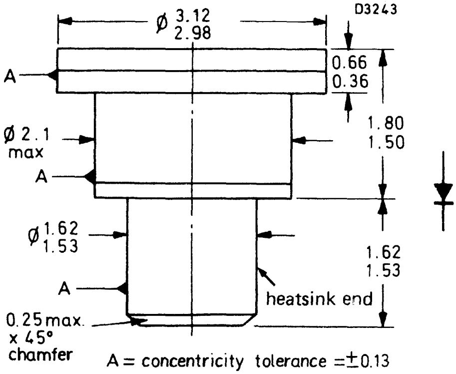


heatsink end

C_S = 0.25pF typ.

L_S = 0.65nH typ.

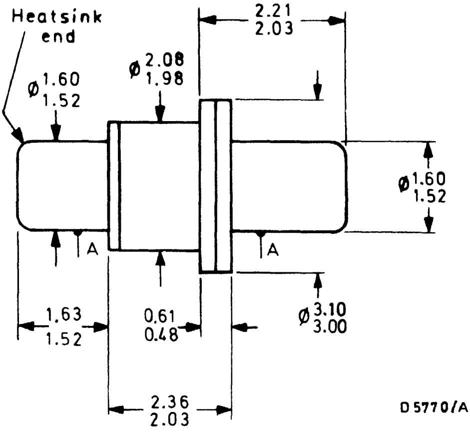
case style SOD–45



A = concentricity tolerance = ±0.13

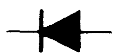
C_S = 0.30pF typ.
L_S = 0.40nH typ.

case style SOD–31
conforms to BS3934 SO–86



A = concentricity tolerance = ±0.13

C_S = 0.25pF typ.
L_S = 0.65nH typ.



GALLIUM ARSENIDE HYPER-ABRUPT VARACTOR DIODES

This device range is completing development and samples are now available. Production is planned for January 1985. They are designed for frequency tuning in military and professional applications. The diodes are normally supplied with a ± 10% capacitance tolerance. Closer tolerances are available on request. This series of diodes is available in a wide range of ceramic packages, in addition to those shown in this data. Devices may also be supplied as passivated chips.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS — MICROWAVE SEMICONDUCTORS

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Storage temperature	T_{stg}	−55 to +150	°C
Ambient temperature range for operation	T_{amb}	−55 to +100	°C

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Reverse breakdown voltage, I_R = 10 μA	$V_{(BR)R}$	15	–	–	V
Total capacitance, −2 V (notes 1 and 2)	C_T	0.8	–	10	pF
Capacitance ratio C_T (0 V) / C_T (−12 V)	at 1 pF	–	6:1	–	
	at 5 pF	–	10:1	–	
	at 10 pF	–	12:1	–	
Q at −2 V (note 3)	C_T = 1 pF	3000	–	–	
	C_T = 10 pF	1000	–	–	

NOTES

1. Capacitance is measured at 1 MHz in case style SOD-31.
2. Other capacitances can be made available on request within these limits.
3. Measurements at microwave frequencies are converted to Q at 50 MHz.
4. Case parasitics C_s and L_s are shown on the outline drawings.

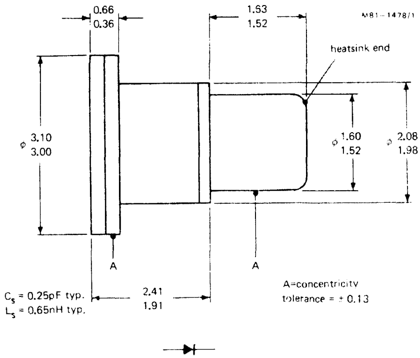
Ordering information

When ordering, please specify:

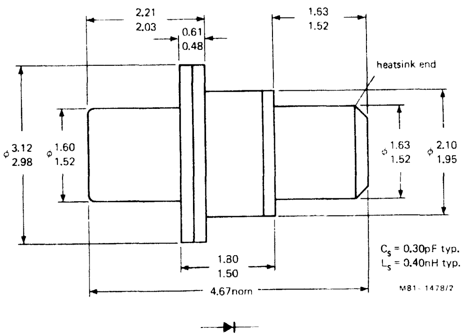
1. Reverse breakdown voltage.
2. **Total** capacitance and measurement voltage.
3. Voltage tuning range.
4. Capacitance tolerance.
5. Package data.

MECHANICAL DATA

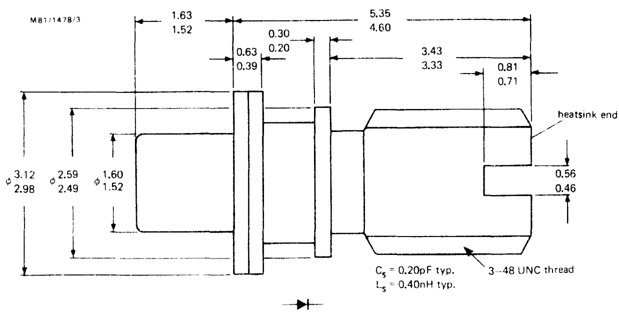
Dimensions in mm



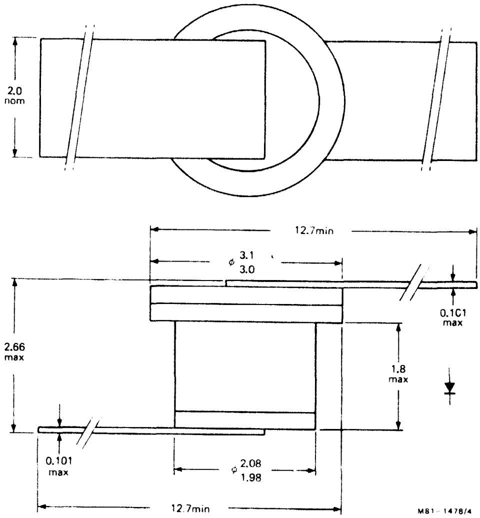
case style MO–63



case style MO–64

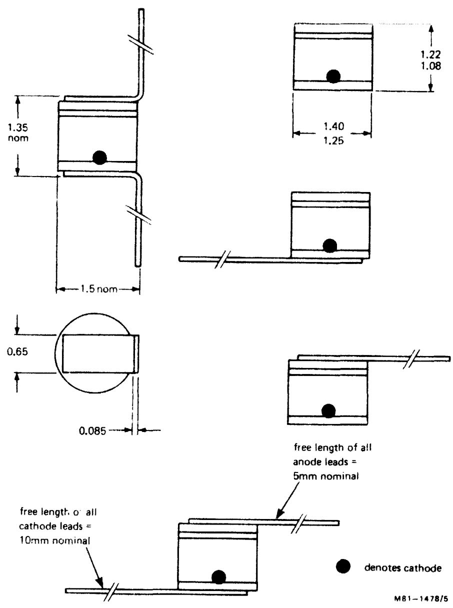


case style MO–65



C_s = 0.25pF typ.
L_s = 0.65nH type

case style MO–66



case style MO–67

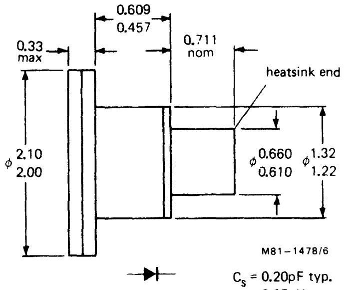
case style MO–68

case style MO–69

case style MO–70

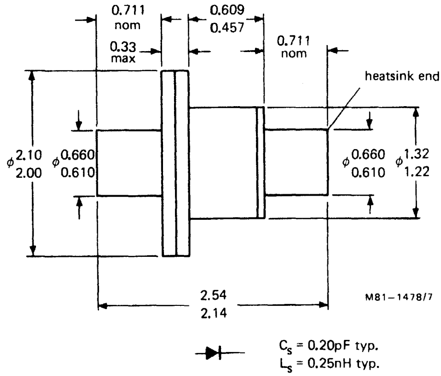
case style MO–71

for all casestyles: C_s = 0.15pF typ.
L_s = 0.20nH typ.



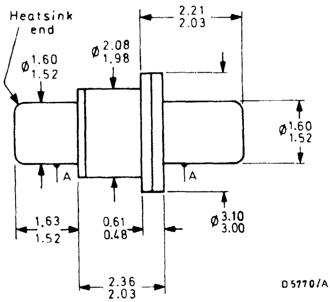
C_s = 0.20pF typ.
L_s = 0.25nH typ.

case style MO–72



C_s = 0.20pF typ.
L_s = 0.25nH typ.

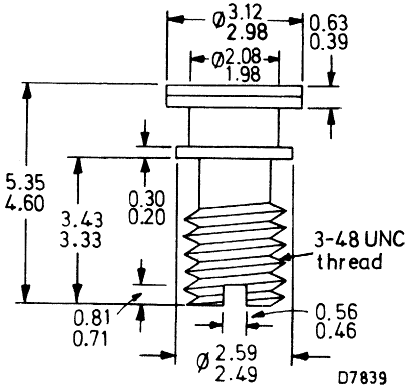
case style MO–73



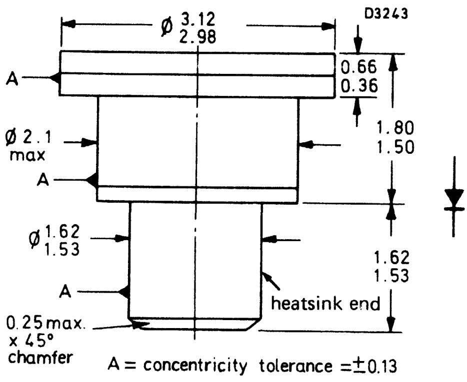
A = concentricity tolerance = ±0.13

C_S = 0.25pF typ.
L_S = 0.65nH typ.

case style SOD–31
conforms to BS3934 SO–86

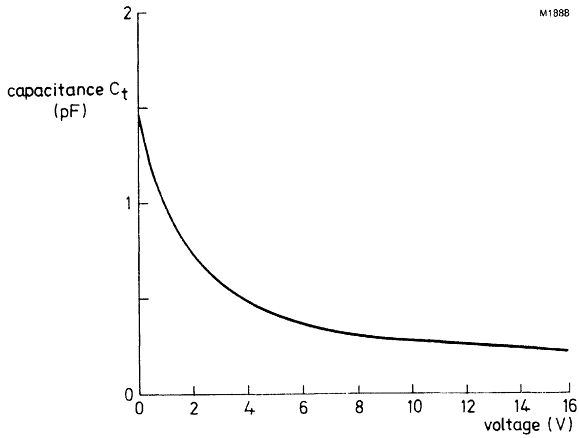


case style SOD–44



C_S = 0.30pF typ.
L_S = 0.40nH typ.

case style SOD–45



Capacitance as a function of voltage
C_s = 0.12 pF approx.

LIMITER VARACTOR
DIODES

GALLIUM ARSENIDE LIMITER DIODES

Gallium arsenide varactor diodes for limiter applications from C to X-band. Very low insertion loss and high isolation characteristics may be obtained. The diodes are of the diffused mesa type and are mounted in standard microwave packages. They conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

			CXY22A	CXY22B	
Operating frequency range	f		2.0 to 7.0	7.0 to 12	Ghz
Total capacitance at 0 V	C_T		0.85	0.55	pF
Insertion loss*		typ.	0.2	0.3	dB
High power attenuation*		typ.	20	16	dB

*Depends on circuit configuration, see page 2

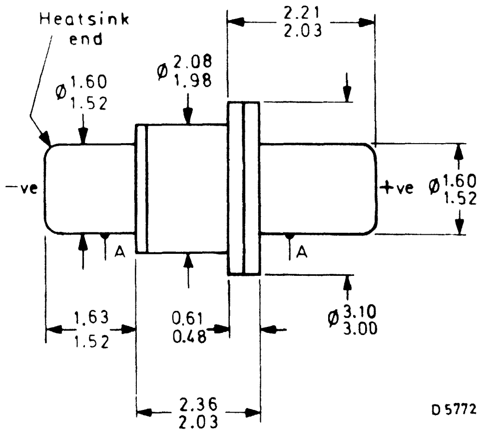
Unless otherwise shown, data is applicable to both types.

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm

Conforms to SOD-31 and BS3934 SO-86



A = concentricity tolerance = ± 0.13

> Devices may be selected to suit customers' specific requirements, including alternative packages. It is recommended that the device is functionally tested, by the supplier, in the customer's circuit.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}		−55 to +150	°C
Ambient temperature range	T_{amb}		−55 to +100	°C
D.C. reverse voltage	V_R	max.	6.0	V

CHARACTERISTICS

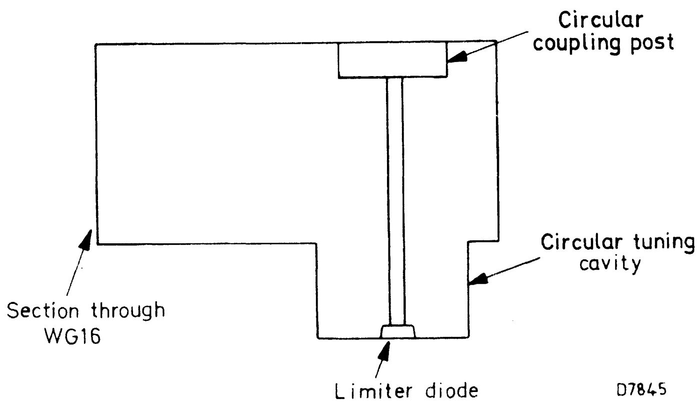
			CXY22A	CXY22B	
Reverse current, $V_R = 6.0$ V	I_R	max.	1.0	1.0	μA
D.C. forward voltage, $I_F = 50$ mA	V_F	max.	1.45	1.45	V
Total capacitance, $V_R = 0$, f = 1 MHz	C_T	typ.	0.85	0.55	pF
Series resistance, $V_R = 0$	r_s	typ.	1.0	1.2	Ω

TYPICAL X-BAND LIMITER USING CXY22B

This is a resonant circuit in rectangular waveguide, operating by reflection of a high input power:

Centre frequency	f_o	9.4	GHz
Bandwidth at 1 mW max., v.s.w.r. = 1.2:1	Δf_o	300	MHz
Insertion loss at 1 mW max.		0.3	dB
Insertion loss at 100 mW, c.w.		6.0	dB
Insertion loss at 5 W peak, p.r.f. 1 kHz, 1 μs		16	dB
Safe peak power handling*, p.r.f. 1 kHz, 1 μs		50	W

*Peak power handling depends on pulse length and duty cycle, as well as circuit design.



OSCILLATORS

X-BAND GUNN OSCILLATORS

This is a series of Gunn oscillators with fixed frequencies in X-band. Applications include all forms of miniature radar systems. A suffix S indicates that the device operates as a self-oscillating mixer (auto detector).

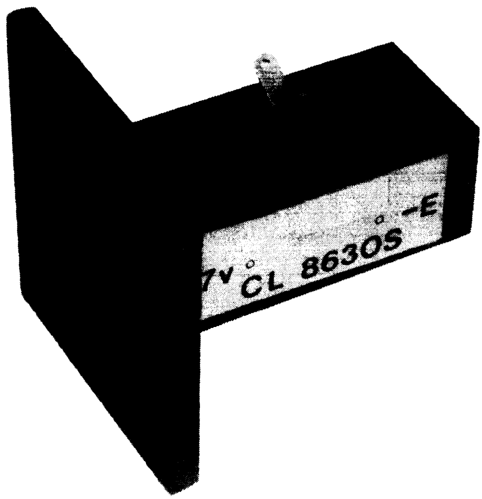
QUICK REFERENCE DATA

Type No.	Centre frequency GHz
CL8630, CL8630S	10.687
CL8631, CL8631S	9.35
CL8632, CL8632S	9.47
CL8633, CL8633S	10.525

Supply voltage		+7.0	V
Power output (at 7.0 V)	typ.	8.0	mW
Frequency temperature coefficient	typ.	−0.25	MHz/°C

Output is via a square plain flange WG16. WR90. 5985-99-083-0052

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS



RATINGS (at 25 ^{o}C)

Limiting values in accordance with the Absolute Maximum System (IEC134)

Supply voltage (d.c.)	max.	+7.5	V
Supply voltage (for less than 1 ms)	max.	+9.0	V
Supply current, threshold	max.	200	mA
Supply current, operating	max.	160	mA
Temperature range		0 to +40	^{o}C

CHARACTERISTICS

	min.	typ.	max.	
Power output (at 7.0 V)	5.0	10.0	–	mW
Frequency temperature coefficient	–	0.25	–0.4	MHz/^{o}C
Second harmonic	–	–35	–	dBm
Threshold current	–	–	225	mA
Gunn operating current	–	120	160	mA
Frequency pushing	–	4.0	–	MHz/V
Frequency (fixed)	–			
CL8630, CL8630S	10.675	10.687	10.699	GHz
CL8631, CL8631S	9.338	9.350	9.362	GHz
CL8632, CL8632S	9.458	9.470	9.482	GHz
CL8633, CL8633S	10.513	10.525	10.537	GHz
A.M. noise to carrier ratio (1 Hz to 1 kHz bandwidth) CL8630 to CL8633	–	–94	–	dB
Output voltage for input 66 dB down on output power (at 12 dB min. $\frac{\text{signal + noise}}{\text{noise}}$) CL8630S to CL8633S	80	120	–	μV

OPERATING NOTES (4 and 5 apply only to CL8630 to CL8633 and notes 6, 7 and 8 only to CL8630S to CL8633S).

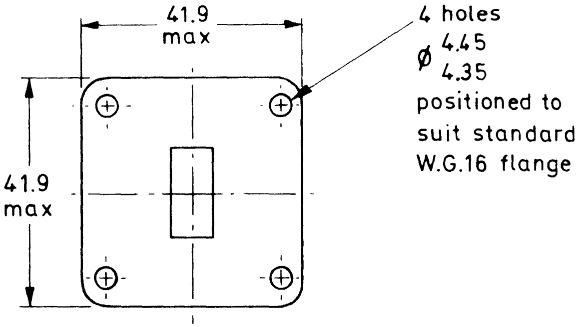
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 9 volts. An 8.2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5 V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10 nF) is connected across the oscillator terminals to suppress low frequency oscillation which may occur in the power supply.
4. When used in a Doppler radar system, modulation of the oscillator supply voltage within the 1 Hz to 1 kHz band will degrade the a.m. signal to noise ratio at the output of the associated mixer, as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components. The a.m. component will contribute directly and the f.m. component may contribute from demodulation by the slope of the bandpass characteristic of the mixer. The f.m. component may be demodulated by the non-linear response characteristic of the associated detecting element.

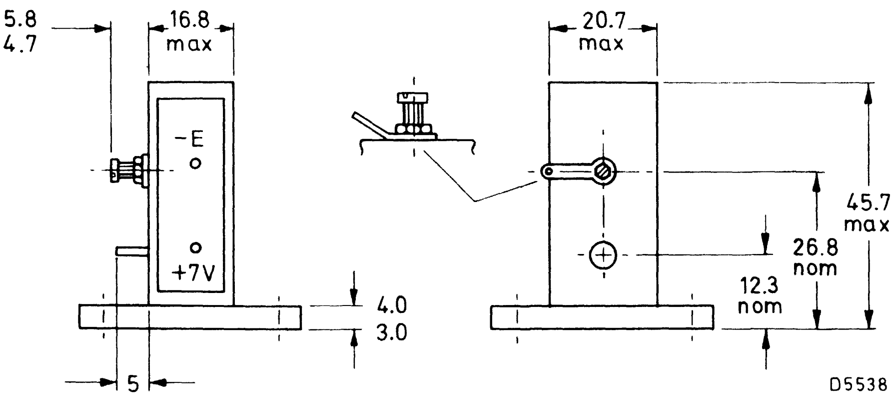
5. Second harmonic level is measured into a W.G.16 load with a v.s.w.r. <1.1:1 at fundamental frequency. The level is equivalent to that radiated from a low v.s.w.r. X-band antenna, for example, our ACX–01A.
6. A return signal 66 dB down on radiated power will be achieved from a man target of radar cross-section 1.0 m^2 at a range of 12 m, when operating with an antenna gain of 20 dB.
7. System bandwidth 1 Hz to 1 kHz.
8. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

MECHANICAL DATA

Dimensions in mm

CL8630
CL8630S
CL8633
CL8633S

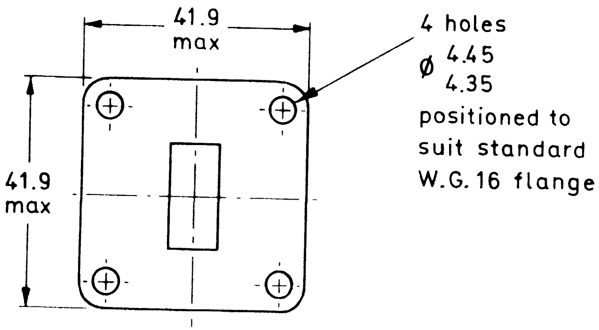


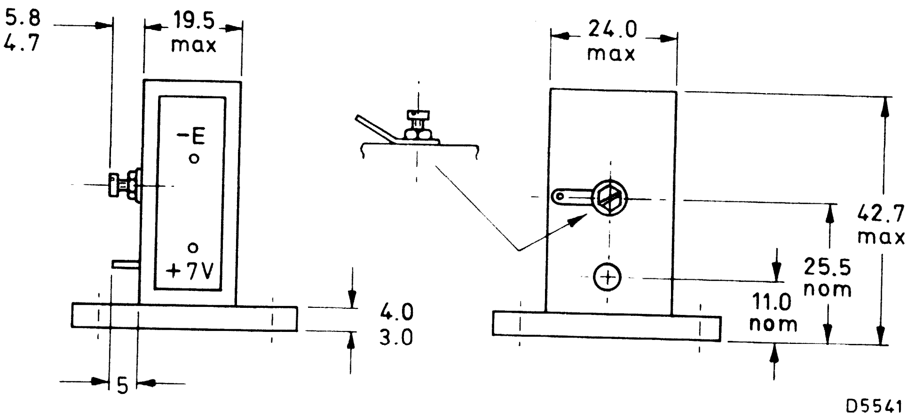


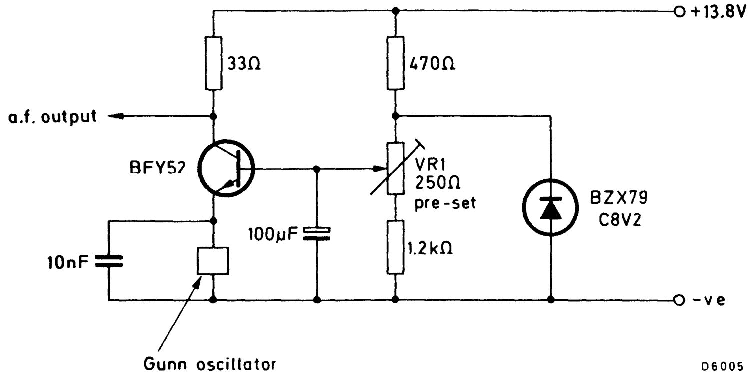
MECHANICAL DATA

CL8631
CL8631S
CL8632
CL8632S

Dimensions in mm







VR_1 is used to set voltage at 7.0 V across Gunn oscillator.

Circuit used for sensitivity measurement (self-oscillating versions only).

MIXER AND DETECTOR MODULES

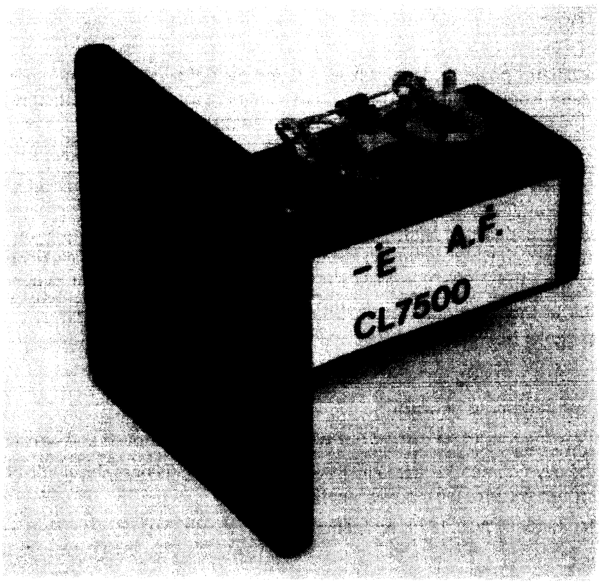
X-BAND MIXER/DETECTOR MODULES

These are waveguide single ended mixers designed for use in the 9 to 11 GHz band. They are primarily intended for Doppler control systems, for example intruder alarms deriving local oscillator drive from the transmitter output of a Gunn oscillator from our CL8630 series.
These devices can be used as microwave detectors. Examples of this application are sensing deliberate beam obstruction in a microwave protected area and as a receiver in a microwave barrier or fence.

QUICK REFERENCE DATA

Centre frequency CL7500		10.687	GHz
CL7504		9.900	GHz ←
CL7520		9.350	GHz
Sensitivity for −90 dBm input	typ.	40	µV
Noise level (32 µA d.c. bias, 1 Hz to 1 kHz bandwidth)	typ.	1.0	µV

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Storage temperature range	T_{stg}	−10 to +100	°C
Ambient temperature range	T_{amb}	−10 to +50	°C

TYPICAL OPERATING CONDITIONS

Local oscillator level	−18	dBm
D.C..bias	32	μA
Total load (d.c. and i.f.)	10	kΩ

CHARACTERISTICS (T_{amb} = 25 °C)

		min.	typ.	max.	
Mixer					
Sensitivity for −90 dBm input (with a 10 kΩ load)		15	40	–	μV
Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) (note 1)		–	1.0	2.0	μV
Detector					
Tangential sensitivity at centre frequency (note 2)	S_{ts}	–	−50	–	dBm

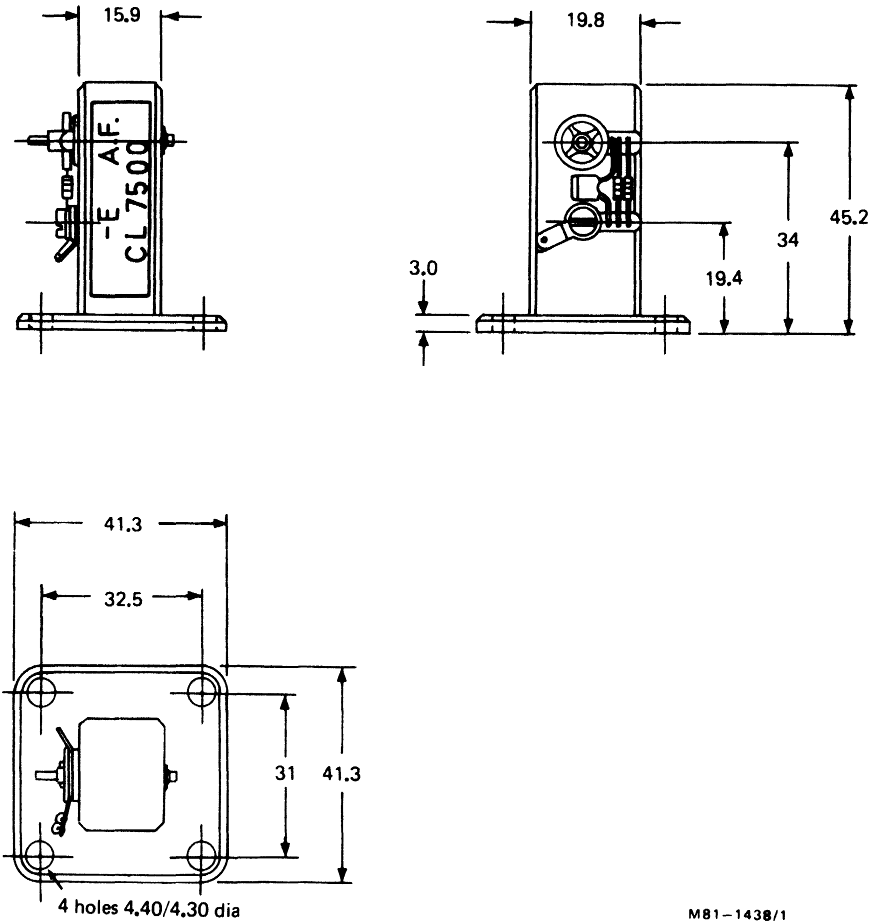
Notes

1. When the local oscillator power is derived from a Gunn oscillator with an a.m. noise to carrier ratio of −94 dB (typically from our CL8630 series), the minimum sensitivity specified represents a signal to noise ratio at the mixer output of 18 dB (typically 24 dB).
2. When operated as a detector with 32 μA bias, measured in a 0 to 2 MHz bandwidth.
3. The module is supplied with a protection circuit connected between the mixer a.f.and earth terminals The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed. Mixer and earth connections should be made direct to the appropriate terminals and not to the protection circuit tags.
4. Precautions similar to those required for CMOS devices are necessary, namely:
   a) Earthed wrist straps should be worn.
   b) Table tops or other working surfaces should be conductive and earthed.
   c) Anti-static clothing should be worn.
   d) No electrical testing should be carried out without specific, approved and written test procedures.
   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
5. Connections to be made to W.G.16 components.

MECHANICAL DATA

Dimensions in mm

CL7500

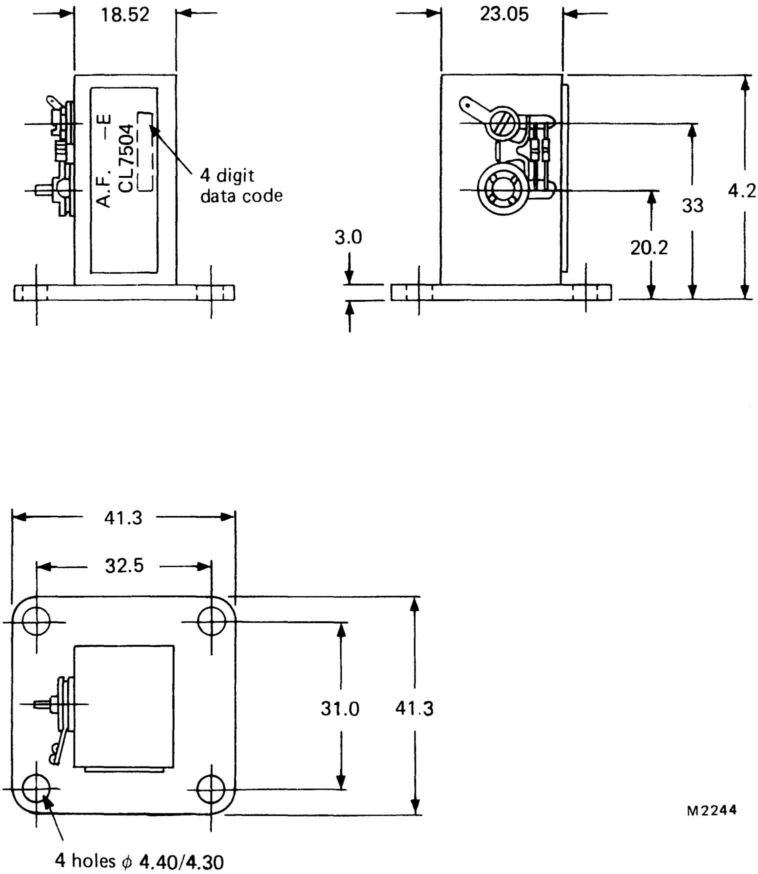


M81–1438/1

→ **MECHANICAL DATA**

Dimensions in mm

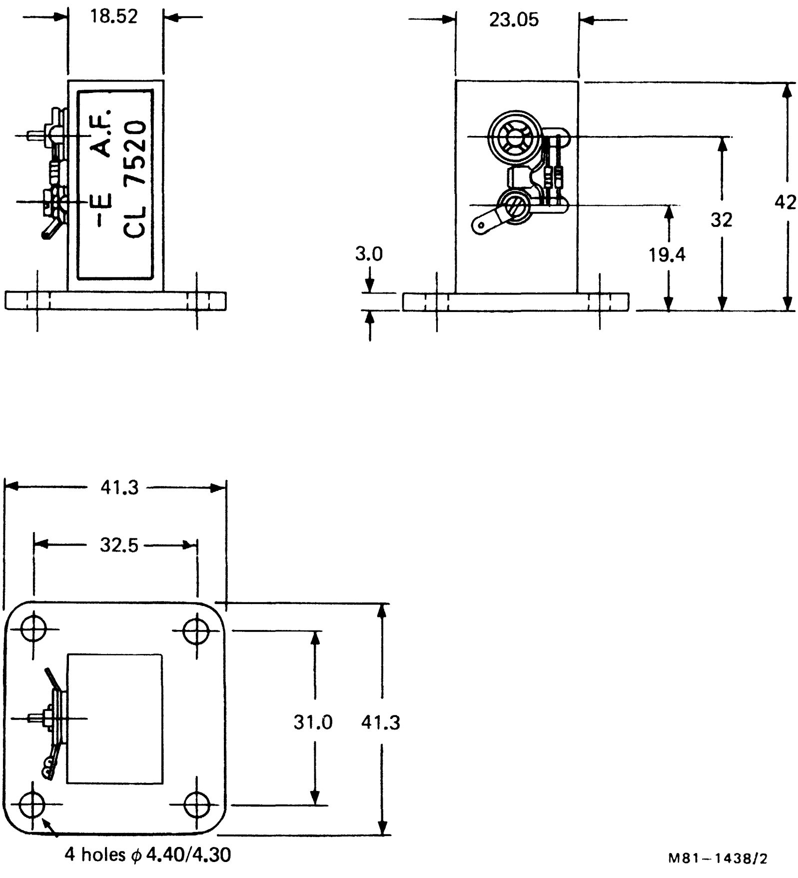
CL7504



MECHANICAL DATA

CL7520

Dimensions in mm



DOPPLER MODULES

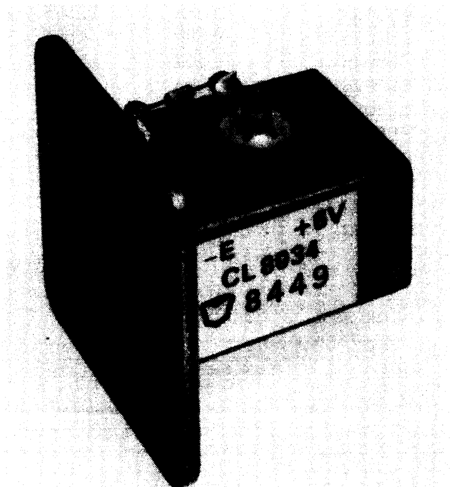
C.W./PULSED FET OSCILLATOR

Fixed frequency low current GaAs FET oscillator operating in X-band. Applications include all forms of c.w. and pulsed miniature Doppler radar systems.

QUICK REFERENCE DATA

Type No.		Centre frequency (GHz)	
CL8030		10.687	
CL8032		9.470	
CL8033		10.525	
CL8034		9.900	
CL8035		10.565	
CL8036		10.670	
CL8038		9.520	
CL8039		9.830	
CL8040		10.425	
CL8041		10.550	
CL8042		10.587	
CL8043		9.950	
Supply voltage (d.c.)		+6.0	V
Power output (at 6.0 V d.c.)	typ.	8	mW
Supply current (at 6.0 V)	typ.	25	mA

This data must be read in conjunction with – GENERAL SAFETY RECOMMENDATIONS – MICRCWAVE SEMICONDUCTORS



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Supply voltage (d.c.)		max.	+6.5	V
Supply voltage (1.0 ms max.)		max.	+8	V
Load v.s.w.r.		max.	1.5:1	
Storage temperature range	T_{stg}		−25 to +70	°C
Ambient temperature range	T_{amb}		−25 to +50	°C

OPERATING CONDITIONS

Supply voltage range		5.8 to 6.2	V
FET operating current (note 1)	typ.	25	mA

CHARACTERISTICS at 25 °C

	min.	typ.	max.	
Power output (at 6.0 V d.c.)	5	8	–	mW
Frequency temperature coefficient	–	−0.8		MHz/°C
Frequency pushing	–	7	–	MHz/V
FET operating current (note 1)	–	25	40	mA
Switch-on time	–	30	–	ns
A.M. noise to carrier ratio (note 2)	–	−90	−83	dBc

Type No.	min. freq.	centre freq.	max. freq.	
CL8030	10.675	10.687	10.699	GHz
CL8032	9.458	9.470	9.482	GHz
CL8033	10.513	10.525	10.537	GHz
CL8034	9,888	9.900	9.912	GHz
CL8035	10.553	10.565	10.577	GHz
CL8036	10.658	10.670	10.682	GHz
CL8038	9.508	9.520	9.532	GHz
CL8039	9.818	9.830	9.842	GHz
CL8040	10.413	10.425	0.437	GHz
CL8041	10.538	10.550	10.562	GHz
CL8042	10.575	10.587	10.599	GHz
CL8043	9.938	9.950	9.962	GHz

OUTPUT

Via square plane flange WG16.WR90 5985-99-083-0052.

MASS 100 g

Alternative antennae and operating frequencies, may be made to suit customers' specific requirements.

NOTES

1. For c.w. operation, the FET power supply should have a low source impedance and be capable of supplying up to 50 mA at approximately 2 V during the switch-on phase.

   The FET is protected from over-voltage and reverse bias by a 6.8 V voltage regulator diode, but damage may occur if over-voltage or a reversed supply is maintained for an extended period. The voltage regulator should not be removed. ←

2. Noise measured in a 1 Hz to 1 kHz bandwidth from carrier.

3. The FET has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons used for the FET connections are isolated from mains supplies and that the FET voltage regulator diode is not removed when all wiring has been completed. FET and earth connections should be made direct to the appropriate terminals.

4. Precautions similar to those required for CMOS devices are necessary, namely:

   a) Earthed wrist straps should be worn.

   b) Table tops or other working surfaces should be conductive and earthed.

   c) Anti-static clothing should be worn.

   d) No electrical testing should be carried out without specific, approved and written test procedures.

   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.

5. Since an iris coupled output is used on this oscillator, it will not operate correctly if used without a waveguide load or horn.

6. Pulsed operation

Although primarily designed for operation under c.w. conditions, the CL8030 series of oscillators are well suited to pulsed operation.

Switch-on time is low (< 100 ns), oscillator noise output is unchanged and satisfactory operation over the operating temperature range is obtained into a load v.s.w.r. of 1.5:1.

In general, pulsed operation is achievable with simple, low cost circuits, and, compared to Gunn oscillators, has the following advantages:

1. Low current operation (25 mA compared with 150 mA).
2. Absence of starting problems.
3. Low voltage operation (6 V).
4. Absence of low frequency negative resistance effects.

A suitable circuit for pulsing the oscillator, using a 555 timer, is shown in Fig.1. This circuit includes output short circuit protection and with the component values shown produces a square wave output at up to 50 kHz. The use of alternative timing components will allow operation at different frequencies and duty cycles.

Pulse circuits other than those shown in Fig.1 may be used satisfactorily, the main requirement, other than the correct voltage and current capability, being fast rise and fall times (< 100 ns).

Due to the low switch-on voltage of the oscillator it is also necessary that the output voltage in the 'off' state should be less than 1 volt.

Operation at frequencies and duty cycles below the 50 kHz square wave mentioned earlier is satisfactory, but operation at higher frequencies has not been investigated.

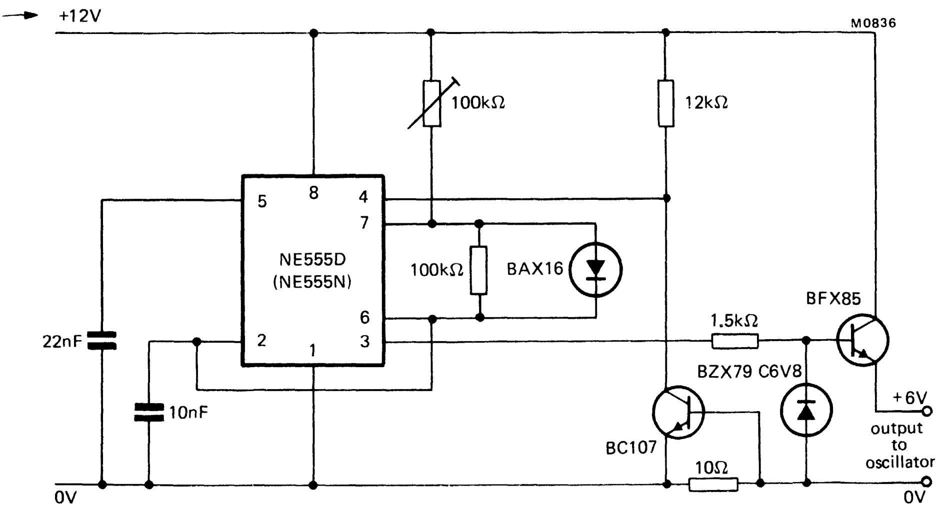
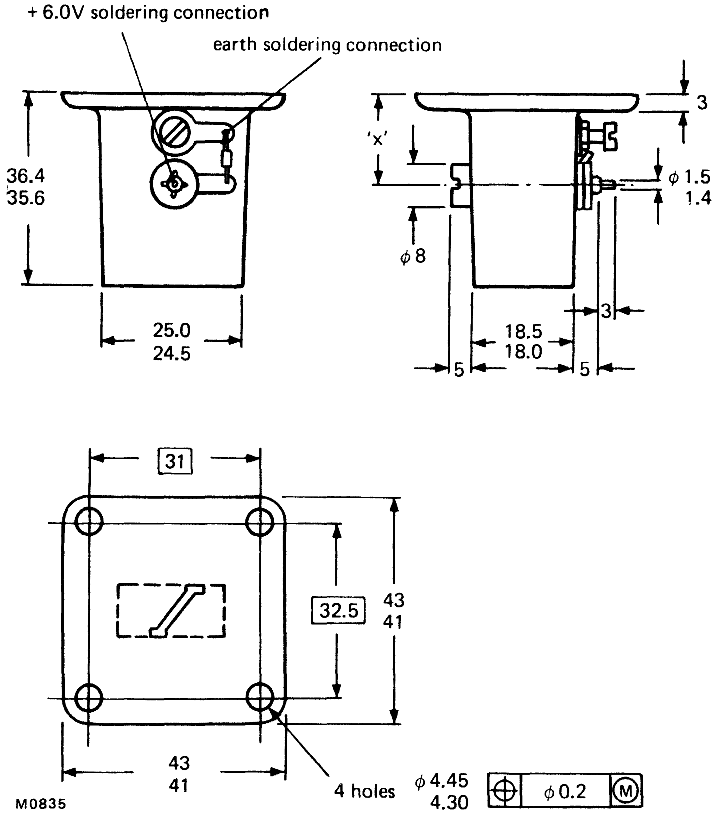


Fig.1 Recommended pulse circuit

MECHANICAL DATA

Dimensions in mm

	x
CL8030, 33, 35, 36, 40, 41, 42	17.5
CL8032, 38	25
CL8034, 39, 43	21



C.W./PULSED DOPPLER MODULE

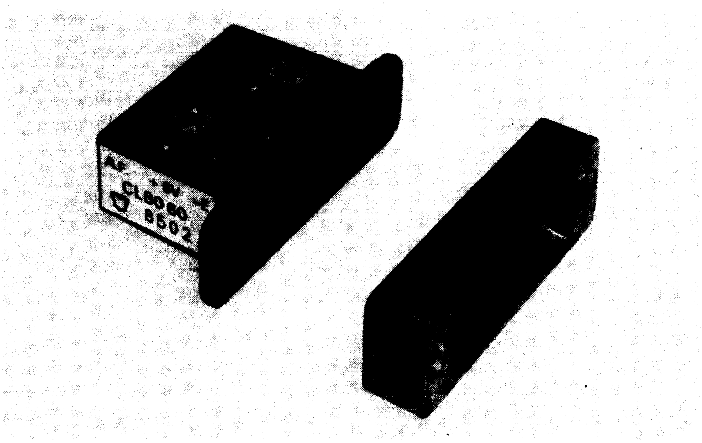
Fixed frequency low current GaAs FET oscillator and mixer cavity operating in X-band. Applications include all forms of c.w. and pulsed Doppler radar systems.

QUICK REFERENCE DATA

Type No.	Centre frequency (GHz)
CL8060	10.687
CL8062	9.470
CL8063	10.525
CL8064	9.900
CL8065	10.565
CL8066	10.670
CL8068	9.520
CL8069	9.830
CL8070	10.425
CL8071	10.550
CL8072	10.587
CL8073	9.950

Supply voltage (d.c.)		+6.0	V
Power output (at 6.0 V d.c.)	typ.	8	mW
Voltage output for power input 100 dB down on power output (notes 1 and 4)	typ.	30	μV
Noise output voltage	typ.	3	μV
Supply current (at 6.0 V)	typ.	25	mA

This data must be read in conjunction with – GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Supply voltage (d.c.)		max.	+6.5	V
Supply voltage (1.0 ms max.)		max.	+8	V
Load v.s.w.r.		max.	1.5:1	
Storage temperature range	T_{stg}		−25 to +70	°C
Ambient temperature range	T_{amb}		−25 to +50	°C

OPERATING CONDITIONS

Supply voltage range (note 2)		5.8 to 6.2	V
FET operating current (note 3)	typ.	25	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)		30 to 35	μA
A.F. load (fig.1)		10	kΩ

CHARACTERISTICS at 25 °C

	min.	typ.	max.	
Voltage output for power input 100 dB down on power output (notes 1 and 4)	20	30	–	μV
Noise output voltage (notes 1 and 4)	–	3	10	μV
Power output (at 6.0 V d.c.)	–	8	–	mW
Frequency temperature coefficient	–	−0.3	–	MHz/°C
Frequency pushing	–	7	–	MHz/V
FET operating current (note 3)	–	25	40	mA
Switch-on time (note 10)	–	30	–	ns

Type No.	min. freq.	centre freq.	max. freq.	
CL8060	10.675	10.687	10.699	GHz
CL8062	9.458	9.470	9.482	GHz
CL8063	10.513	10.525	10.537	GHz
CL8064	9.888	9.900	9.912	GHz
CL8065	10.553	10.565	10.577	GHz
CL8066	10.658	10.670	10.682	GHz
CL8068	9.508	9.520	9.532	GHz
CL8069	9.818	9.830	9.842	GHz
CL8070	10.413	10.425	10.437	GHz
CL8071	10.538	10.550	10.562	GHz
CL8072	10.575	10.587	10.599	GHz
CL8073	9.938	9.950	9.962	GHz

MASS (including 5dB antenna) 210 g

Alternative antennae and operating frequencies, may be made to suit customers' specific requirements.

NOTES

1. A return signal 100 dB down on radiated power will be achieved from a man target of radar cross-section 1.0 m^2 at a range of 15 m, when operating with the antenna supplied (antenna gain is 5 dB typ.)

   Extended range may be obtained for a reduced $\frac{\text{signal + noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e. free from extraneous moving or vibrating objects.

   Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to the manufacturer.
2. It is essential that the module's earth terminal is used as the common return for the FET voltage (+6.0 V) and the d.c. bias supplied to the a.f. terminal. In addition, the soldered connection to the mixer should be made direct to the mixer terminal and not to the associated protection circuit.
3. For c.w. operation, the FET power supply should have a low source impedance and be capable of supplying up to 50 mA at approximately 2 V during the switch-on-phase.
4. Noise measured at a frequency 1 Hz to 1 kHz from carrier.
5. The FET is protected from over-voltage and reverse bias by a 6.8 V voltage regulator diode, but damage may occur if over-voltage or a reversed supply is maintained for an extended period. The voltage regulator diode should not be removed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer and FET have low junction capacitances and may be damaged by transients of very short duration. It is therefore recommended that soldering irons used for the mixer and FET connections are isolated from mains supplies and that the mixer protection circuit and FET voltage regulator diode are not removed when all wiring has been completed. Mixer, FET and earth connections should be made direct to the appropriate terminals and not to the protection circuit tags.
7 Precautions similar to those required for CMOS devices are necessary, namely:
   a) Earthed wrist straps should be worn.
   b) Table tops or other working surfaces should be conductive and earthed.
   c) Anti-static clothing should be worn.
   d) No electrical testing should be carried out without specific, approved and written test procedures.
   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module. Since an iris coupled output is used in this module, it is essential, for correct operation of the oscillator, that the module is used with the antenna supplied. A design for a higher gain antenna for use in longer range systems can be developed to meet customers' requirements.

9. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction.

Fig.3 describes the preferred arrangement.

10. Pulsed operation

Although primarily designed for operation under c.w. conditions, the microwave oscillator in the CL8060 series of Doppler modules is well suited to pulsed operation.

Switch-on time is low ($< 100\ \mu s$), oscillator noise output is unchanged and satisfactory operation over the operating temperature range is obtained into a load v.s.w.r. of 1.5:1.

In general, pulsed operation is achievable with simple, low cost circuits, and, compared to Gunn oscillators, has the following advantages:

1. Low current operation (25 mA compared with 150 mA).
2. Absence of starting problems.
3. Low voltage operation (6 V).
4. Absence of low frequency negative resistance effects.

A suitable circuit for pulsing the oscillator, using a 555 timer, is shown in Fig.2. This circuit includes output short circuit protection and, with the component values shown produces a square wave output at up to 50 kHz. The use of alternative timing components will allow operation at different frequencies and duty cycles.

Pulse circuits other than those shown in Fig.2 may be used satisfactorily, the main requirement, other than the correct voltage and current capability, being fast rise and fall times (< 100 ns).

Due to the low switch-on voltage of the oscillator it is also necessary that the output voltage in the 'off' state should be less than 1 volt.

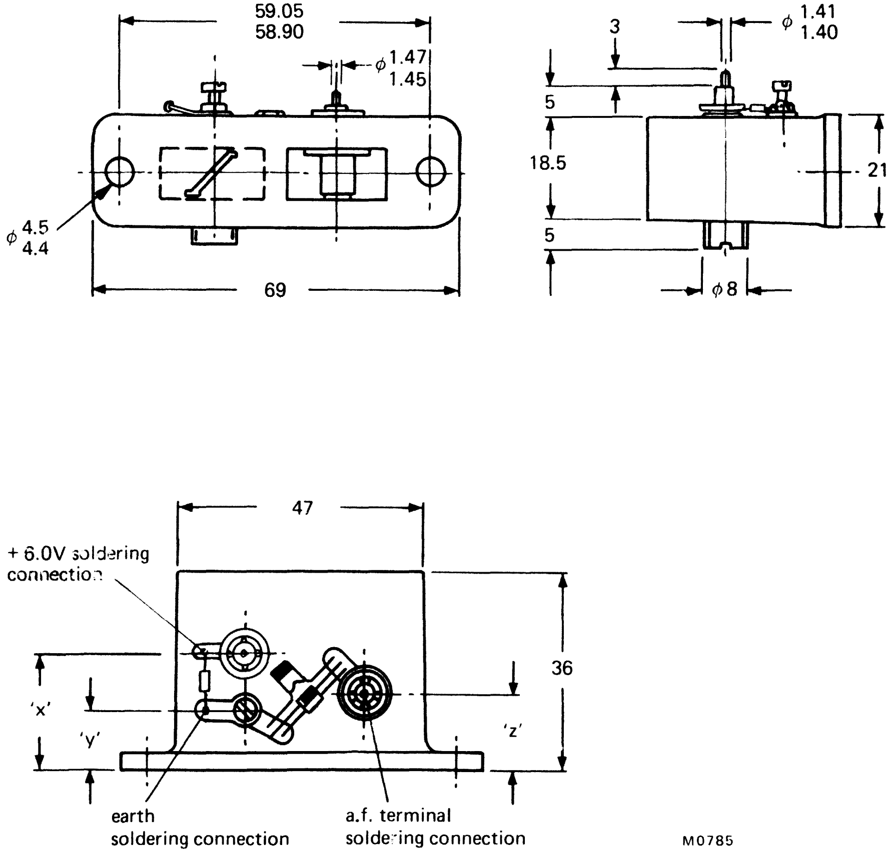
Operation at frequencies and duty cycles below the 50 kHz square wave mentioned earlier is satisfactory. but operation at higher frequencies has not been investigated.

To date, two methods have been generally used for return signal processing in pulsed Doppler radars. These are based on either a high pulse repetition rate and low pass filtering in the receiver, or a lower repetition rate and the use of sample and hold circuits in the receiver.

MECHANICAL DATA

Dimensions in mm ◄—

	x	y	z
CL8060, 63, 65, 66, CL8070, 71, 72	17.5	9.0	26.5
CL8062, 68	25	12.5	8.7
CL8064, 69, 73	21	10.5	13.3

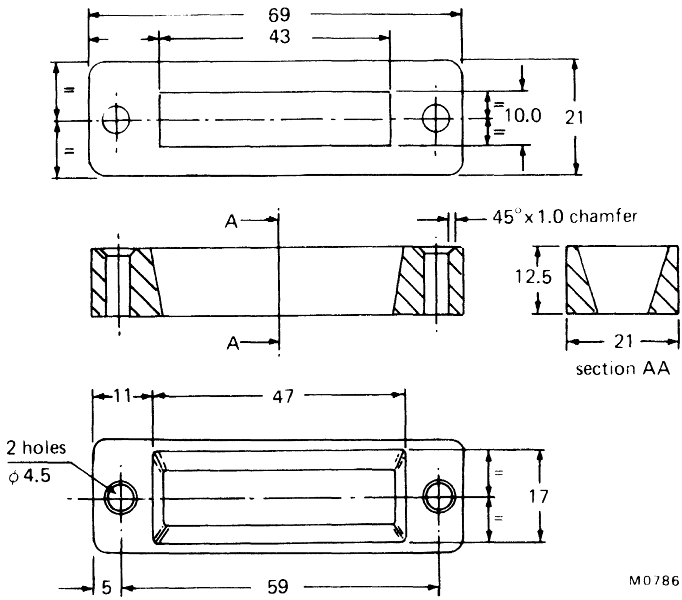


M0785

MECHANICAL DATA

Dimensions in mm

Waveguide antenna



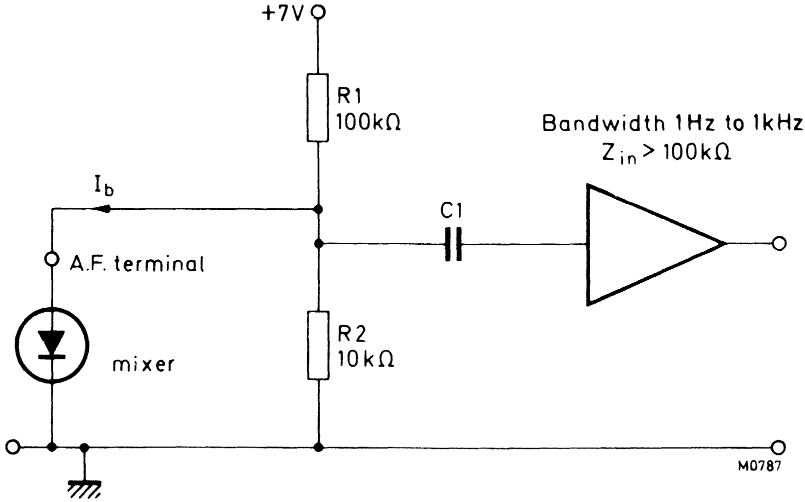


Fig.1 Circuit used to measure a.f. performance

Notes

1. The current I_b should be approximately 35 μA with the FET disconnected and approximately 42 μA with the FET operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in}.

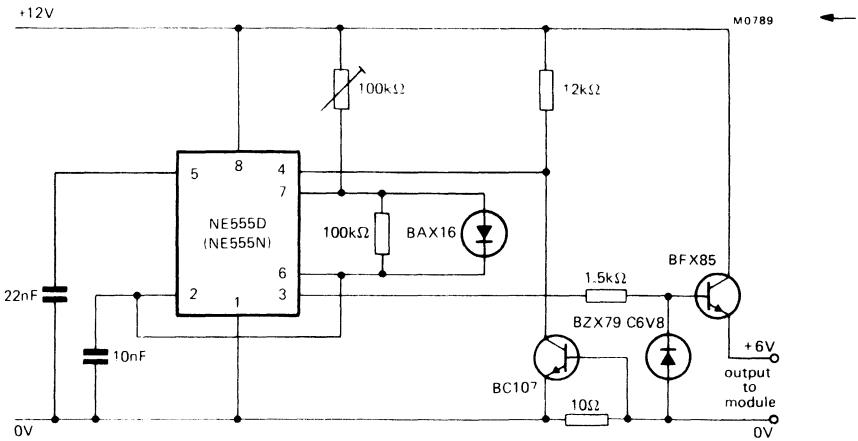


Fig.2 Recommended pulse circuit

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6 mm thick metal plate with aperture dimensions as shown in Fig.3.

In this configuration, the metal plate forms the front panel of the equipment and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42 μA. (35 μA d.c. bias + 7 μA from − 19 dBm of coupled l.o. power).

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25 mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is described below.

In this case, the l.o. power coupled to the mixer will be −11 dBm and the total mixer bias current will now be approximately 60 μA.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For −11 dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

However, further increase in the level of coupled l.o. power arising from the use of thick or 'micro-wave' reflective covering materials will:

(a) continue to increase the a.f. output voltage from the mixer, (N.B. the increase will not be the same for all modules), but at the same time degrade the signal to noise ratio.

(b) present a mismatch to the FET oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

L.O. coupling (dBm)	Mixer total bias (μA)	Antenna covering material
–	35 (d.c. only)	–
−19	42	No covering
−15	50	1 to 2 cm expanded polythene or polystyrene
−11	61	0.25 mm Cobex plastic
−6	70	0.5 mm Cobex plastic

→ Cobex is a product of:

Wardle Storeys
Brantham,
MANNINGTREE,
Essex,
CO11 1NJ,
England.

PANEL MOUNTING DETAILS

Dimensions in mm

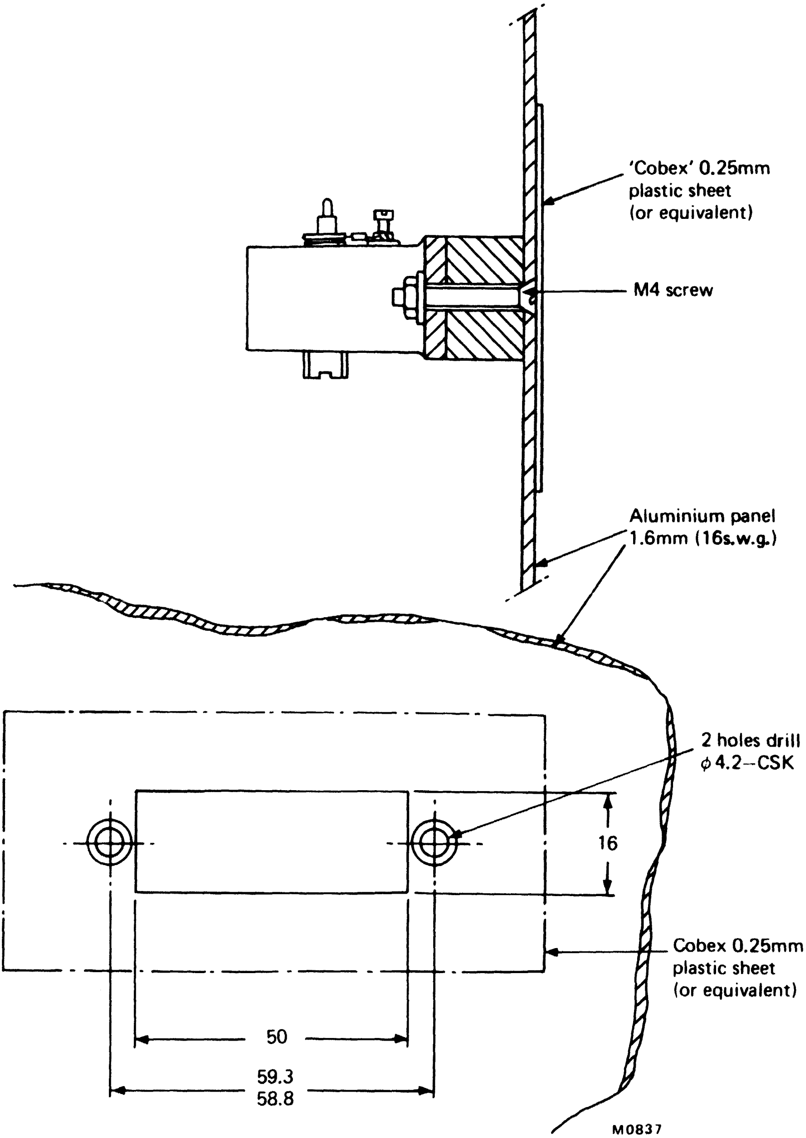


Fig.3

X-BAND DOPPLER RADAR MODULES

This is a series of fixed frequency Gunn oscillators and mixer cavities for operation in X-band. Applications include all forms of Doppler radar systems.

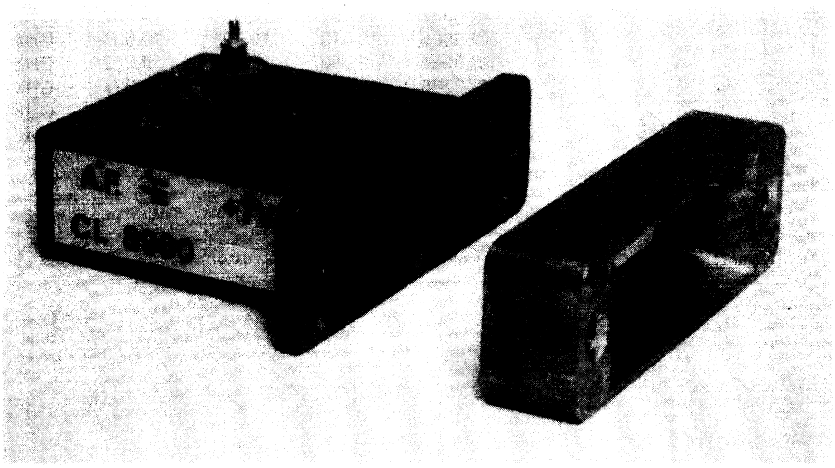
QUICK REFERENCE DATA

Type No	Centre frequency GHz
CL8960	10.687
CL8961	9.350
CL8962	9.470
CL8963	10.525
CL8964	9.900
CL8965	10.565
CL8967	10.365
CL8968	9.520

Supply voltage		+7.0	V
Power output (at 7.0 V)	typ.	10	mW
Voltage output for power input 100 dB down on power output at 18 dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (note 1 and page 9)	typ.	40	μV

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS.

Module with antenna as supplied



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Supply voltage (d.c.)	max.	+7.5	V
Supply voltage (for less than 1 ms)	max.	+9.0	V
Load v.s.w.r.	max.	1.5:1	
Storage temperature range		−10 to +70	°C
Ambient temperature range		0 to +40	°C

OPERATING CONDITIONS

Supply voltage range (note 2)		6.8 to 7.2	V
Gunn operating current (note 3)	typ.	130	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)		30 to 35	μA
A.F. load (page 8)		10	kΩ

CHARACTERISTICS

		min.	typ.	max.	
Voltage output for power input 100 dB down on power output at 18 dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (notes 1 and 4 and page 9)		20	40	–	μV
Power output at 7.0 V		–	10	—	mW
Frequency temperature coefficient		–	−0.25	−0.40	MHz/°C
Frequency pushing		–	4.0	–	MHz/V
Gunn operating current (note 3)		–	130	165	mA
Polar diagram			page 10		
Centre frequency, fixed in the range:	CL8960	10.675	10.687	10.699	GHz
	CL8961	9.338	9.350	9.362	GHz
	CL8962	9.458	9.470	9.482	GHz
	CL8963	10.513	10.525	10.537	GHz
	CL8964	9.888	9.900	9.912	GHz
	CL8965	10.553	10.565	10.577	GHz
	CL8967	10.353	10.365	10.377	GHz
	CL8968	9.508	9.520	9.532	GHz

MASS 210 g

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

NOTES

1. A return signal 100 dB down on radiated power will be achieved from a man target of radar cross-section 1.0 m^2 at a range of 15 m, when operating with the antenna supplied (antenna gain is 5 dB typ.).

   Extended range may be obtained for a reduced $\frac{\text{signal + noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e. free from extraneous moving or vibrating objects. For example, 110 dB path loss is obtained from a man target of radar cross-section 1.0 m^2 at a range of 25 m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15 dB with an output voltage of 16 μV min.

   Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to the manufacturer.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7 V) and the d.c. bias supplied to the a.f. terminal. In addition, the soldered connection to the mixer should be made direct to the mixer terminal and not to the associated protection circuit.

3. The Gunn effect device has a voltage current characteristic as shown on page 8. The power supply should have a low source impedance and be capable of supplying up to 250 mA at approximately 3 V during the switch-on phase.

4. Noise measured at a frequency 1 Hz to 1 kHz from carrier.

5. The Gunn device will be damaged if the supply is reversed.

6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and the protection circuit is not removed when all wiring has been completed. Mixer and earth connections should be made direct to the appropriate terminals and not the the protection circuit tags.

7. Precautions similar to those required for CMOS devices are necessary, namely:
   (a) Earthed wrist straps should be worn.
   (b) Table tops or other working surfaces should be conductive and earthed.
   (c) Anti-static clothing should be worn.
   (d) No electrical testing should be carried out without specific, approved and written test procedures.
   (e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.

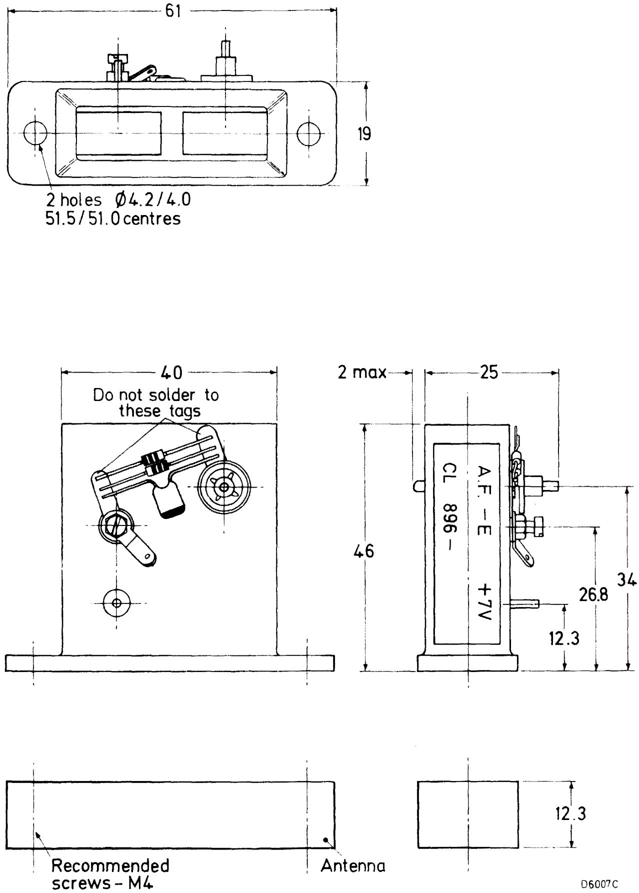
8. The above conditions apply when operated into the antenna supplied with the module.

9. A 10 nF capacitor should be connected across and close to the +7 V and earth terminals to suppress parasitic oscillations in the power supply.

10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 12 describes the preferred arrangement.

MECHANICAL DATA Dimensions in mm

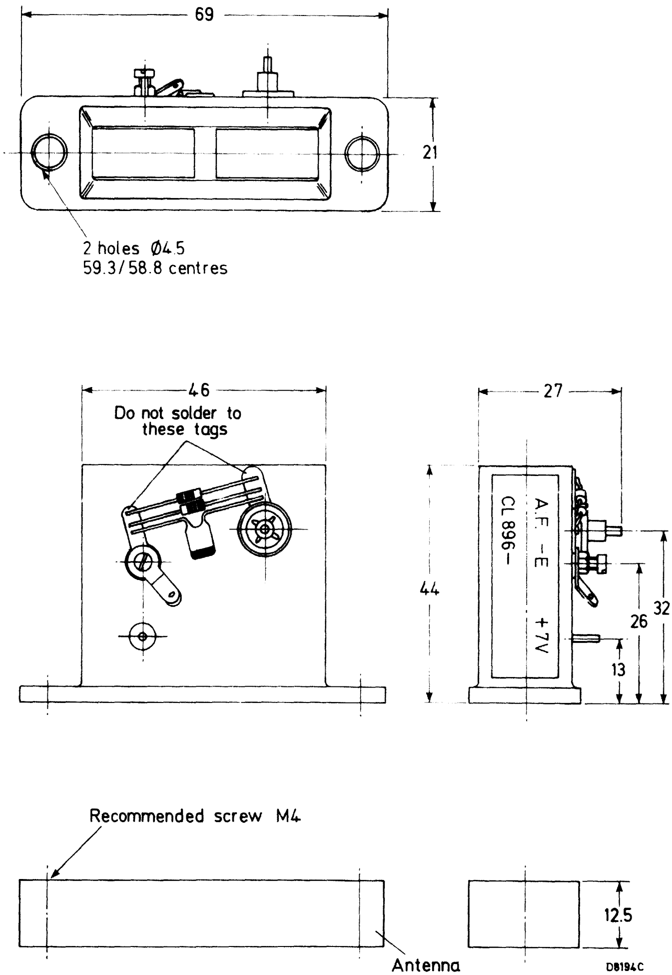
CL8960
CL8963
CL8965



MECHANICAL DATA

Dimensions in mm

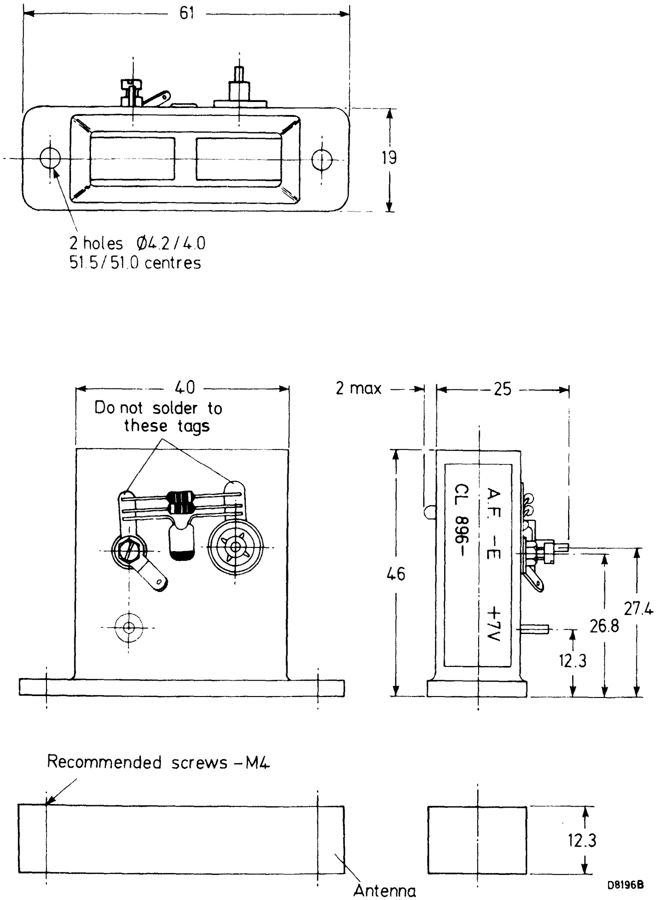
CL8961
CL8962
CL8968



MECHANICAL DATA

Dimensions in mm

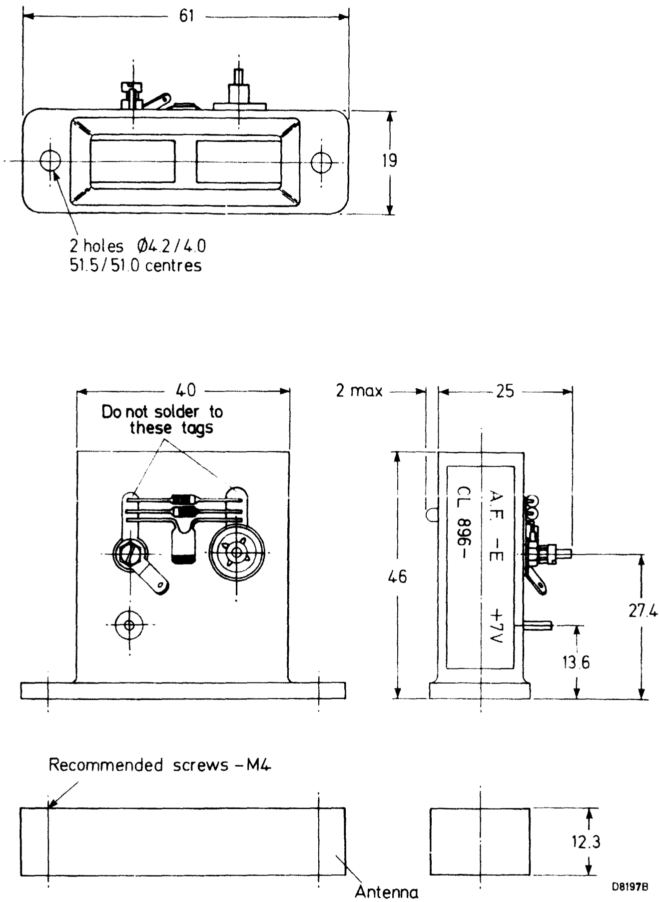
CL8964

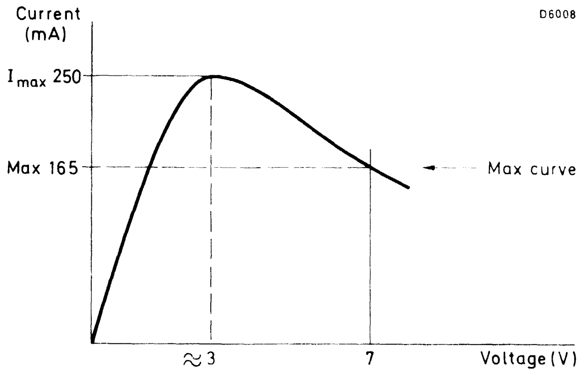


MECHANICAL DATA

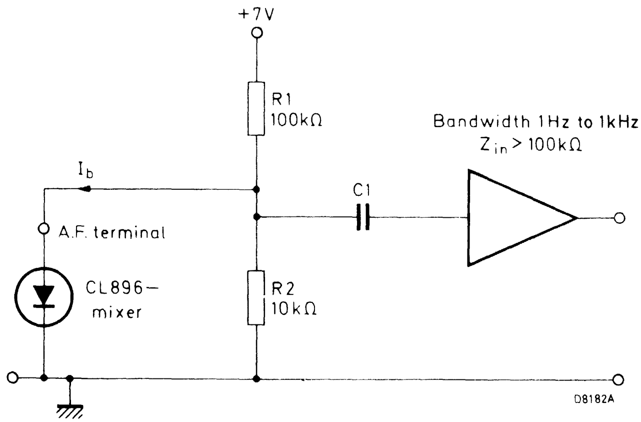
Dimensions in mm

CL8967



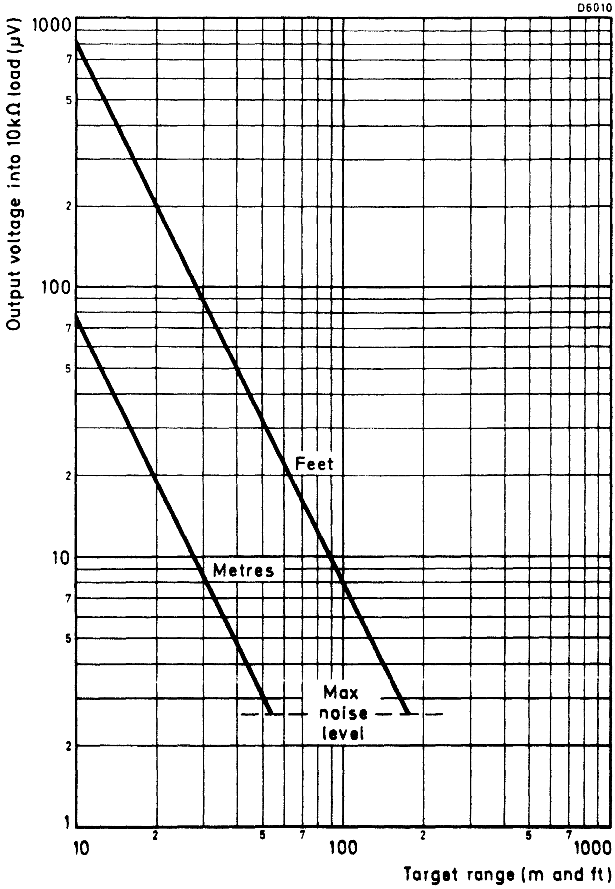


Typical Gunn device characteristic

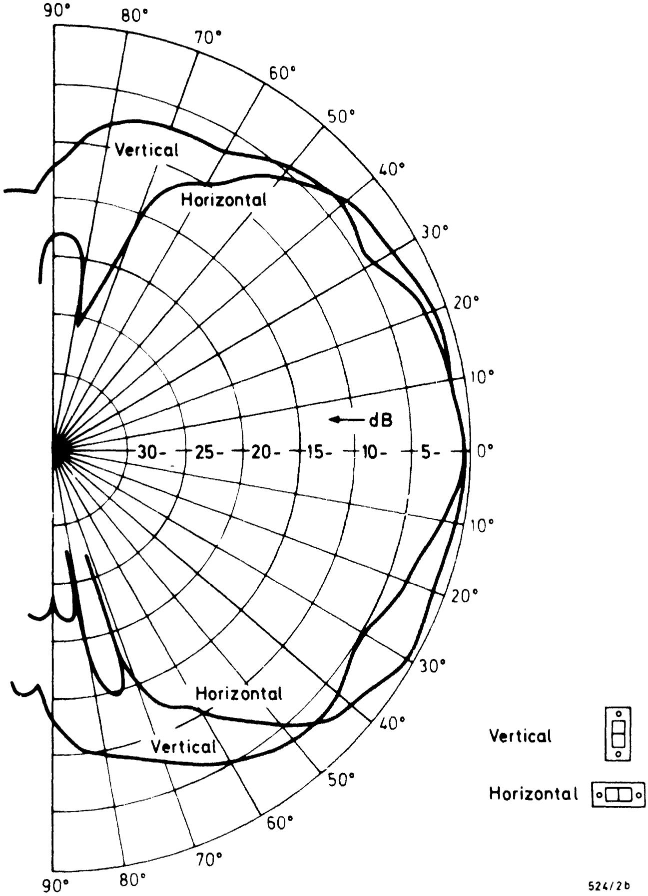


Circuit used to measure a.f. performance

Notes
1. The current Ib should be approximately 35 μA with the Gunn device disconnected and approximately 42 μA with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in}.



Minimum output for a man target



Typical polar diagram for antenna supplied

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6 mm thick metal plate with aperture dimensions as shown on page 12.
In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained.
Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.
The total mixer bias under the optimum operating conditions is approximately 42 μA. (35 μA d.c. bias + 7 μA from −19 dBm of coupled l.o. power).
If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25 mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is described below.
In this case, the l.o. power coupled to the mixer will be −11 dBm, and the total mixer bias current will now be approximately 60 μA.
The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For −11 dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.
However, further increase in the level of coupled l.o. power arising from the use of thick or 'micro-wave' reflective covering materials, will:

(a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.

(b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

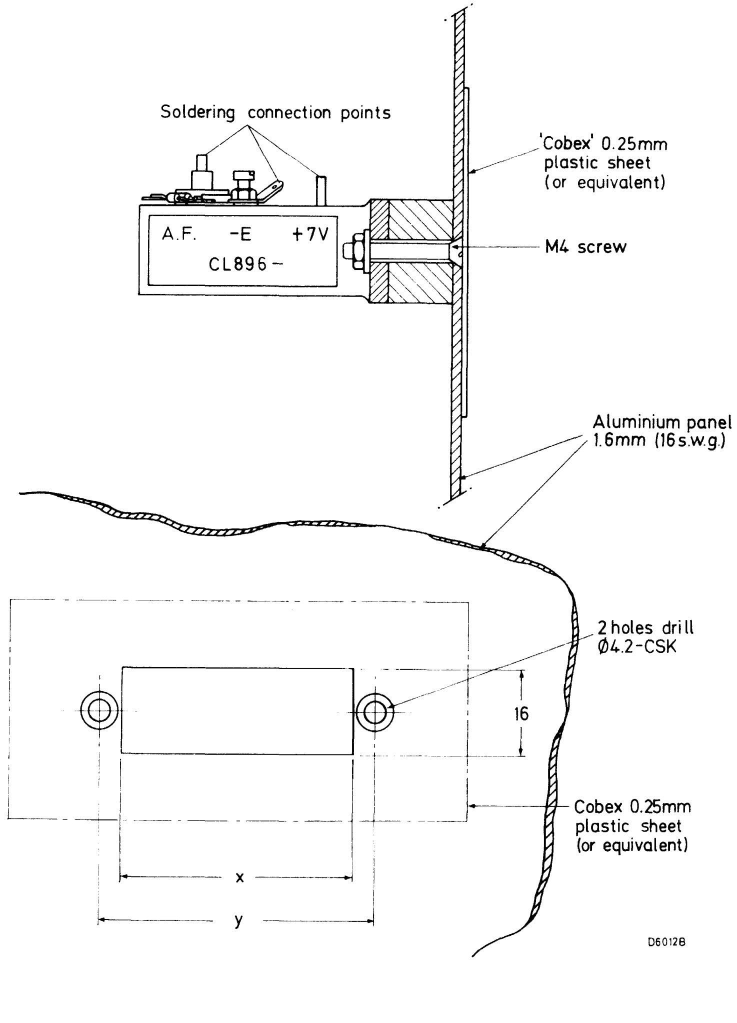
L.O. coupling (dBm)	Mixer total bias (μA)	Antenna covering material
–	35 (d.c.only)	–
−19	42	No covering
−15	50	1 to 2 cm expanded polythene or polystyrene
−11	61	0.25 mm Cobex plastic
−6	70	0.5 mm Cobex plastic

Cobex is a product of:

Wardle Storeys
Brantham,
MANNINGTREE,
Essex,
CO11 1NJ,
England.

PANEL MOUNTING DETAILS

Dimensions in mm



CL8960 CL8963 CL8964 CL8965 CL8967	x = 43 y = 51.5/51.0	CL8961 CL8962 CL8968	x = 50 y = 59.3/58.8

CIRCULATORS AND ISOLATORS

MICROSTRIP CIRCULATORS AND ISOLATORS

These components are designed on the basis of microstrip transmission lines of nominally 50 Ω characteristic impedance. They are intended to be mounted between microstrip circuits where required.

The circulators consist of a ferrite substrate which supports a thin-film circulator pattern and ground plane. Two ticonal magnets mounted above and below the substrate provide the biasing magnetic field. For isolators the third port is terminated with a matched load.

To facilitate assembly between two adjacent circuits the units have a square or rectangular substrate, the edges of which are precision ground to fine tolerances. Assembly into the circuits should be carried out by bonding techniques or by pressure contacts. The use of soldering techniques for this purpose will result in the destruction of the component and/or degradation of its electrical performance. Some examples of suitable mounting techniques are given on pages 6 and 7.

The electrical characteristics are guaranteed when measured in our standard test jigs, which are available as standard accessories.

TERMS AND DEFINITIONS

Frequency range

This is the range within which the isolator or circulator meets the guaranteed specification.

Isolation

In an isolator, isolation is the ratio, expressed in dB, of the input power to the output power for signal injection in the reverse direction (matched source and load).

In a circulator, isolation is the ratio, expressed in dB, of the power entering a port to the power scattered into the adjacent port on the side opposed to the normal circulation (matched source and the other ports correctly terminated).

Insertion loss

This is the attenuation that results from including the device in the transmission system. It is given as a power ratio, expressed in dB, which compares the situation before and after the insertion of an isolator or circulator.

Maximum power

In an isolator, the maximum power is the highest power that may be passed through it (without damage) in the forward direction into a v.s.w.r. of 2. This power value must not be exceeded.

In a circulator, the maximum power is the highest power it can handle at sea level and at maximum ambient temperature when one port is terminated with a mismatch giving v.s.w.r. of 2, whilst the next port is matched with a v.s.w.r. of 1.2 or less. This power value must not be exceeded.

Temperature range

This is the ambient temperature range within which isolators and circulators function to specification. Circulators still function outside the temperature range but their electrical behaviour may be far outside the guaranteed specifications. Isolators can be stored at any temperature between −55 and +125 °C.

MICROSTRIP CIRCULATORS

Electrical data (as measured in the related test jig)

Maximum power (c.w.) 10 W
Storage temperature −55 to + 125 °C

frequency range GHz	isolation		insertion loss		v.s.w.r.		operational temperature °C	catalogue number	related test jig
	min. dB	typ. dB	max. dB	typ. dB	max.	typ.		2722 169 followed by	
1.7 to 1.9 1.9 to 2.1 2.1 to 2.3	20	22	0.5	0.30	1.25	1.15	−10 to + 60	03161 03171 03181	00141
2.1 to 2.3 2.2 to 2.5 2.4 to 2.7	20	22	0.4	0.25	1.25	1.20	0 to + 50	03182 03001 03201	00021
2.7 to 3.1 3.0 to 3.5	20	22	0.4	0.30	1.20	1.15	0 to + 50	03021 03011	00031
3.6 to 4.2	20	25	0.4	0.25	1.20	1.10	−10 to + 70	03041	00041
4.4 to 5.0 4.7 to 5.2 5.9 to 6.5 6.4 to 7.1 7.1 to 7.7	20	25	0.4	0.20	1.20	1.10	−10 to + 70	03051 03061 03071 03081 03091	00061
7.7 to 8.5	20	25	0.4	0.25	1.20	1.10	−10 to + 70	03101	00081
8.5 to 9.6 8.0 to 10.4	20 20	25 22	0.4 0.4	0.25 0.25	1.20 1.25	1.10 1.15	−10 to + 70	03111 03121	00181
8.0 to 12.0 9.0 to 11.5	17 20	19 22	0.5 0.4	0.40 0.25	1.35 1.25	1.25 1.15	−10 to + 70	03131 03141	00101
10.5 to 13.0	20	22	0.4	0.30	1.25	1.15	−10 to + 70	03211	00191
13.0 to 14.5 14.4 to 15.25 15.0 to 16.0	20	22	0.5	0.30	1.25	1.15	−10 to + 70	03221 03151 03231	00121
12.0 to 18.0	17	19	0.6	0.40	1.35	1.25	−10 to + 70	03241	00121

MICROSTRIP CIRCULATORS

Dimensions in mm

Mechanical data

Tolerances ± 0.05 mm unless otherwise stated.

catalogue number 2722 169 followed by	a	b	c	d ± 0.2	e	f max.	g ±0.005	mass g
03161 03171 03181	38.10	38.10	8.00	21.0	16.5	7.0	1.02	17
03182 03001 03201	25.40	25.40	8.00	13.0	12.0	7.0	1.02	8.0
03021 03011	25.40	25.40	5.50	14.0	12.0	7.0	1.02	8.0
03041	18.98	18.98	5.00	10.0	9.5	7.0	1.02	5.0
03051 03061 03071 03081 03091	12.62	12.62	4.00	6.30	5.2	8.0 8.0 10 10 10	1.02	2.0 2.0 2.5 2.5 2.5
03101	10.40	12.62	4.50	5.80	5.2	7.0	0.51	2.0
03111 03121	8.17	9.85	2.95	5.00	4.3	7.0	0.51	1.5
03131 03141	8.17	9.85	3.40	4.65	4.3	7.0	0.51	1.5
03211	8.17	9.85	3.65	4.40	3.7	7.5	0.51	1.5
03221 03151 03231 03241	6.32	7.60	2.50	3.60	3.0	7.0	0.51	0.75

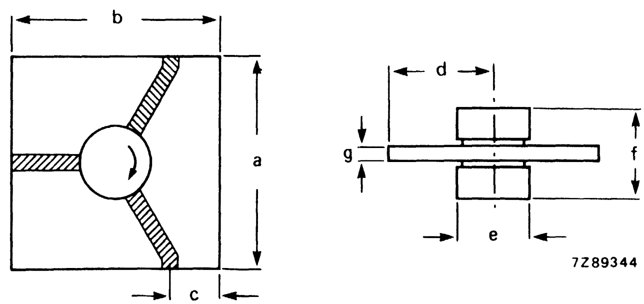


Fig.1

MICROSTRIP ISOLATORS

→ **Electrical data** (as measured in the related test jig)

Maximum power (c.w.) 10 W
Maximum reverse power 100 mW
Storage temperature −55 to + 125 °C

frequency range GHz	isolation		insertion loss		v.s.w.r.		operational temperature °C	catalogue number	related test jig
	min. dB	typ. dB	max. dB	typ. dB	max.	typ.		2722 169 followed by	
1.7 to 1.9 1.9 to 2.1 2.1 to 2.3	20	22	0.5	0.30	1.25	1.15	−10 to + 60	01161 01171 01181	00151
2.1 to 2.3 2.2 to 2.5 2.4 to 2.7	20	22	0.50 0.40 0.40	0.30 0.25 0.30	1.30	1.20	0 to +50 0 to +50 −10 to +70	01182 01191 01241	00161
2.8 to 3.2	18	20	0.6	0.40	1.35	1.25	−30 to +85	01211	00171
2.7 to 3.1 3.0 to 3.5	20	22	0.4	0.30	1.20	1.15	0 to + 50	01211 01201	00171
3.6 to 4.2	20	25	0.4	0.25	1.20	1.10	−10 to + 70	01041	00051
4.4 to 5.0 4.7 to 5.2 5.9 to 6.5 6.4 to 7.1 7.1 to 7.7	20	25	0.4	0.20	1.20	1.10	−10 to + 70	01051 01061 01071 01081 01091	00071
7.7 to 8.5	20	25	0.4	0.25	1.20	1.10	−10 to + 70	01101	00091
8.5 to 9.6 8.0 to 10.4 8.0 to 12.0 9.0 to 11.5	20 20 17 20	25 22 19 22	0.4 0.4 0.5 0.4	0.25 0.25 0.40 0.25	1.20 1.25 1.35 1.25	1.10 1.15 1.25 1.15	−10 to + 70	01111 01121 01131 01141	00111
10.5 to 13.0	20	22	0.4	0.30	1.25	1.15	−10 to + 70	01251	00201
13.4 to 14.5 14.4 to 15.25 15.0 to 16.0	20	22	0.5	0.30	1.25	1.15	−10 to + 70	01261 01151 01271	00131
12.0 to 18.0	17	19	0.6	0.40	1.35	1.25	−10 to + 70	01281	00131

MICROSTRIP ISOLATORS

Dimensions in mm

Mechanical data

Tolerances ± 0.05 mm unless otherwise stated.

catalogue number 2722 169 followed by	a	b	c	d ± 0.2	e	f max.	g ±0.005	h max.	mass g
01161 01171 01181	38.10	38.10	8.00	21.0	16.5	7.0	1.02	1.7	17
01182 01191 01241	25.40	25.40	8.00	13.0	12.0	7.0	1.02	1.7	8.0
01211 01201	25.40	25.40	5.50	14.0	12.0	7.0	1.02	1.7	8.0
01041	18.98	18.98	5.00	10.0	9.5	7.0	1.02	1.7	5.0
01051 01061 01071 01081 01091	12.62	12.62	4.00	6.30	5.2	8.0 8.0 10 10 10	1.02	1.7	2.0 2.0 2.5 2.5 2.5
01101	10.40	16.0	3.50	10.20	5.2	7.0	0.51	1.3	2
01111 01121	8.17	12.62	2.40	8.40	4.3	7.0	0.51	1.3	1.5
01131 01141	8.17	12.62	2.40	8.40	4.3	7.0	0.51	1.3	1.5
01251	8.17	12.62	2.85	7.95	3.7	7.5	0.51	1.3	1.5
01261 01151 01271 01281	6.32	11.00	2.50	7.00	3.0	8.0	0.51	1.3	0.75

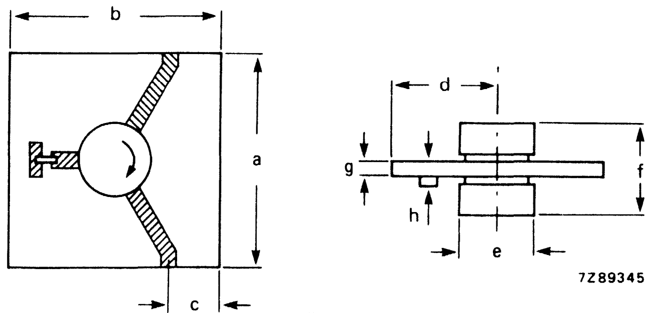


Fig.2

MOUNTING AND INTERCONNECTION IN MIC HOUSINGS

Dimensions in mm

All devices are rectangular to facilitate insertion into associated circuitry.

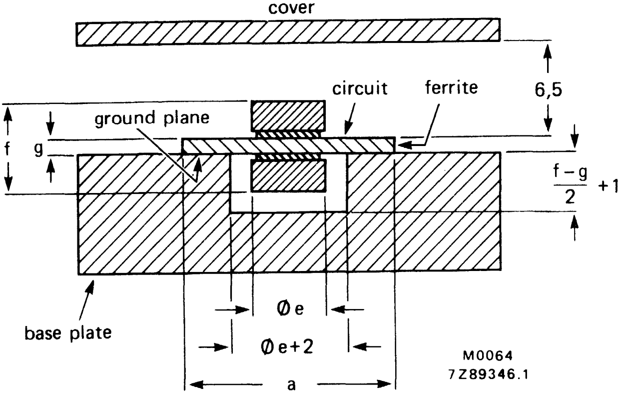


Fig. 3.

This figure gives the size of the recess in the base-plate and the height of the cover, assuming these parts are made of non-magnetic material. Increase these dimensions if magnetic material is used.

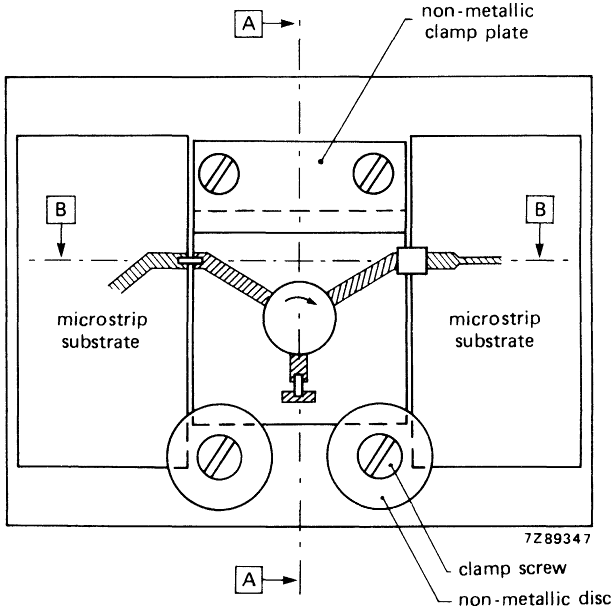


Fig. 4.

Two methods of mounting an isolator between MIC substrates:

- top: mounting the isolator independent of the MIC substrates using a non-metallic clamp-plate.
- bottom: clamping the isolator to the MIC substrates using non-metallic (e.g. nylon) discs.

The figure also shows two ways of making the electrical connections:

- left: gold beam bonding
- right: pressure contact.

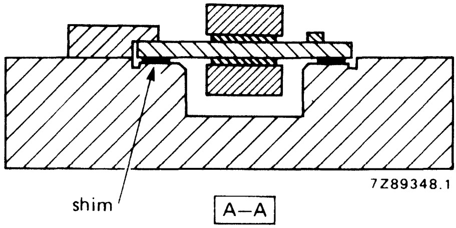


Fig. 5.

The cross-section through A-A (Fig.5) shows again the clamp-plate mounting. The figure also shows how to obtain a good ground connection to the base plate by using a shim of ductile conducting material (such as indium). A shim provides other advantages too, notably:

– by choosing the proper thickness, it can be used to align the isolator (or circulator) surface with the adjacent MIC substrate surface.
– its ductility reduces stresses within the substrates caused by differential expansion.
– it compensates for small surface irregularities in the base-plate.

A good ground contact can also be made using solder or conducting adhesives. These may introduce stresses, however, so they are not recommended. If the use of solder or adhesive cannot be avoided, use a low temperature process; i.e. for solder, 10 seconds at a maximum of 200 °C and for an adhesive, curing temperature of less than 150 °C.

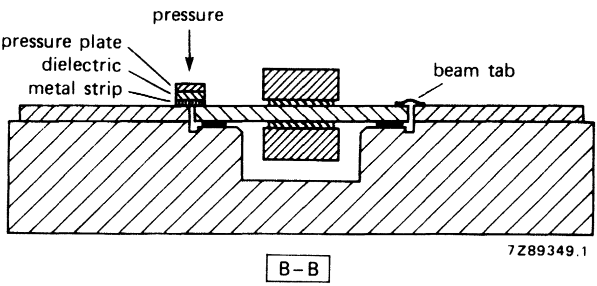


Fig.6

Cross section through B-B (Fig.6) illustrating the connection techniques:

left: pressure contact

right: gold beam bond, which can be made ultrasonically or thermosonically, or by thermocompression.

Careful milling is essential (rectangular and no burrs). Air gaps should be minimized but should not be less than 25 µm at room temperature.

Note: the linear expansion coefficient of ferrite is about 1×10^{-5}/°C.

CAUTIONARY NOTE

Isolators and circulators have magnetic fields that are carefully adjusted for optimum operation; they should not, therefore, be subjected to strong external magnetic fields.

NOTE ON ELECTRICAL PARAMETERS

Stated electrical parameters are valid only when measured on a test jig supplied by us.

→ ENVIRONMENTAL DATA

Rapid change of temperature to BS2011: part N, 5 cycles, T_{min} = –55 °C, T_{max} = +125 °C.

Dry heat to BS2011: part Ba, T_{max} = +125 °C, duration = 72 hrs.

Die shear strength: max. force 120 g/mm^2 to MIL-STD-883B method 2019.2.

CIRCULATORS AND ISOLATORS

INTRODUCTION

This Data Handbook gives only a selection of circulators and isolators from our production line which, we think, are of common interest and which shows our capability. Should you require other executions, different connectors, different frequencies or any other data, please contact us.

Circulators and isolators are key elements in modern v.h.f., u.h.f. and microwave engineering. Their fundamental property of non-reciprocity is capable of simplifying the construction and improving the stability, efficiency and accuracy of radar, communication and testing systems.

The devices contain a core of ferrite material biased by a static magnetic field. This field orients the electron spins within the ferrite to produce a gyromagnetic effect. The non-reciprocal behaviour occurs when a r.f. signal, applied perpendicular to the biasing field, interacts with the precessing electrons to set up a standing-wave pattern within the core.

CIRCULATORS

A circulator is a passive non-reciprocal device with three or more ports. Energy introduced into one port is transferred to an adjacent port, the other ports being isolated. Although circulators can be made with any number of ports, the most commonly used are 3-port and 4-port ones, the symbols for which are given in Figs 1 and 2.

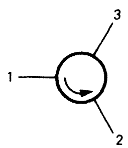


Fig. 1 Symbol for 3-port circulator.

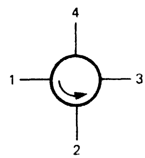


Fig. 2 Symbol for 4-port circulator.

Energy entering into port 1 emerges from port 2; energy entering into port 2 emerges from port 3, and so on in cyclic order.

ISOLATORS

An isolator is a passive non-reciprocal 2-port device which permits r.f. energy to pass through it in one direction whilst absorbing energy in the reverse direction.

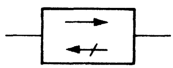


Fig. 3 Symbol for an isolator.

TERMS AND DEFINITIONS

Frequency range

This is the range within which the circulator or isolator meets the guaranteed specification.

Isolation

In a circulator, isolation is the ratio, expressed in dB, of the power entering a port to the power scattered into the adjacent port on the side opposed to the normal circulation (matched source and the other ports correctly terminated).

In an isolator, isolation is the ratio, expressed in dB, of the input power to the output power for signal injection in the reverse direction (matched source and load).

Insertion loss

The attenuation that results from including the device in the transmission system. It is given as a power ratio, expressed in dB, which compares the situation before and after the insertion of a circulator/isolator (matched source and the other ports correctly terminated).

Maximum power

In a circulator, the maximum power is the largest power it can handle at sea level and at maximum ambient temperature when one port is terminated with a mismatch giving a VSWR of 2, whilst the next port is matched with a VSWR of 1,2 or less, unless otherwise stated. This power value must not be exceeded. If the mismatch of the load is expected to exceed a VSWR of 2, a circulator of higher power handling capacity should be used.

The maximum power is the maximum continuous-wave power unless a maximum peak power is separately stated. If this value is exceeded the circulator can be damaged by arcing in its internal transmission structure. Power values are valid for one signal passage only. If more than one signal passes through the circulator, the peak power of the combined signal should not exceed the indicated maximum peak power.

In an isolator, the maximum power is the largest power that may be passed through it in the forward direction into a load with a VSWR of 2, unless otherwise stated. This power value must not be exceeded.

Temperature range

The ambient temperature range within which circulators and isolators function to specification. (When necessary, special temperature compensation is built in for circulators.) Circulators still function outside the temperature range but their electrical behaviour may then be far outside the guaranteed specifications. However, no permanent damage can be expected unless a large temperature rise is caused by excessive power handling.

CAUTIONARY NOTES

Circulators and isolators have internal fields that are carefully adjusted for optimum operation; they should not, therefore, be subjected to strong external magnetic fields. During storage and transport a minimum distance of 10 mm to other circulators/isolators and ferromagnetic material is recommended. During operation this distance should be at least 20 mm.
Care must be taken that condensation of humidity, especially in water-cooled items, does not occur.

QUALITY GUARANTEE

Subject to the Conditions of Guarantee the Manufacturer guarantees that circulators and isolators supplied to the purchaser meet the specifications published in the Manufacturer's Data Handbook and are free from defects in material and workmanship.

STANDARD TEST SPECIFICATIONS

Initial measurements

These measurements have been carried out at room temperature and at the extreme temperatures, with a power level not exceeding 10 mW.

Tropical test

This test has been carried out completely in accordance with IEC 68 test D, accelerated damp heat. This test begins with the temperature at 55 ± 2 °C and R.H. at 95 to 100% for a period of 16 hours, followed by a period of 8 hours with the temperature at + 25 °C and R.H. 80 to 100% to complete the 24-hour cycle: the test consists of 6 uninterrupted cycles.

Vibration test

This test has been carried out completely in accordance with MIL-STD-202D, method 201A: frequency range 10 to 55 to 10 Hz for 2 hours in each of the X, Y and Z directions, with a total excursion of 1,5 mm.

Thermal shock test

This test has been carried out completely in accordance with MIL-STD-202D, method 107C under condition A: 5 cycles with extreme temperatures of −55 °C and + 85 °C; each cycle of 1 hour's duration.

Mechanical shock test

This test has been carried out in accordance with MIL-STD-202D, method 213A under condition G: peak value 100 g, duration 6 ms, and also with extreme peak values up to 800 g, duration approximately 1 ms for each device, referring to the results of the drop test.

Drop test

This test has been carried out in accordance with ISO 2248, part IV: packaging complete, filled transport packages, vertical impact.

R.F. power test

The devices have been tested in accordance with the definition of maximum power in the Data Handbook (VSWR = 2). The ambient temperature of 25 °C was increased to the maximum operating temperature and the duration of the test was 1 hour for each device.

Final measurements

On completion of the above tests final measurements were carried out at a temperature of + 25 °C and with a power level not exceeding 10 mW. The results of these tests should be within the guaranteed values.

Dimensions and visual appearance

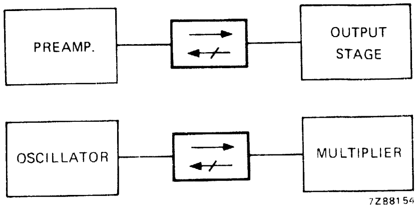
These have been checked in accordance with the published data.

Note

On request, different tests and/or additional tests to those above can be carried out.

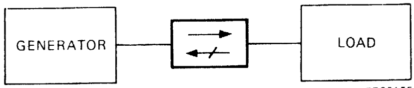
APPLICATIONS

Decoupling of circuit stages



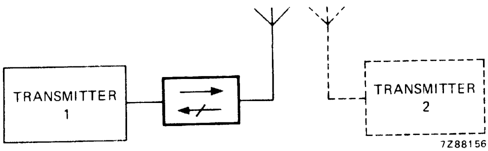
7Z88154

Reflection suppression
in test chains



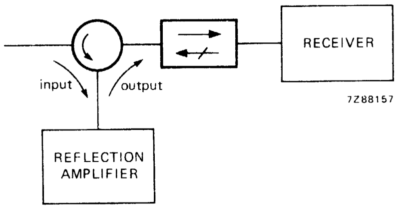
7Z88155

Suppression of reflections from
- long line to aerial
- mismatch by aerial damage
- feedback from nearby transmitters



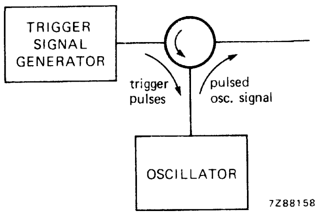
7Z88156

Separate input and output of a reflection amplifier, such as parametric amplifiers; tunnel, Gunn or Impatt diode amplifiers



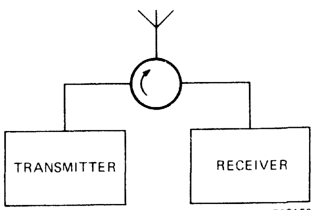
7Z88157

Feed trigger signals into an oscillator



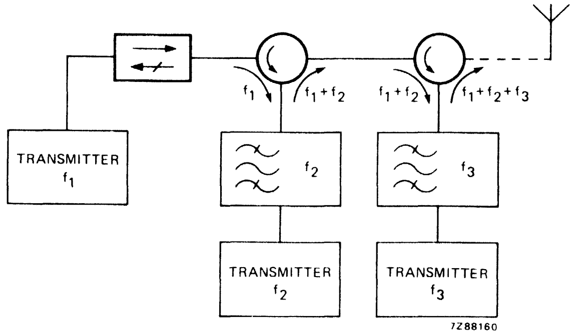
7Z88158

Avoid separate aerial for transmitter and receiver

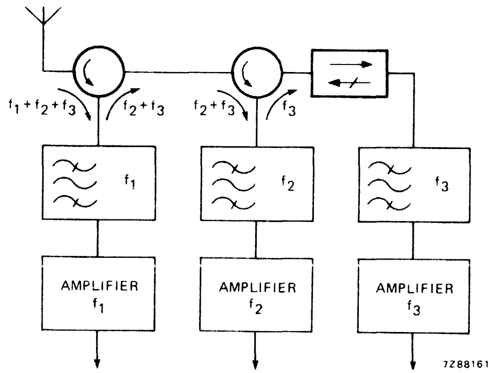


7Z88159

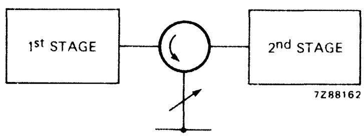
Connect different transmitters to a common aerial



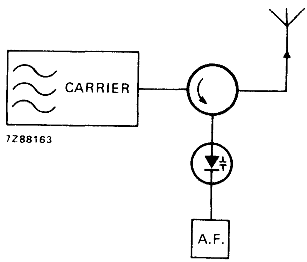
Separate a range of frequencies received by a common aerial

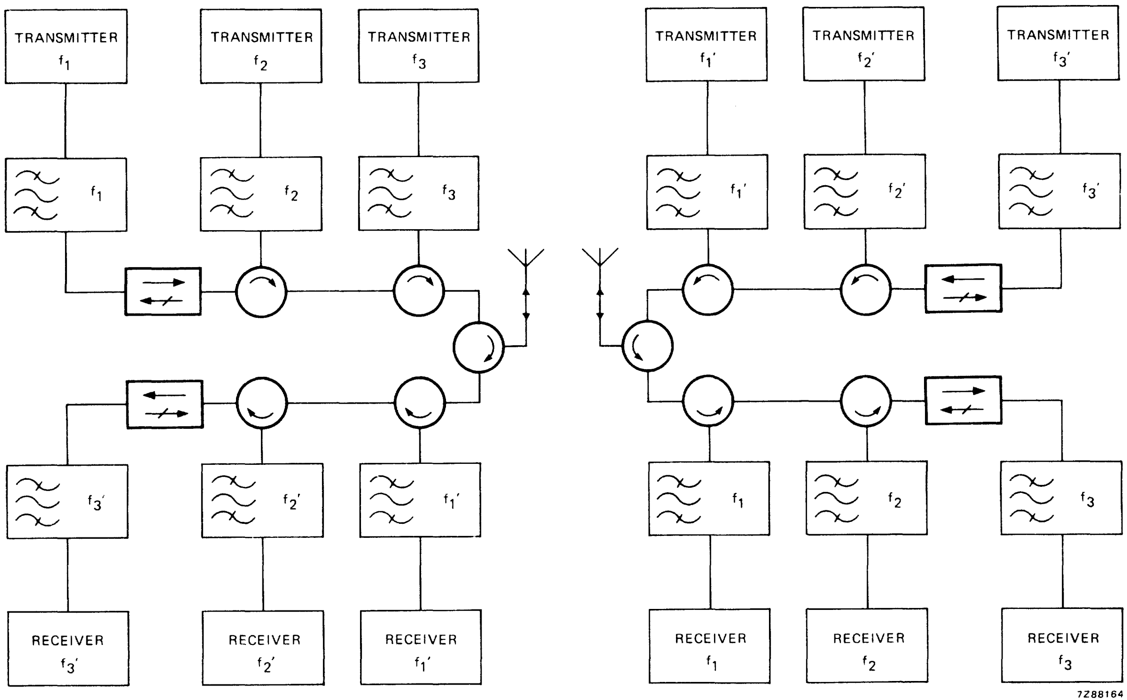


Variable phase shifters with a variable short-circuit

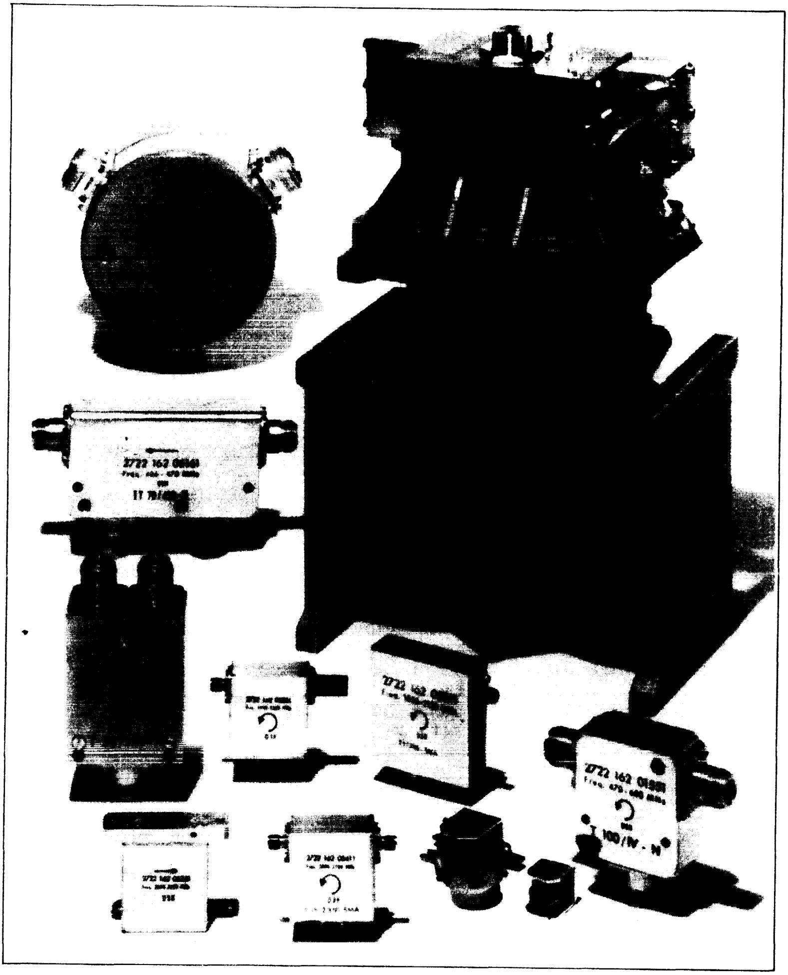


Phase modulation with a variable capacitance diode as a variable reactance





Signal combination and separation used together in a frequency-multiplexed, multichannel transceiver system

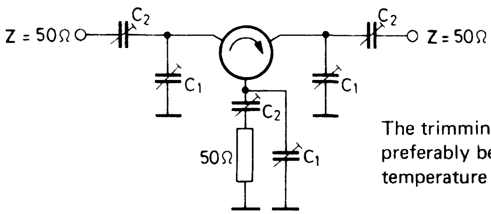


Preferred application: fixed and mobile communication.

type	dimensions Fig.	frequency range* MHz	maximum power forward W	maximum power reflected W
2722 162 09041	1	400 to 500	25	total reflection permitted
2722 162 09002	2	68 to 150	40	total reflection permitted
2722 162 09012	2	140 to 260	40	total reflection permitted
2722 162 09022	2	230 to 470	40	total reflection permitted

* For instantaneous bandwidth see diagram.

The technical characteristics have been measured in the following circuit:



The trimming capacitors should preferably be of a type with low temperature coefficient.

VX712212EA

type	C1 (pF)	C2 (pF)
2722 162 09041	2 to 15	2 to 10
2722 162 09002	25 to 200	20 to 150
2722 162 09012	5,5 to 65	5,5 to 65
2722 162 09022	2 to 16,5	2 to 16,5

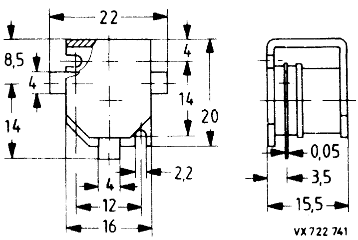


Fig. 1.

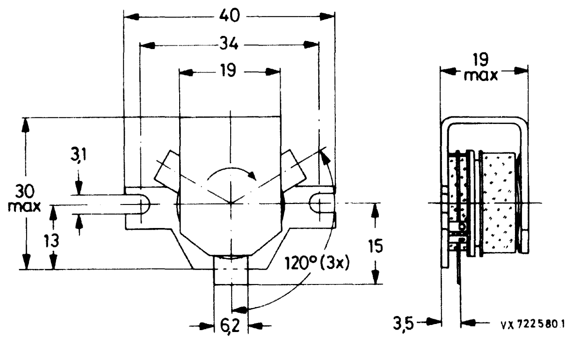
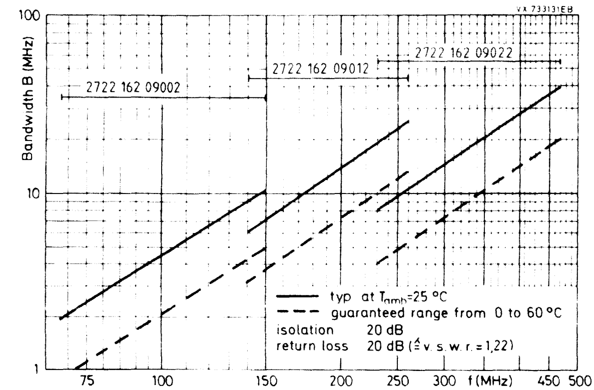
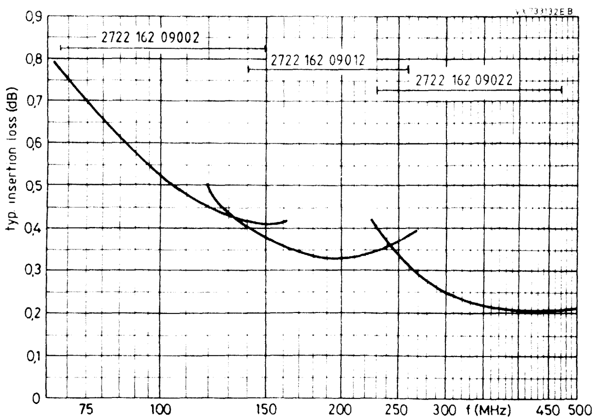


Fig. 2.

insertion loss dB	isolation dB	VSWR	temp. range °C	connector	mass g
⩽ 0,5	⩾ 20	⩽ 1,25	0 to 60	solder pins	20
⩽ 0,9 (⩽ 100 MHz) ⩽ 0,7 (> 100 MHz)	⩾ 20	⩽ 1,22	0 to 60		40
⩽ 0,6	⩾ 20	⩽ 1,22	0 to 60		40
⩽ 0,5	⩾ 20	⩽ 1,22	0 to 60		40





Preferred application: fixed and mobile communication

type	dimensions Fig.	frequency range* MHz	maximum power CW W	maximum power reflected W
2722 162 02912	3	72 to 73	20	20
02732		73 to 74	20	20
02722		83 to 84	20	20
02862		86,5 to 87,5	20	20
02942		100 to 101	20	20
02902		138 to 141	25	20
02952		144,5 to 147,5	20	20
02962		153,5 to 156,5	20	20
06002		156 to 157	20	20
02992		161 to 162	15	15
06891		176,5 to 183,5	20	20
06901		200,5 to 207,5	20	20
06911		208,5 to 215,5	20	20
2722 162 05151	4	74,5 to 75,5	25	20
05001		138 to 141	110	110
05141		146,5 ± 2,5	110	110
05201		153,5 ± 2,6	110	110
03831		159,5 ± 2,6	110	110
03841		160,5 ± 2,6	110	110
05281		166,0 ± 2,6	110	110
03851		168,0 ± 2,6	110	110
05751		146 to 165**	110	110
05761		160 to 174**	110	110
06291		201 to 209	100	100

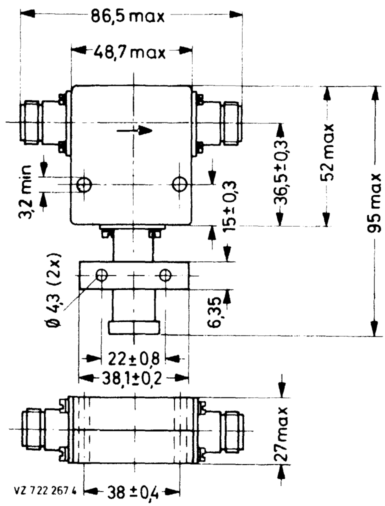


Fig. 3.

* Other frequencies on request.
** Tunable instantaneous bandwidth min. 5 MHz.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		g
		0,7				0 to 50		220
		0,8				0 to 55		
		0,7				0 to 55		
		0,7				0 to 50		
		0,7				0 to 50	N	
		0,4				0 to 55	female	
20		0,6		1,25		0 to 50		
		0,6				0 to 50		
		0,6				0 to 50		
		0,6				0 to 50		
		0,6				0 to 55		
		0,6				0 to 55		
		0,6				0 to 55		
		0,8				0 to 55		400
		0,4				0 to 55		
		0,4				0 to 55		
		0,4				0 to 55		
		0,4				0 to 55	N	
20		0,4		1,25		0 to 55	female	
		0,4				0 to 55		
		0,4				0 to 55		
		0,4				0 to 55		
		0,4				0 to 55		
		0,5				0 to 55		

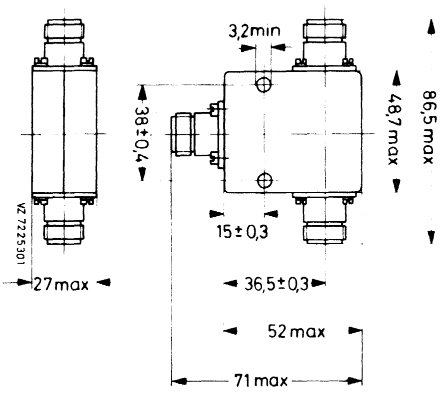


Fig. 4.

Preferred application: fixed and mobile communication

type	dimensions Fig.	frequency range MHz	maximum power	
			CW W	reflected W
2722 162 03342 03332	5 6	96 to 146	50	
2722 162 03732 03722 05781	5 6 5	225 to 400	60 60 200	
2722 162 06111 05321	7 8	600 to 960	10	

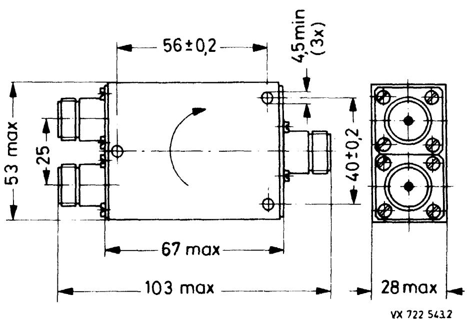


Fig. 5.

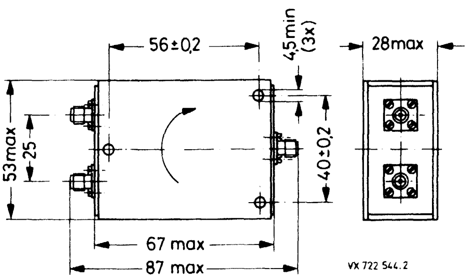


Fig. 6.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		g
18		1,3		1,3		−10 to + 60	N female SMA female	400 380
16 16 17		1,3 1,3 0,75	1,0	1,3 1,3 1,35		−40 to + 80 −40 to + 80 0 to + 55	N female SMA female N female	400 380 400
13	15	0,9	0,6	1,65	1,4	−25 to + 65	SMA female	400

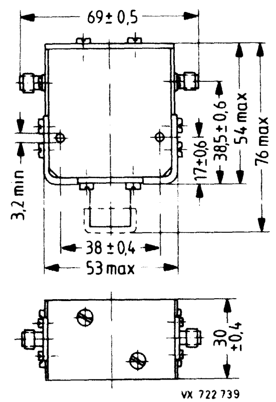


Fig. 7.

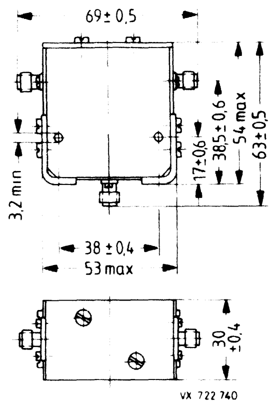


Fig. 8.

Preferred application: fixed and mobile communication

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 01931 01941 01951	9	225 to 270 270 to 330 330 to 400	150	
2722 162 03421 05091	10	270 to 330 330 to 400	60	

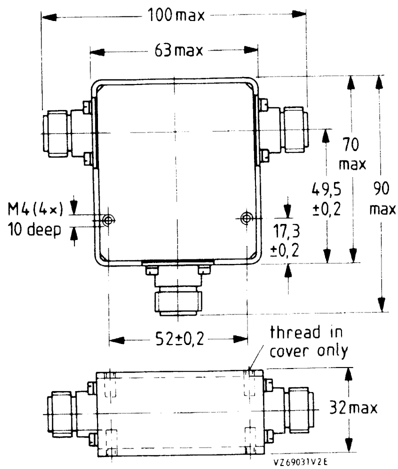


Fig. 9.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		g
18	21	0,35	0,2 0,2 0,3	1,35	1,25	0 to 70	N female	725
18	21	0,35	0,2	1,35	1,25	0 to 70	SMA female	725

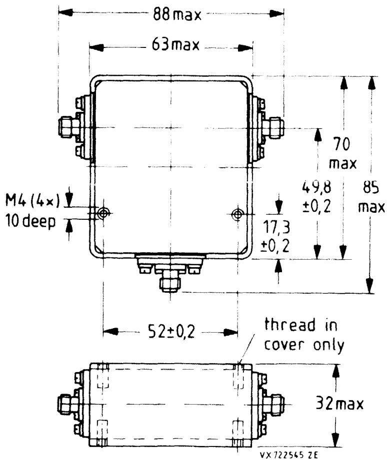


Fig. 10.

Preferred application: fixed and mobile communication

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 02712	11	400 to 470	20	
2722 162 09031	12	451 to 456	25	
2722 162 02931 02981 02921	13	406 to 414 450 to 458 510 to 514	70	70
2722 162 06161	13	406 to 470	100	
2722 162 02851	13	460 to 468	100	
2722 162 03411 05101	14 15	400 to 470 400 to 470	100	100
2722 162 01555	14	462 to 468	100	
2722 162 06671 06841	13 16	806 to 960 930 to 965	100 60	

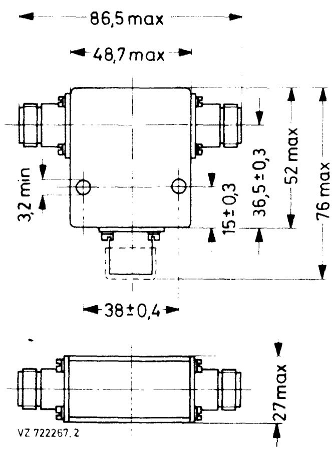


Fig. 11.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		g
20		0,5		1,25		−10 to + 60	N female	400
25		0,4		1,25		−25 to + 55	Solder pins	42
45	55	1,0 0,8 0,8	0,7 0,6 0,6	1,25	1,15	−10 to + 60	N female	700
50	55	0,8	0,7	1,25	1,15	−20 to + 60	N female	700
45	55	0,8	0,4	1,25	1,115	−10 to + 60	N female	700
20	25	0,5	0,35	1,25	1,15	−10 to + 60	N female SMA female	400
25		0,5		1,20		−10 to + 60	N female	400
45	55	0,8	0,5	1,25	1,15 1,20	−10 to + 60	N female	700 350

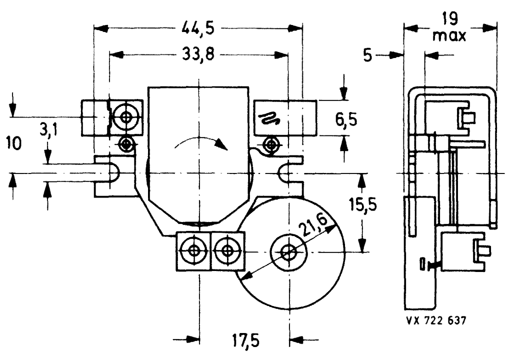


Fig. 12.

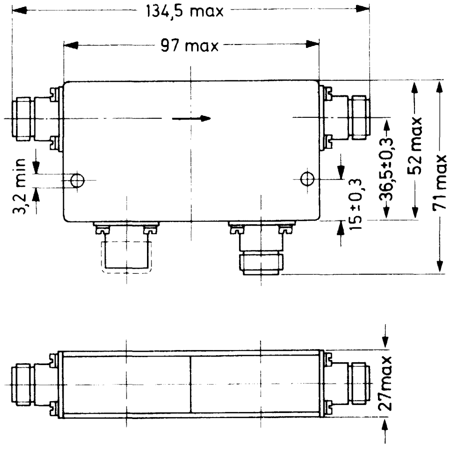

134,5 max
97 max
3,2 min
15±0,3
36,5±0,3
52 max
71 max
27max

Fig. 13.

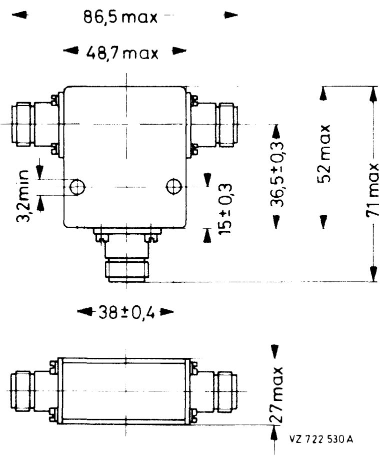

86,5 max
48,7 max
3,2min
15±0,3
36,5±0,3
52 max
71 max
38±0,4
27max
VZ 722 530 A

Fig. 14.

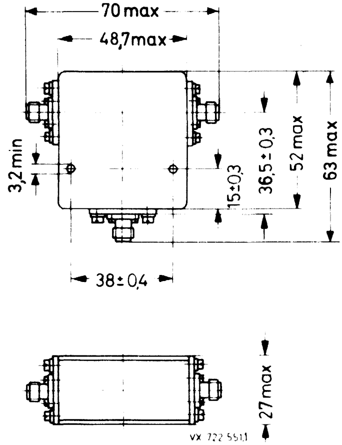

70 max
48,7max
3,2 min
15±0,3
36,5±0,3
52 max
63 max
38±0,4
27 max
VX 722 551.1

Fig. 15.

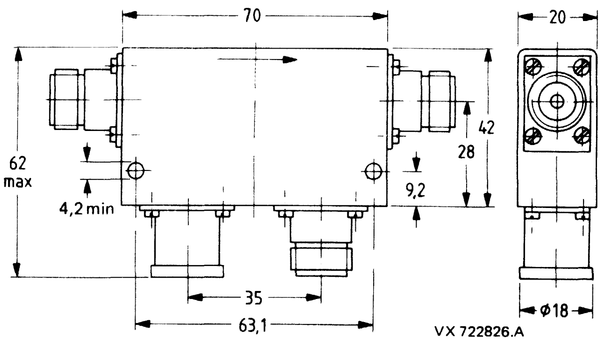

70
20
62
max
4,2 min
42
28
9,2
35
63,1
ϕ18
VX 722826.A

Fig. 16.

Preferred application: VHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	 peak W
2722 162 01871 01861 01851 03171	17	160 to 178 173 to 204 200 to 230 225 to 270	500	850
2722 162 03641 03631 03621 03651	18	160 to 178 173 to 204 200 to 230 225 to 270	500	850
2722 162 05031	19	195 to 205	1000	1800
2722 162 03681 03671 03661 03691	20	160 to 178 173 to 204 200 to 230 225 to 270	1000	1800
2722 162 01901 01891 01881 03181	21	160 to 178 173 to 204 200 to 230 225 to 270	1000	1800

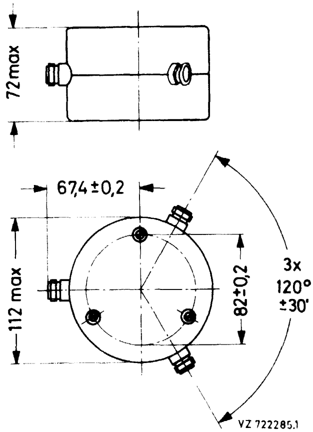


Fig. 17.

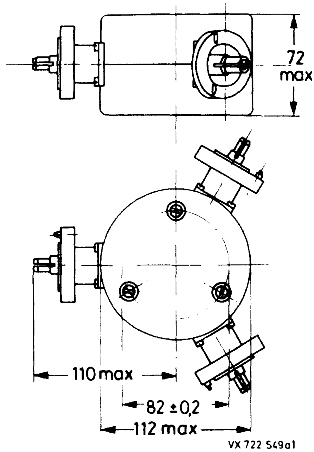


Fig. 18.

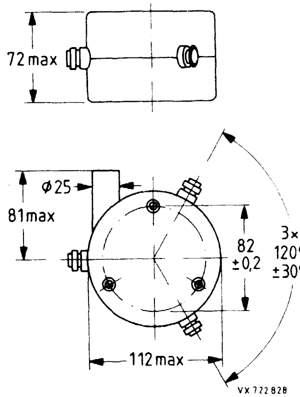


Fig. 19.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		g
20	24	0,35	0,3	1,25	1,15	−10 to + 60	N female	2100
20	24	0,35	0,3	1,25	1,15	−10 to + 60	EIA 7/8"	2700
20		0,4		1,25		−10 to + 40*	N female	2100
20	24	0,35	0,3	1,25	1,15	−10 to + 40*	EIA 7/8"	2700
20	24	0,35	0,3	1,25	1,15	−10 to + 40*	HF 7/16 female	2150

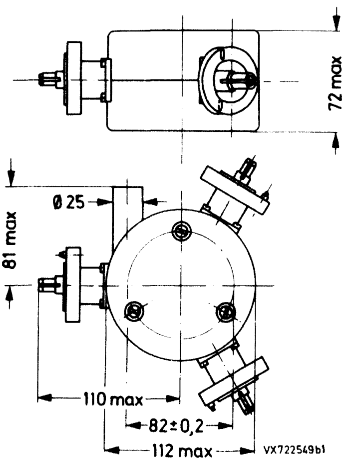


Fig. 20.

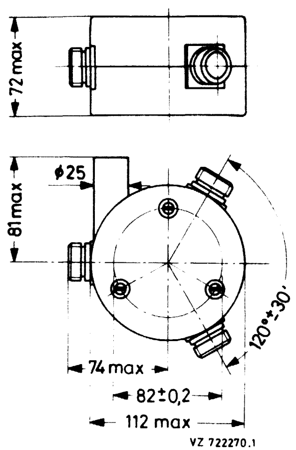


Fig. 21.

* With (filtered) air cooling at 250 Pa pressure drop; max. inlet temperature 40 °C; max. permissible temperature of the connectors + 55 °C.

Preferred application: UHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power peak W
2722 162 02691 02701 02401	22	470 to 600 600 to 800 790 to 1000	10	100
2722 162 02751 02741	23	600 to 800 790 to 1000	10	100
2722 162 02671 02681	24	470 to 600 600 to 800	10	100
2722 162 03871 03821 03811	25	470 to 600 600 to 800 790 to 1000	50	200
2722 162 01551 01563 01561 03261 03263*	26	470 to 600 550 to 650 600 to 800 790 to 1000 790 to 1000	100	200
2722 162 03961 03971 03981	27	470 to 600 600 to 800 790 to 1000	100	200

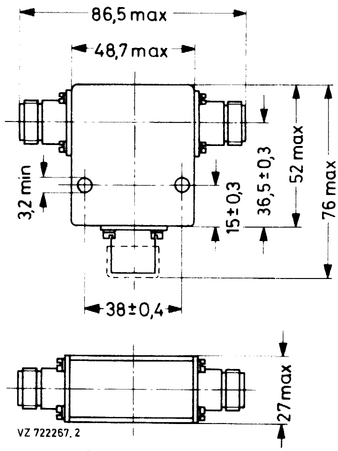


Fig. 22.

* Low noise.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C	**	g
20	25	0,5	0,35	1,25	1,15	−10 to + 60	N female	400
20	25	0,5	0,35	1,25	1,15	−10 to + 60	SMA female	400
20	25	0,5	0,35	1,25	1,15	−10 to + 60	4,1/9,5 female	400
20	25	0,5	0,35 0,35 0,3	1,25	1,15 1,15 1,14	−10 to + 60	SMA female	400
20	25	0,5	0,35 0,35 0,35 0,3 0,3	1,25	1,15 1,15 1,15 1,14 1,14	−10 to + 60	N female	400
20	25	0,5	0,35 0,35 0,3	1,25	1,15 1,15 1,14	−10 to + 60	N male	400

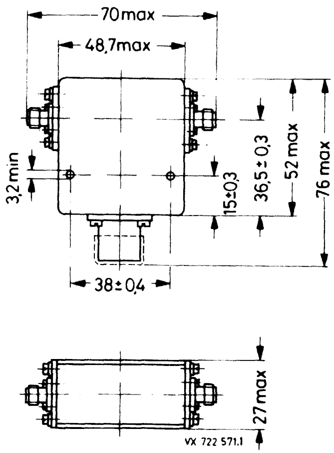


Fig. 23.

** Other connectors on request.

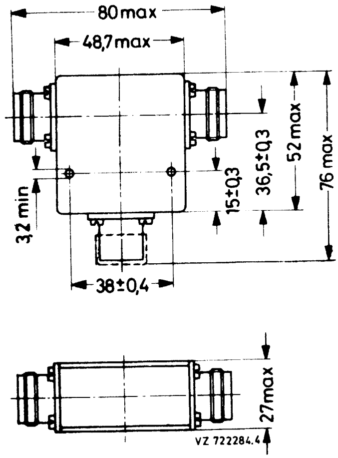

80 max
48,7 max
52 max
76 max
36,5±0,3
15±0,3
3,2 min
38±0,4
27 max
VZ 722284.4

Fig. 24.

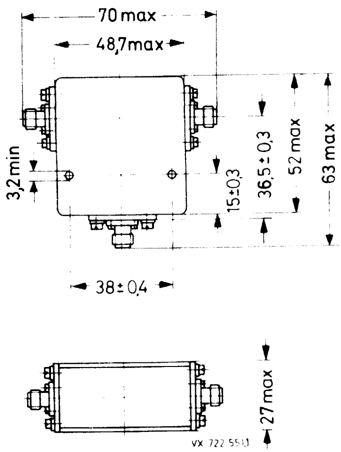

70 max
48,7 max
52 max
63 max
36,5 ± 0,3
15±0,3
3,2 min
38 ± 0,4
27 max

Fig. 25.

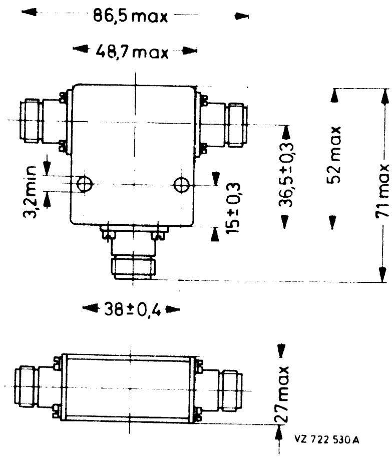

86,5 max
48,7 max
3,2min
15±0,3
36,5±0,3
52 max
71 max
38±0,4
27max
VZ 722 530A

Fig. 26.

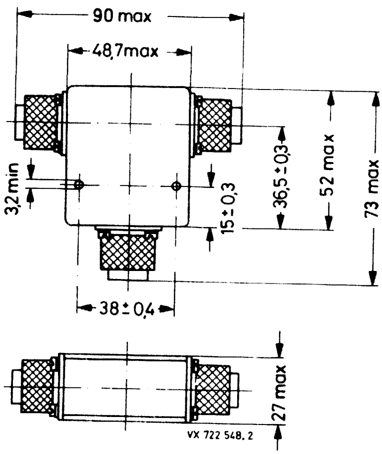

90 max
48,7max
3,2min
15±0,3
36,5±0,3
52 max
73 max
38±0,4
27 max
VX 722 548. 2

Fig. 27.

Preferred application: UHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power peak W
2722 162 01572 01582 01592 01612	28	400 to 470 470 to 600 590 to 720 710 to 860	300	500
2722 162 01632 01642 01662	29	470 to 600 590 to 720 710 to 860	300	500

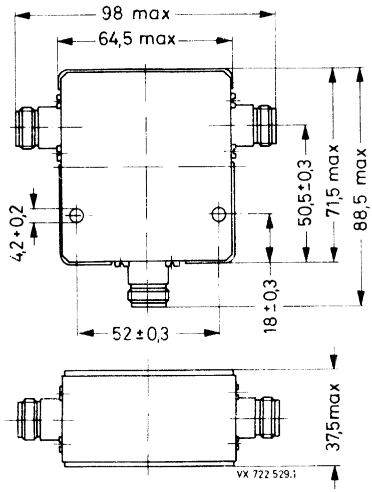


Fig. 28.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	25	0,35	0,20	1,25	1,15	−10 to + 60	N female	1200
20	25	0,35	0,20	1,25	1,15	−10 to + 60	HF 7/16 female	1200

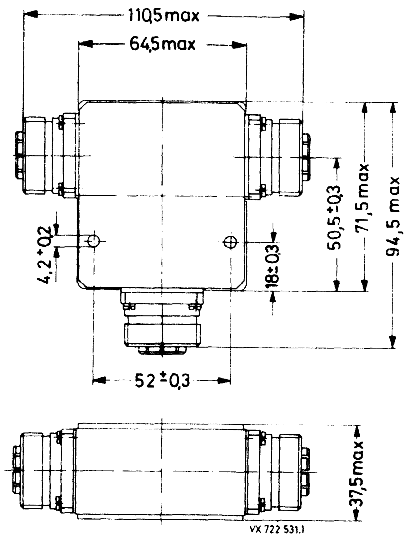


Fig. 29.

Preferred application: UHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power peak W
2722 162 01121 03191 01131 01141	30	470 to 600 600 to 800 590 to 720 710 to 860	500	900
2722 162 03221 03231 03241 03251	31	470 to 600 600 to 800 590 to 720 710 to 860	500	900
2722 162 03141 03151 03201 03211	32	470 to 600 600 to 800 590 to 720 710 to 860	500	900
2722 162 05371 05381 05391	32	470 to 600 590 to 720 710 to 860	700	8000

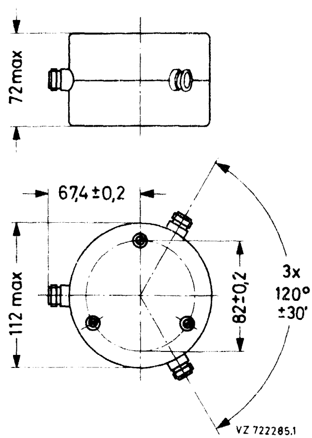


Fig. 30.

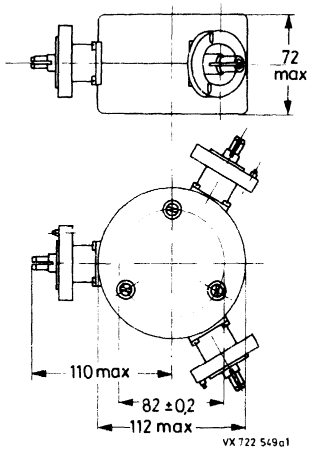


Fig. 31.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
22	24	0,35	0,25	1,2	1,15	−10 to + 70	N female	2080
20	24	0,35	0,25	1,25	1,15	−10 to + 70	EIA 7/8"	2700
20	24	0,35	0,25	1,25	1,15	−10 to + 70	HF 7/16 female	2200
20		0,4		1,25		+ 5 to + 65	HF 7/16 female	2200

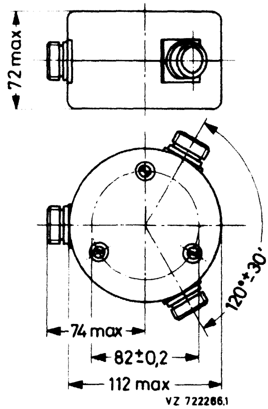


Fig. 32

Preferred application: UHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	 peak W
2722 162 03991	33	433 to 435	2000	2000
2722 162 01771 01791 01781 01801	33	470 to 600 600 to 800 590 to 720 710 to 860	2000	2000
2722 162 01261 01331 01281 01271	34	470 to 600 600 to 800 590 to 720 710 to 860	2000	2000

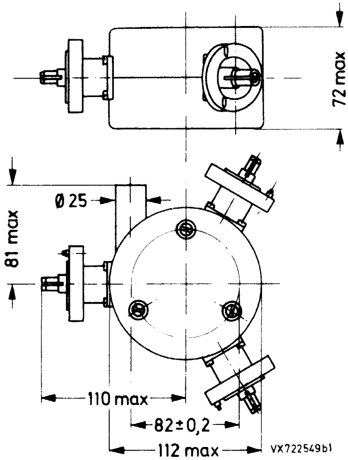


Fig. 33.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	24	0,4	0,3	1,25	1,15	0 to 40*	EIA 7/8"	2700
20	24	0,35	0,25	1,25	1,15	−10 to + 40*	EIA 7/8"	2700
20 20 22 22	24 24 26 26	0,35	0,75	1,25 1,25 1,2 1,2	1,15	−10 to + 40*	HF 7/16 female	2200

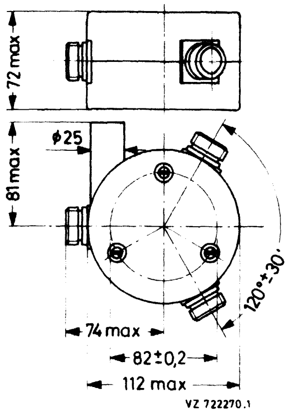


Fig. 34.

* With (filtered) air cooling, at 250 Pa pressure drop; 40 °C inlet temperature, max. permissible temperature of the connectors + 55 °C.

Preferred application: UHF television

type	dimensions Fig.	frequency range MHz	maximum power CW W	peak W
2722 162 03051 03061 03071	35	470 to 600 590 to 720 710 to 860	2000	8000
2722 162 03001 03011 01981	36	470 to 600 590 to 720 710 to 860	2000	8000

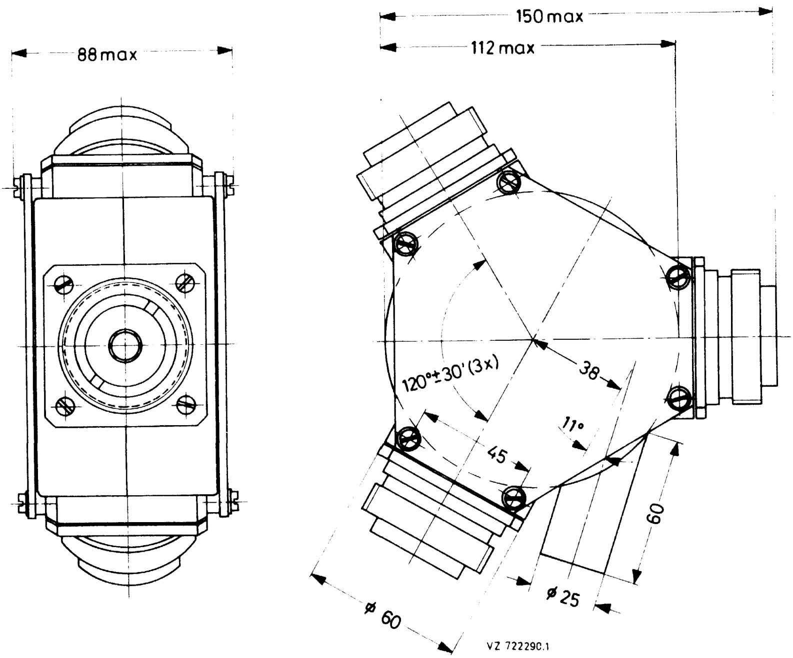


Fig. 35.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20		0,4		1,25		+ 5 to + 40*	HF 13/30 female	
20		0,4		1,25		+ 5 to + 40*	EIA $1\frac{5}{8}''$	3900

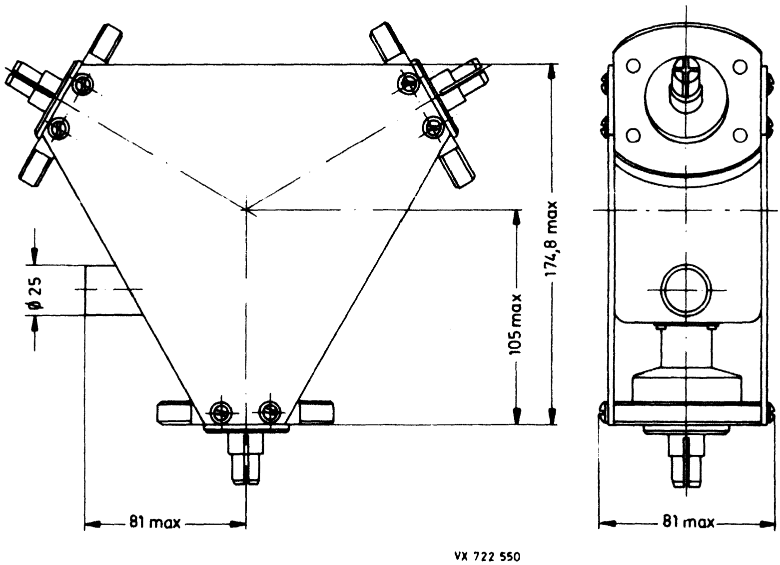


Fig. 36.

* With (filtered) air cooling at 250 Pa pressure drop; 40 °C inlet temperature, max. permissible temperature of the connectors + 55 °C.

Preferred application: radio links and navigation

type	dimensions Fig.	frequency range MHz	maximum power CW W	 reflected W
2722 162 02492 03802	37 38	1427 to 1535	10	
2722 162 05331	39	1350 to 1700	10	
2722 162 05571 06701	39 40	1350 to 2100	10	
2722 162 03591	38	960 to 1225	100	

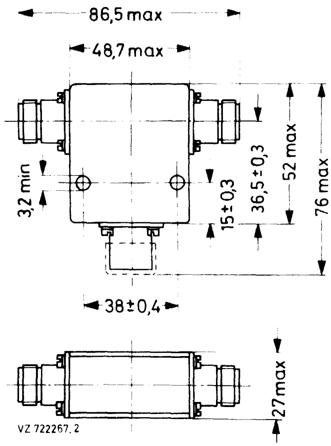


Fig. 37.

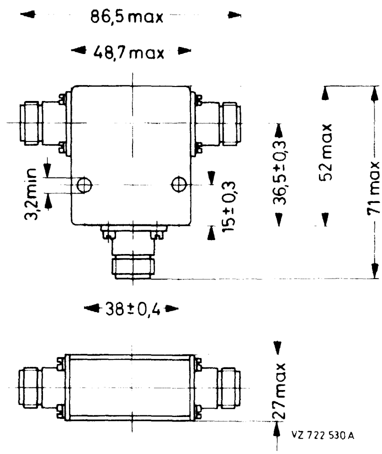


Fig. 38.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	24	0,4	0,3	1,15	1,12	0 to 55	N female	400
20	23	0,4	0,3	1,2	1,15	0 to 45	SMA female	120
17		0,5		1,35		−15 to + 65	SMA female	120
20	22	0,5	0,35	1,25	1,20	−10 to + 60	N female	460

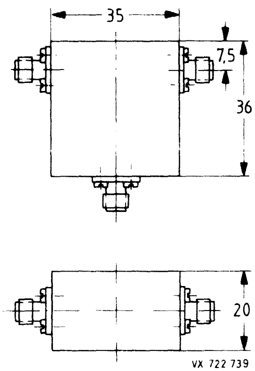


Fig. 39.

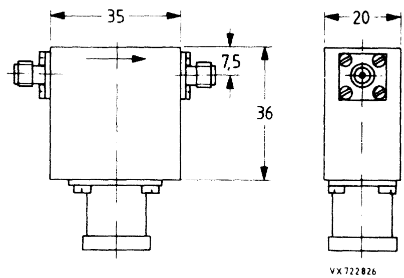


Fig. 40.

Preferred application: radio links

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 02521 02531 02541 02551	43	1470 to 1620 1590 to 1800 1760 to 1940 1890 to 2110	1	1
2722 162 02631 02641 02651 02661	44	1470 to 1620 1590 to 1800 1760 to 1940 1890 to 2110	15	15
2722 162 05241 05251 05231	45	1700 to 2100	30	
2722 162 05261 05271	45	1900 to 2300	30	
2722 162 02571 02581 02591 02601	41	1700 to 2100 1700 to 2100 1900 to 2300 1900 to 2300	15	15
2722 162 05311 05341 05351 05361 05401 05411	41	1700 to 2100 1900 to 2300 2100 to 2500 2300 to 2700 2450 to 2850 2000 to 2700	10	
2722 162 05471	42	1900 to 2300	15	

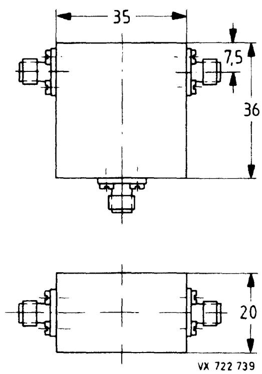


Fig. 41.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	23	0,4	0,3	1,22	1,15	0 to 55	solder pins	100
20	23	0,4	0,3	1,22	1,15	0 to 55	SMA female	150
26 26 20		0,3		1,11 1,11 1,25		0 to 55	SMA 2 x female 1 x male	120
26		0,3		1,11		0 to 55	SMA 2 x female 1 x male	
26		0,25		1,11		0 to 55	SMA 2 x female 1 x male	140
20		0,4		1,2		−20 to + 55	SMA female	120
23		0,3		1,1		− 10 to + 70	1 x N female 2 x SMA female	150

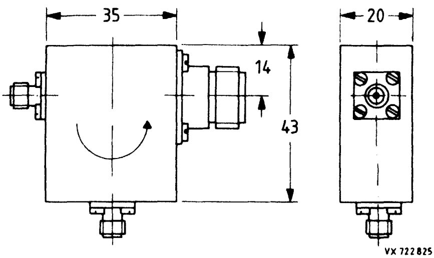


Fig. 42.

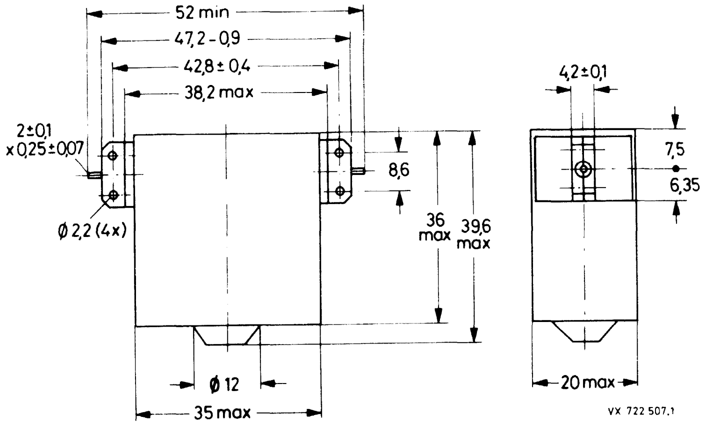

52 min
47,2 - 0,9
42,8 ± 0,4
38,2 max
4,2 ± 0,1
2 ± 0,1
x 0,25 ± 0,07
8,6
7,5
6,35
Ø 2,2 (4x)
36
max
39,6
max
Ø 12
35 max
20 max
VX 722 507.1

Fig. 43.

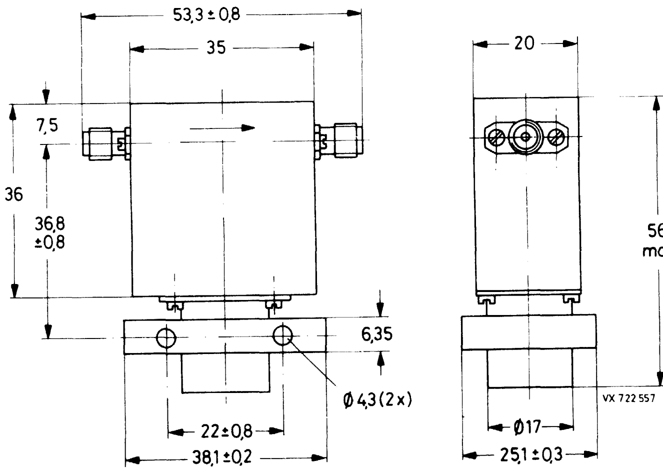

53,3 ± 0,8
35
20
7,5
36
36,8
±0,8
56
max
6,35
Ø 4,3 (2 x)
22 ± 0,8
38,1 ± 0,2
Ø 17
25,1 ± 0,3
VX 722 557

Fig. 44.

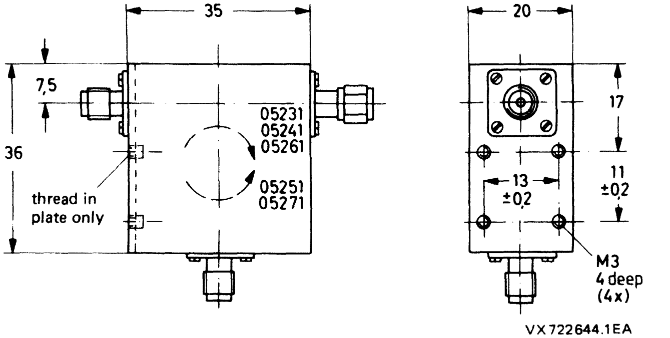

35
20
7,5
36
05231
05241
05261
05251
05271
thread in
plate only
17
11
±0,2
13
±0,2
M3
4 deep
(4x)
VX722644.1EA

Fig. 45.

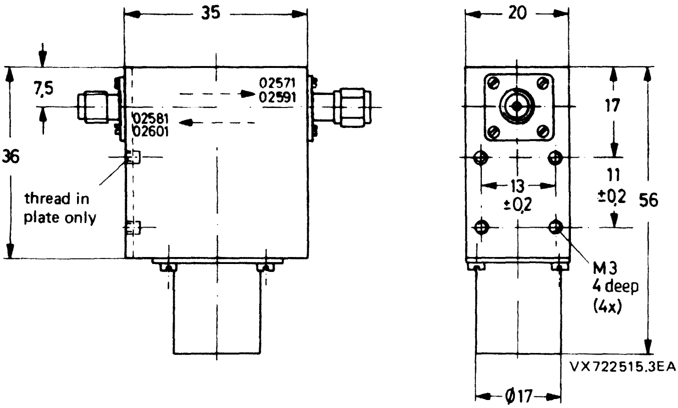

35
20
7,5
36
02571
02591
02581
02601
thread in
plate only
17
11
±0,2
56
13
±0,2
M3
4 deep
(4x)
VX722515.3EA
Ø17

Fig. 46.

Preferred application: radio links

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 03881 03891 03901	47	1680 to 1920 1880 to 2120 2080 to 2320	20	
2722 162 03911 03921 03931	48	1680 to 1920 1880 to 2120 2080 to 2320	50	
2722 162 03951 03941	47 48	1700 to 2300	20 50	
2722 162 02191 02511	49 50	1700 to 2300	20	5

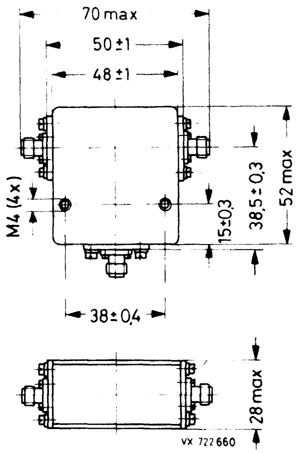


Fig. 47.

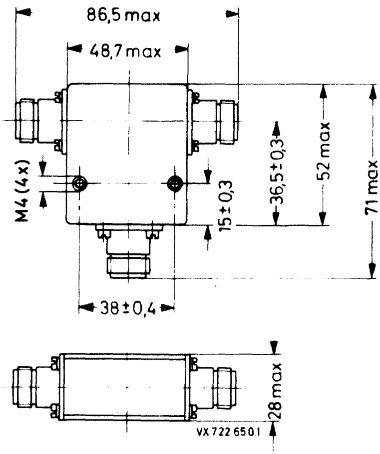


Fig. 48.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
25		0,35		1,12		0 to + 50	SMA female	400
23		0,40		1,15		−20 to + 60	N female	400
20		0,3		1,25		0 to + 55	SMA female N female	400
20		0,3		1,25		0 to + 55	N m + f SMA m + f	400

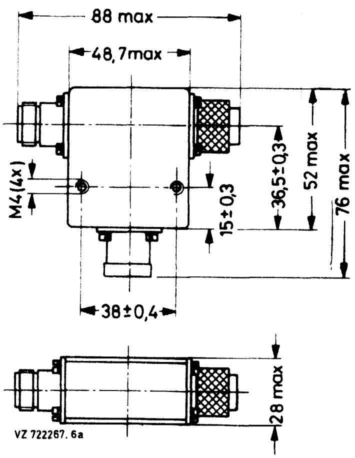


Fig. 49.

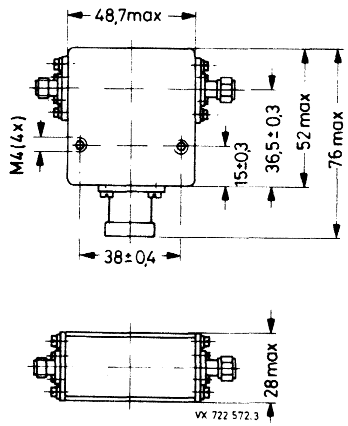


Fig. 50.

Preferred application: radio links

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 06031	51	1630 to 1780	1	1
06321		1815 to 1925		
06041		1890 to 1990		
06051		2038,5 to 2108,5		
06331		2074 to 2184		
06061		2297,5 to 2367,5		

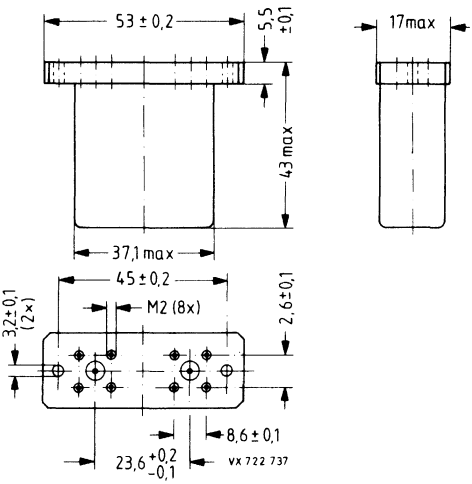


Fig. 51.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20		0,4		1,25		−20 to + 60	SMA female, modified	110

Preferred application: television

type	dimensions Fig.	frequency range MHz	maximum power CW W	 reflected W
2722 162 04051 04061	52	1700 to 2100 1900 to 2300	30	15
2722 162 04091 04101	52	1700 to 2100 1900 to 2300	30	

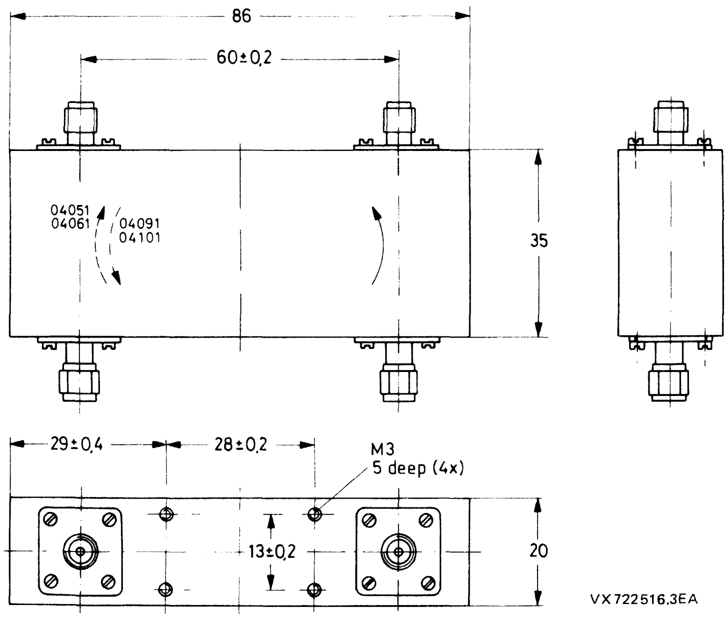


Fig. 52.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
26		0,25		1,11		0 to + 55	SMA male 2 x female 2 x	220
26		0,25		1,11		0 to + 55	SMA male 2 x female 2 x	220

Preferred application: radio links and navigation

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 162 02471	53	4200 to 4400	10	1,5
2722 162 03431 03441	54	3800 to 4200 4400 to 5000	10	
2722 162 04031 04041	55	3800 to 4200 4400 to 5000	10	

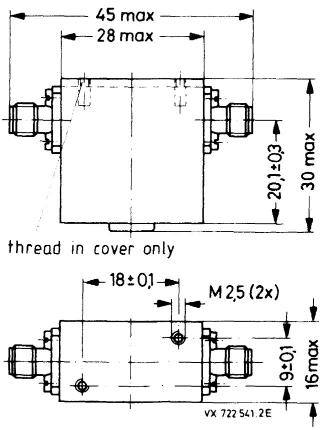


Fig. 53.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
23	25	0,3	0,25	1,2	1,12	−55 to + 90	SMA female	60
25	27	0,25	0,2	1,12	1,10	−10 to + 70	SMA female	110
25	27	0,25	0,2	1,12	1,10	−10 to + 70	SMA female	220

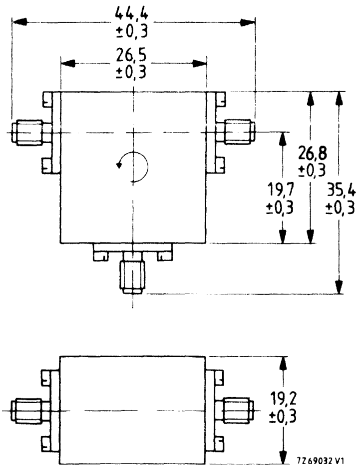


Fig. 54.

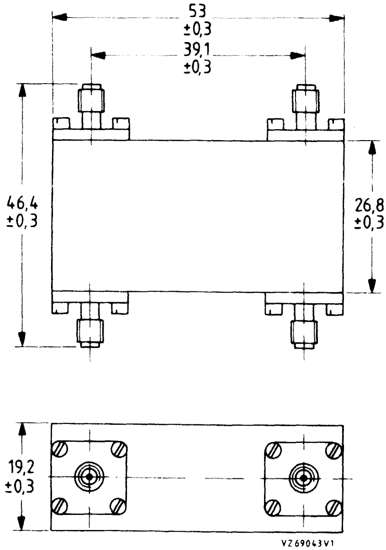


Fig. 55.

Preferred application: radio links

type	dimensions Fig.	frequency range MHz	maximum power CW W	 reflected W
2722 161 04001 04051 04061	56	5925 to 6425 6425 to 7125 7125 to 7750	200	3
2722 161 02211 02311 02321	57	5925 to 6425 6425 to 7125 7125 to 7750	200	

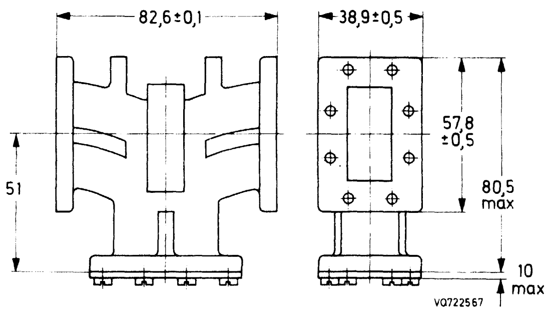


Fig. 56.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
28		0,2		1,08		0 to + 50	IEC-UER 70	230
28		0,2		1,08		0 to + 50	IEC-UER 70	230

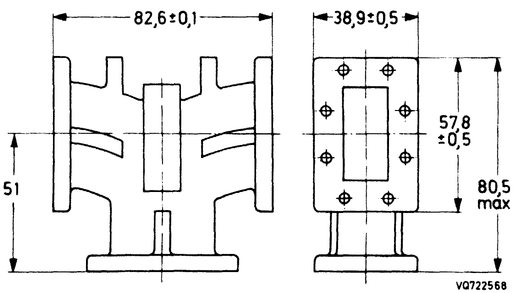


Fig. 57.

Preferred application: microwave measurements

type	dimensions Fig.	frequency range MHz	maximum power	
			CW W	reflected W
2722 162 02091 01491	58 59	2000 to 4000	50	
2722 162 02101 01501	60 61	2000 to 4000	50	
2722 162 02071 01511	62 63	3000 to 6000	20	
2722 162 02111 01811	64 65	4000 to 8000	10	
2722 162 02122 01822	66 67	7000 to 12400	10	
2722 162 02221 03301	68 69	12000 to 18000	5	
2722 162 02231 02501	70 71	7900 to 10400 8900 to 9600	5	
2722 161 02071	72	8200 to 11200	50	

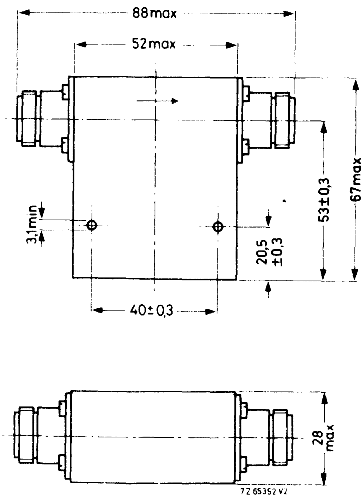


Fig. 58.

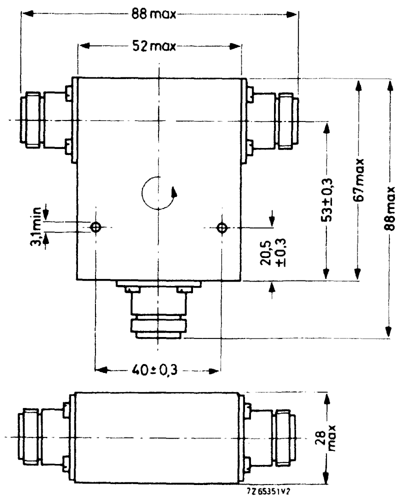


Fig. 59.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	24	0,5	0,35	1,25	1,15	−10 to + 70	N female	300
20	24	0,5	0,35	1,25	1,15	−10 to + 70	SMA female	300
20	24	0,5	0,3	1,25	1,15	−10 to + 70	SMA female	120
20	24	0,5	0,3	1,25	1,15	−10 to + 70	SMA female	100
20	24	0,6	0,35 0,4	1,25	1,15	−10 to + 70	SMA female	60
18	22	0,6	0,35	1,25 1,3	1,2	−10 to + 70	SMA female	20
20	22	0,4	0,35	1,25	1,23	−10 to + 70	SMA female	30
22	30	0,5	0,3	1,18	1,15	+ 10 to + 40	IEC-UBR 100	500

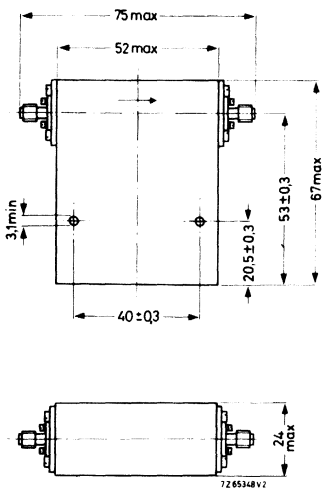


Fig. 60.

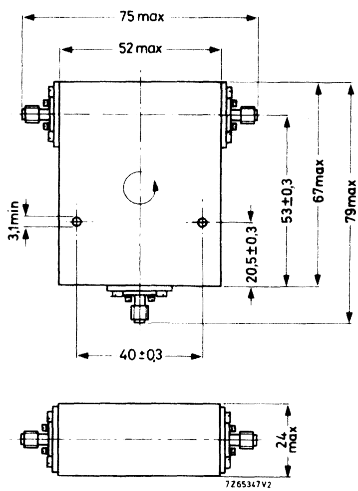


Fig. 61.

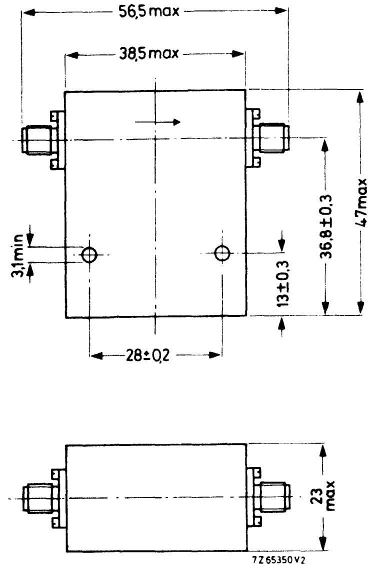


Fig. 62.

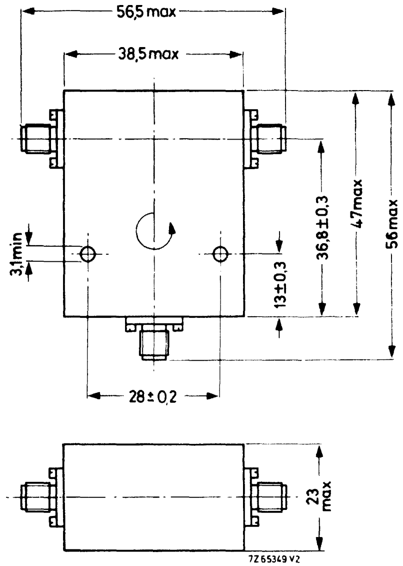


Fig. 63.

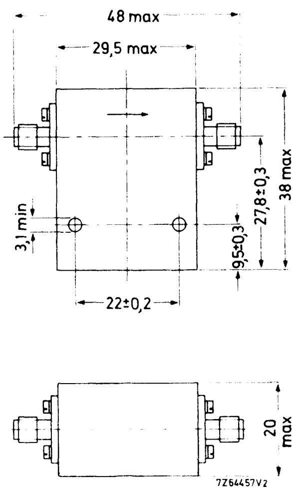


Fig 64.

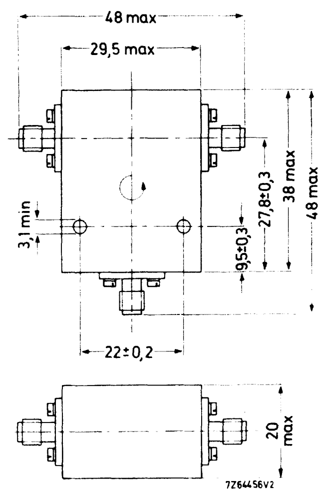


Fig. 65.

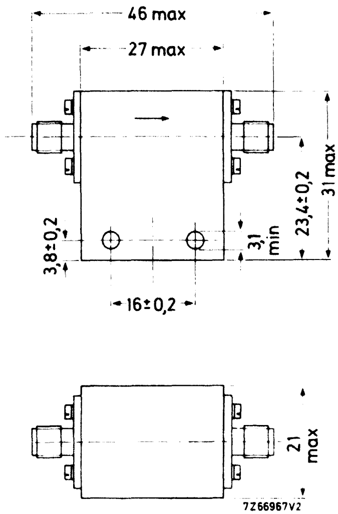


Fig. 66.

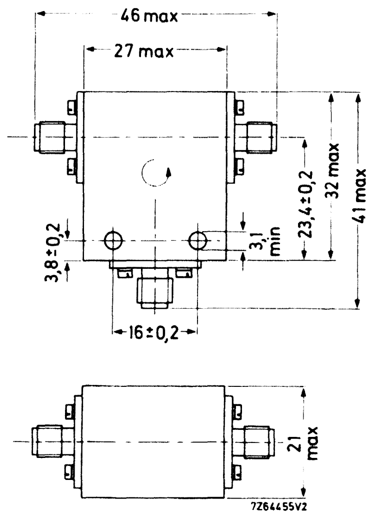


Fig. 67.

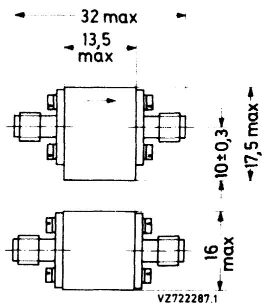


Fig. 68.

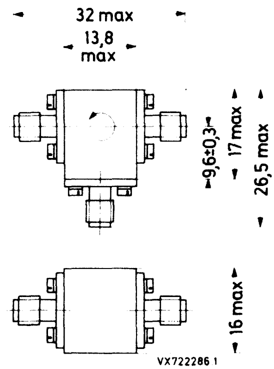


Fig. 69.

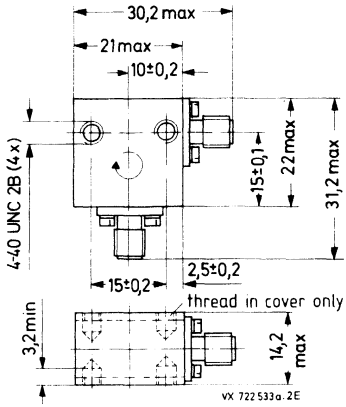

30,2 max
21max
10±0,2
4-40 UNC 2B (4x)
15±0,1
22max
31,2 max
2,5±0,2
15±0,2
thread in cover only
3,2min
14,2 max
VX 722 533a.2E

Fig. 70.

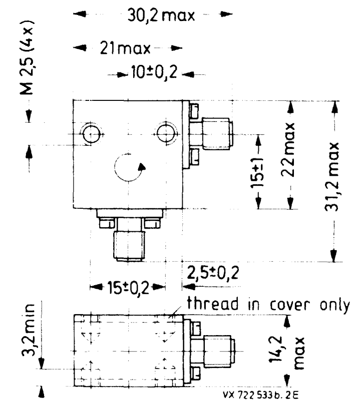

30,2 max
21max
10±0,2
M 2,5 (4x)
15±1
22max
31,2 max
2,5±0,2
15±0,2
thread in cover only
3,2min
14,2 max
VX 722 533b.2E

Fig. 71.

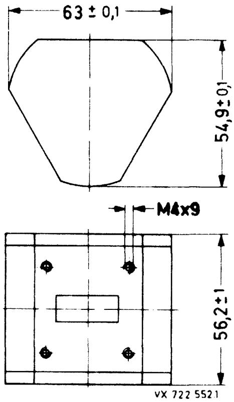


Fig. 72.

Preferred application: radar

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 161 01221 01222*	73	8500 to 9600	1	
2722 161 01361	74	8500 to 9600	5	
2722 161 01211 01261	75 76	8500 to 9600	10	
2722 161 01531	77	10025 to 10325	1	

* With M4-Helicoil.

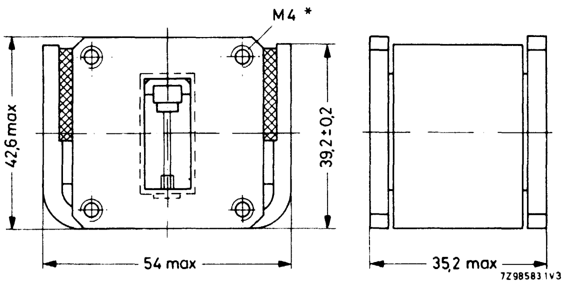


Fig. 73.

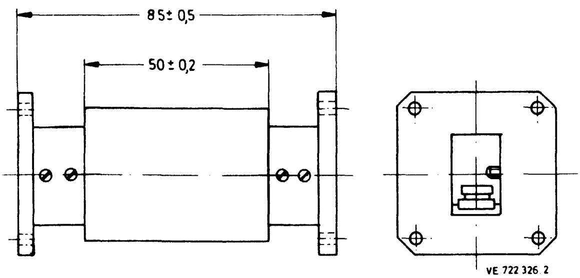


Fig. 74.

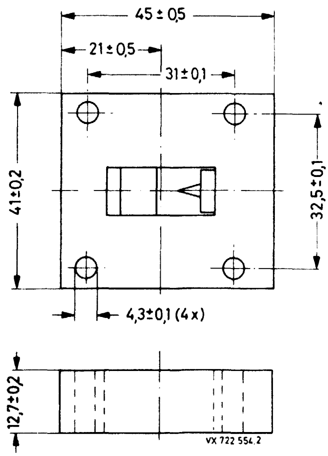


Fig. 77.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
15		0,6		1,15		+ 10 to + 70	IEC-UBR 100	400
30		0,5		1,05		−10 to + 70	IEC-UBR 100	600
30 55		0,5 1,2		1,05 1,20		−10 to + 70	IEC-UBR 100	420 600
20		0,4		1,25		−40 to + 85	IEC-UBR 100	50

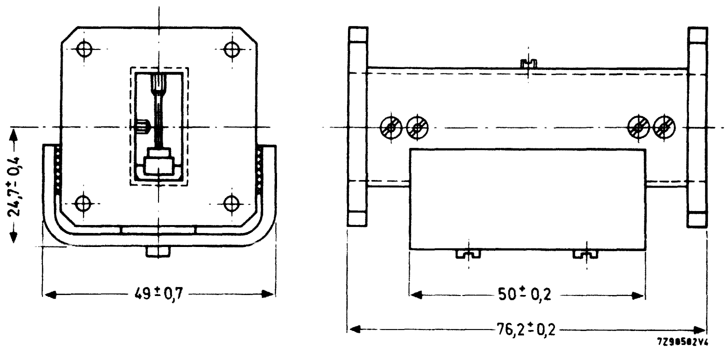


Fig. 75.

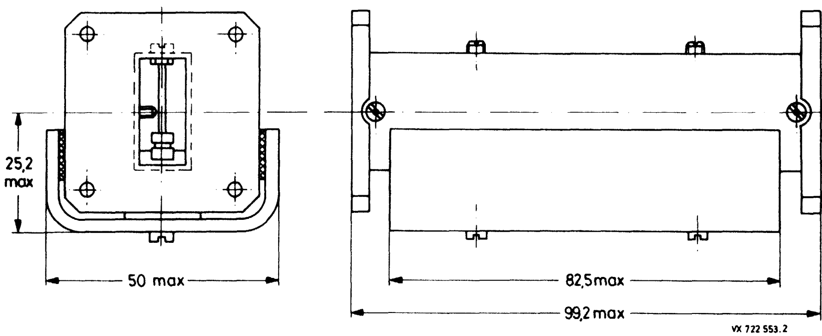


Fig. 76.

Preferred application: microwave heating

type	dimensions	frequency range	maximum power	
	Fig.	MHz	CW W	reflected W
2722 163 02091 02081	78 79	2350 to 2400	3000	3000
2722 163 02071 02061	78 79	2425 to 2475	3000	3000

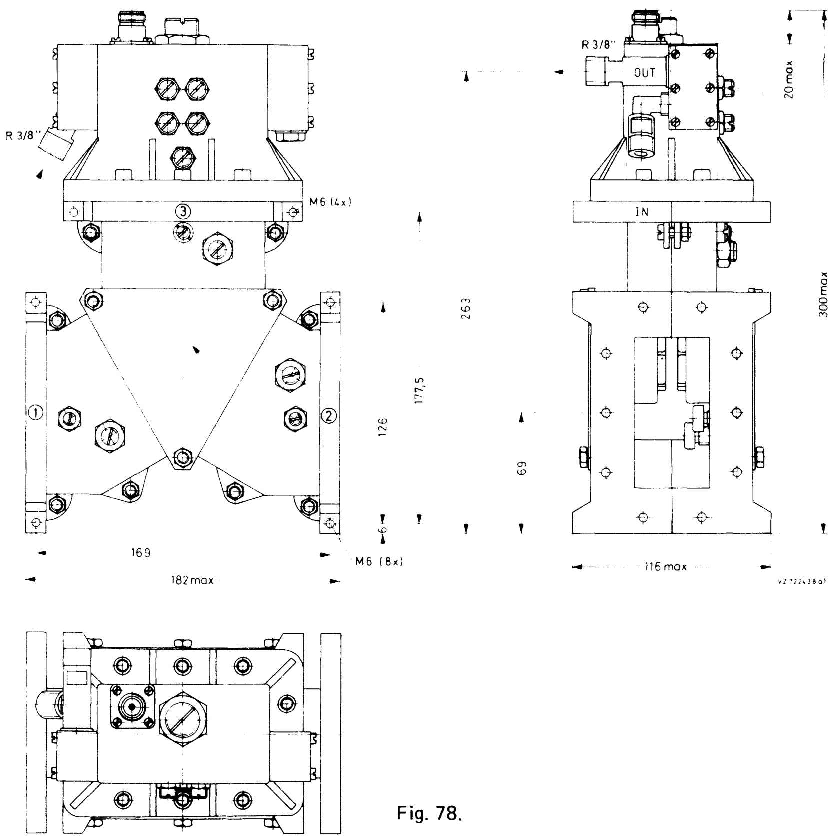


Fig. 78.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	26	0,3	0,2	1,25*		θ_1: max. + 40 θ_2: max. + 50	IEC-PDR 26, monitor-output: N female	4500
20	26	0,3	0,2	1,25*		θ_1: max. + 40 θ_2: max. + 50		4500

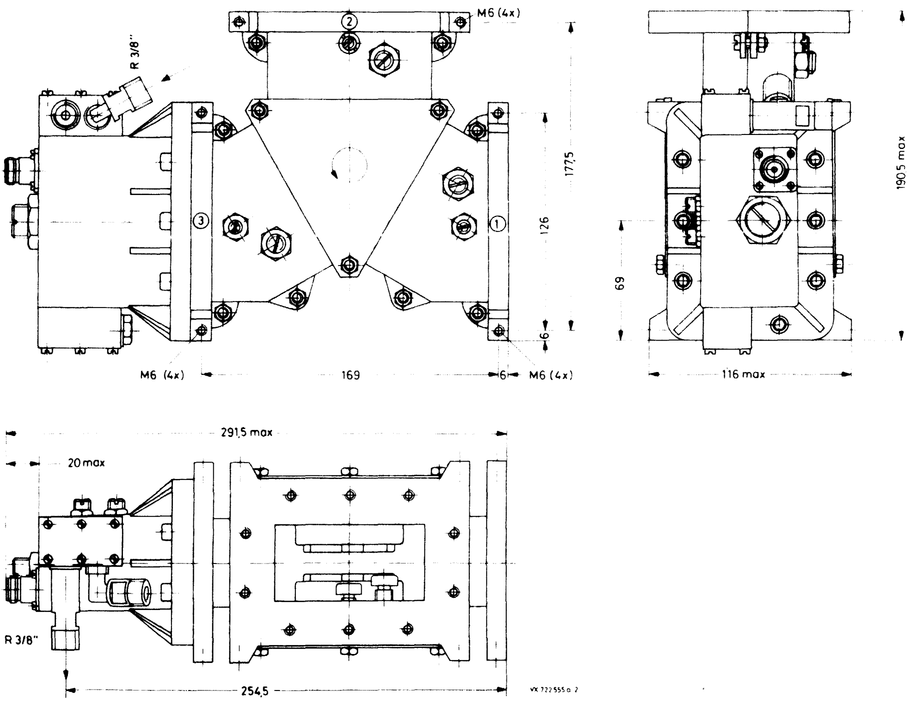


Fig. 79.

* With output short-circuited: S ⩽ 1,5.

Preferred application: microwave heating

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power reflected W
2722 163 02024 02025	80 81	2350 to 2400	6500	6500
2722 163 02004 02005	80 81	2425 to 2475	6500	6500

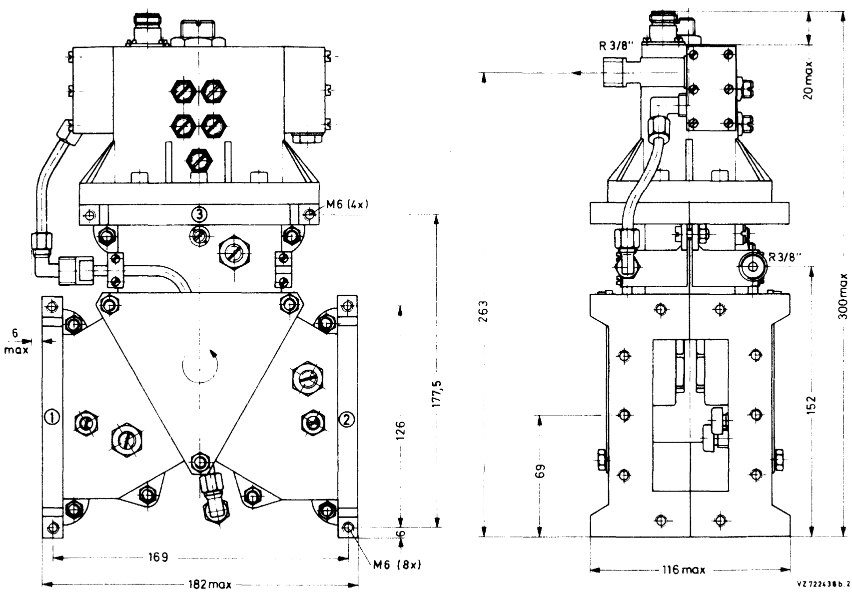


Fig. 80.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20	26	0,3	0,2	1,2*	1,1	θ_1: max. + 40 θ_2: max. + 50	IEC-PDR 26, monitor-output: N female	4700
20	26	0,3	0,2	1,2*	1,1	θ_1: max. + 40 θ_2: max. + 50		4700

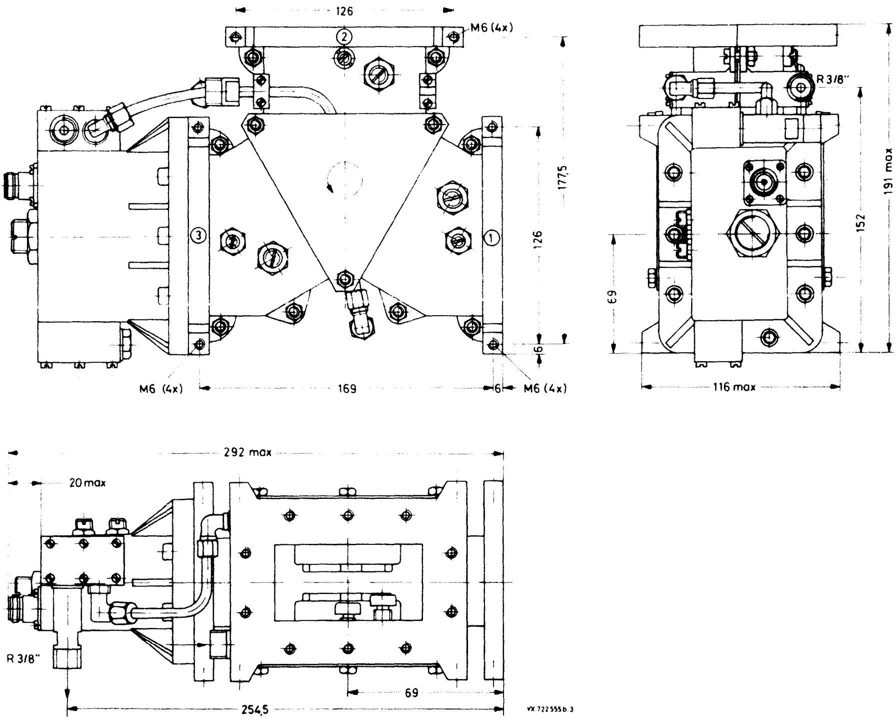


Fig. 81.

* With output short-circuited: S ⩽ 1,5.

Preferred application: microwave heating

type	dimensions Fig.	frequency range MHz	maximum power CW W	maximum power W
2722 163 01021	82	2425 to 2475	6500	

Water load; type 2722 163 02051; dimensions Fig. 83; θ_1: max. + 40 °C; θ_2: max. 50 °C; connector: IEC-PDR26, monitor output: N female.

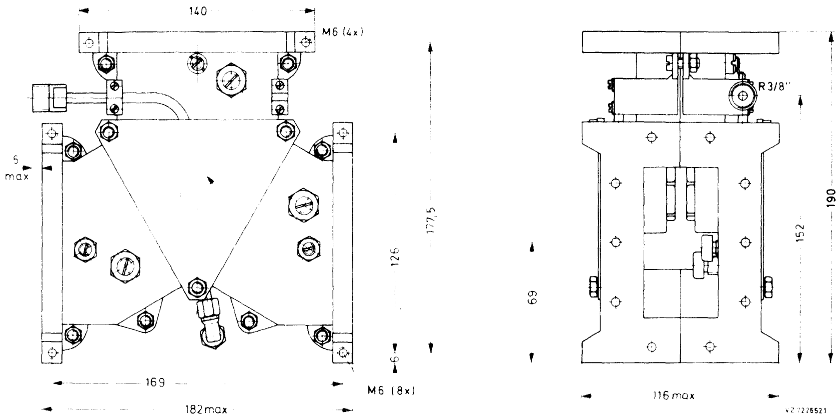


Fig. 82.

isolation		insertion loss		VSWR		temp. range	connector	mass
min. dB	typ. dB	max. dB	typ. dB	max.	typ.	°C		
20		0,3		1,2*		θ_1: max. + 40 θ_2: max. + 50	IEC-PDR 26	

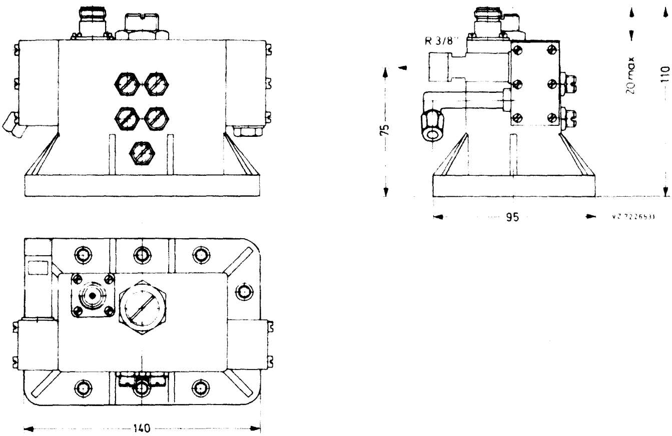


Fig. 83.

* With output short-circuited: S ⩽ 1,5.

MISCELLANEOUS

MICROWAVE HORN ANTENNA

A general purpose X-band antenna for miniature radar systems.
The unit gives a low v.s.w.r. and is of a strong cast construction.

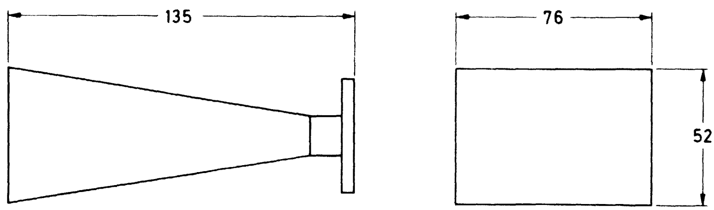
QUICK REFERENCE DATA

CHARACTERISTICS		
Frequency range	9.0 to 11	GHz
Gain	16	dB
Beam angle (both planes)	30	deg
v.s.w.r. max.	1.2	
MECHANICAL DATA		
Weight	160	g
Flange	UBR100 (UG135/U)	

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

MECHANICAL DATA

Dimensions in mm



All dimensions in mm

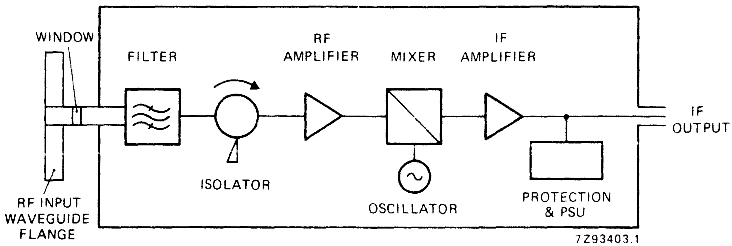
D6006

12 GHz DOWN CONVERTER

This down converter is designed for use with the direct broadcast satellites in Western Europe. It converts the 11,7 to 12,5 GHz signal from a satellite to a frequency of 950 to 1750 MHz.

The down converter consists of the following:

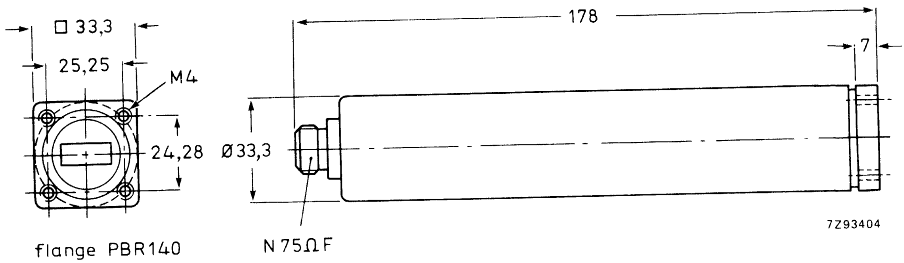
- Waveguide filter
- Isolator
- R.F. amplifier
- Mixer
- Oscillator
- I.F. amplifier
- Power supply and d.c. protection circuits
- Hermetic housing



ELECTRICAL DATA (temperature range −25 °C to + 55 °C)

R.F. band		11,7 to 12,5 GHz
Input noise figure	max.	5 dB
V.S.W.R. at r.f. input	≤	1,5
L.O. frequency		10,75 ± 0,005 GHz
Conversion gain		37,5 ± 2,5 dB
Gain variation in:		
i.f. 800 MHz band	≤	5 dB
27 MHz band	≤	0,5 dB
Local oscillator radiation	≤	−86 dBm
Image rejection	≥	90 dB
I.F. output		950 to 1750 MHz
I.F. output v.s.w.r.	≤	1,5
1 dB compression	≥	5 dBm
Third harmonic intercept	≥	15 dBm
D.C. power supply, centre conductor positive		13 to 16,5 V
D.C. consumption	≤	150 mA

MECHANICAL DATA



R.F. input	PBR-140, Ni-plated
I.F. output	N-female 75 Ω, Ni-plated
Housing	Aluminium, enamel finish white
Hermetic seal	Laser welds

R.F. input closed with special glass window
D.C. power positive on centre conductor
Mass ≤ 250 g

ENVIRONMENTAL DATA, limiting values

Operating temperature	−25 to + 55 °C
Operating mode	continuous
Relative humidity	100%
Vibration	IEC 68-2-6
Shock	IEC 68-2-29

CATALOGUE NUMBER

9360 046 30112

YIG-TUNED OSCILLATORS

These oscillators consistor of a Gunn diode, a microstrip impedance transformer, a YIG sphere and electromagnetic coils. They are intended for use in wideband equipment for civil and military applications in frequency bands from 8 to 18 GHz.

QUICK REFERENCE DATA

type	frequency range GHz	guaranteed minimum output power over tuning range mW
YG1103	8 - 12,4	40
YG1104	10 - 15	20
YG1105	12 - 18	20

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS.

POTENTIAL HAZARD-BERYLLIUM OXIDE

This device contains beryllium oxide, the dust of which is toxic. The device is entirely safe, provided that the beryllium oxide disc is not damaged. Care should be taken to ensure that all those who may handle, use or dispose of this device are aware of its nature and of the necessary safety precautions. In particular, it should never be thrown out with general industrial or domestic waste.

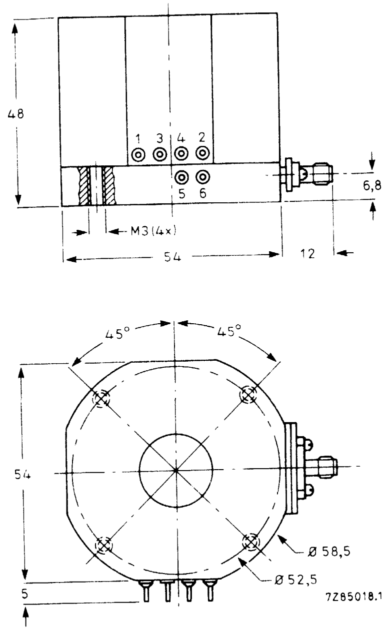
DISPOSAL SERVICE

In the United Kingdom, devices requiring disposal may be returned to the Mullard Service Department at the address below. They must be separately and securely packed and clearly identified. If they are damaged or broken, they must not be sent through the post.

Mullard Service Department,
Mullard Ltd,
P.O. Box No. 142,
Beddington Lane,
CROYDON,
Surrey,
CR9 9EL

MECHANICAL DATA

Dimensions in mm



Connections:
1-2 Main coil
3-4 Fast coil
5 −V Gunn earth
6 +V Gunn

Fig. 1.

ELECTRICAL DATA

		YG1103	YG1104	YG1105	
Frequency range		8 to 12,4	10 to 15	12 to 18	GHz
Linearity	typ.	± 2	± 3	± 3	‰
Output power over tuning range, see Figs 5, 6 and 7, at 25 °C	min.	40	20	20	mW
Power variation in band, at 25 °C	max.	5	5	5	dB
Pulling (VSWR 1,5 : 1)	max.	15	15	15	MHz
Pushing	max.	20	20	20	MHz/V
Phase noise at 3 dBc	max.	50	50	50	kHz
Other parasitics	typ.	−40	−40	−40	dBc
Second harmonic	typ.	−20	−20	−20	dBc
Frequency drift from 0 to +50 °C	typ.	50	50	50	$\cdot 10^{-6}/^{\circ}C$
Sensitivity to external magnetic field	typ.	15	15	15	GHz/T
Hysteresis	typ.	10	12	15	MHz

OPERATING CONDITIONS

Supply voltage of Gunn diode	max.	15	14	12	V
Supply current of Gunn diode	max.	1.0	0.8	1.2	A
Storage temperature			−55 to + 125		°C
Operating temperature, measured on base plate of oscillator			0 to + 50		°C

To obtain optimum characteristics over the whole band, the supply voltage to the Gunn diode must be adjusted with the frequency at the value indicated on the test sheet supplied with the product.

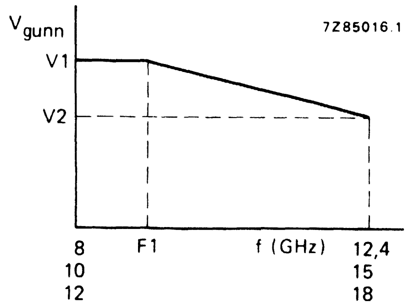


Fig. 2.

A curve giving measured data is supplied with each oscillator. The Gunn diode will be damaged if its polarity is reversed. Maximum supply voltages of the Gunn diode must not be exceeded. The oscillator must be bolted to a heatsink. To ensure good thermal contact, the oscillator has an unpainted machined flat baseplate.

Typical coil data		see Fig. 3.
Main coil:		
Tuning sensitivity up to 100 Hz		17,5 MHz/mA
Current		< 1,2 A
Resistance		7 Ω
Inductance at 1 kHz		165 ± 15 mH
Fast coil:		
Tuning sensitivity at 100 Hz, Fig. 4	typ.	320 kHz/mA
Tuning sensitivity at 1 MHz, Fig. 4	typ.	90 kHz/mA
Resistance		< 1 Ω
Inductance		< 10 μH
Current		< 1 A

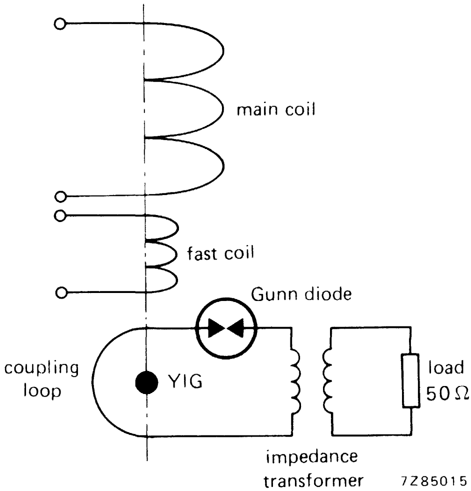


Fig. 3.

PERFORMANCE CURVES

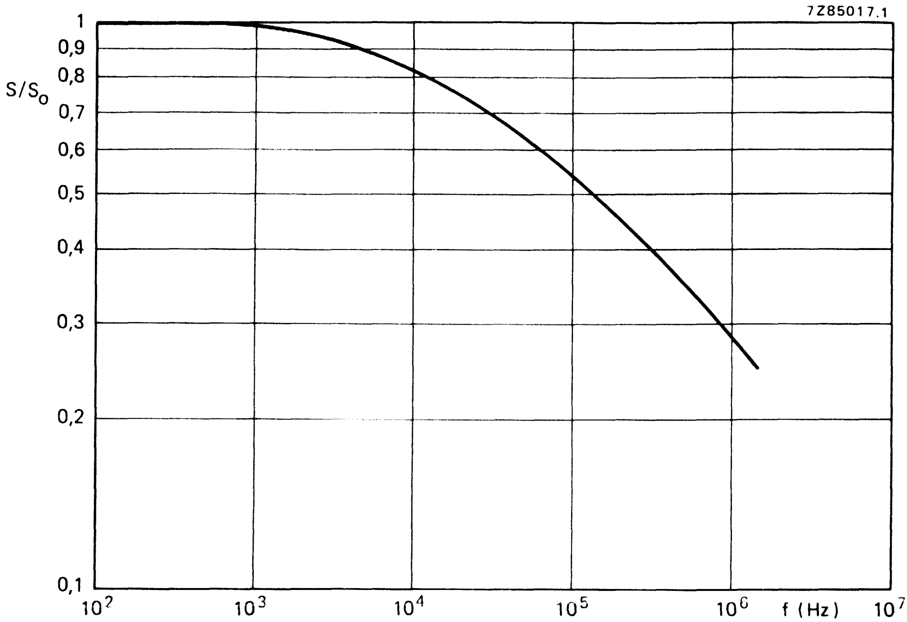


Fig. 4 Typical sensitivity variation of the fast coil versus the sweeping frequency
S_o = 320 kHz/mA.

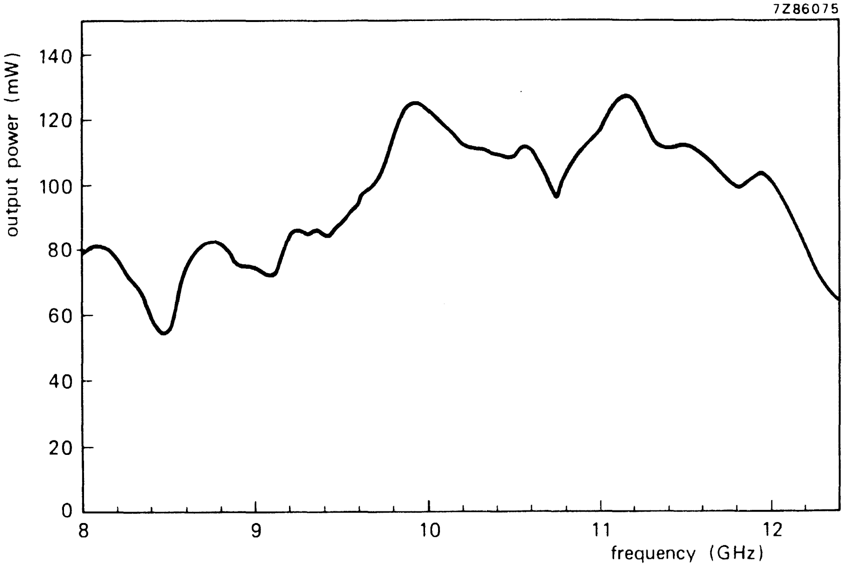


Fig. 5 Typical test curve of YG1103.

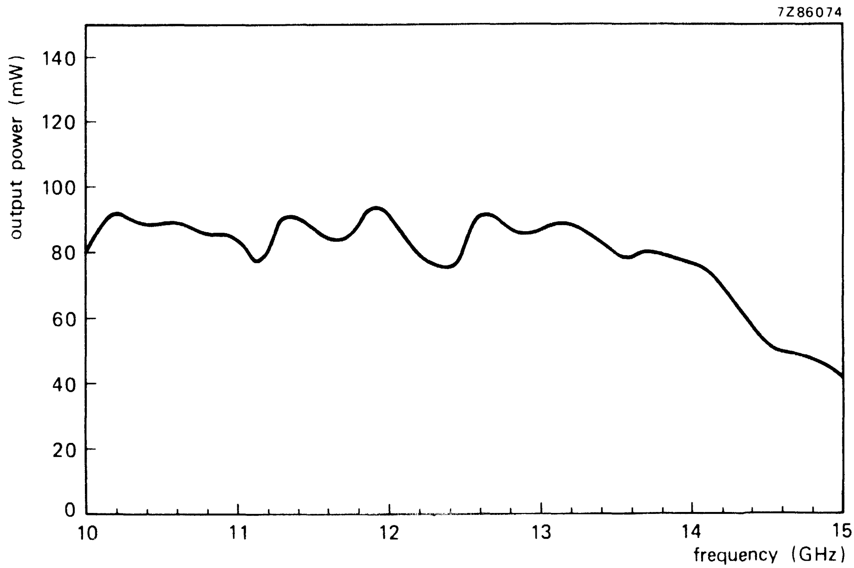


Fig. 6 Typical test curve of YG1104.

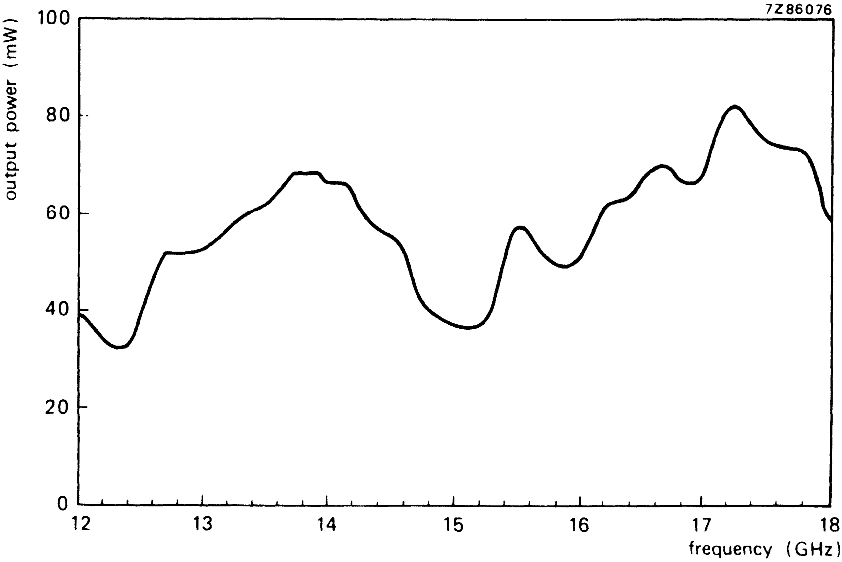


Fig. 7 Typical test curve of YG1105.

YIG TUNED-OSCILLATOR

This hermetically sealed, very linear and temperature stabilized YIG tuned-oscillator consists of a Gunn diode, a microstrip impedance transformer, a YIG sphere and electromagnetic coils. It is intended for use in wideband equipment for military applications in the frequency band from 12 to 18 GHz and features an operating temperature range from −40 to +85 °C.

QUICK REFERENCE DATA

Frequency range		12 to 18	GHz
Frequency drift with temperature −40 to 85 °C	max.	± 25	MHz
Overall linearity, over total operating temperature range		<± 50	MHz
Output power, over total tuning range and over total temperature range	typ.	20	mW

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS.

POTENTIAL HAZARD-BERYLLIUM OXIDE

This device contains beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the beryllium oxide disc is not damaged. Care should be taken to ensure that all those who may handle, use or dispose of this device are aware of its nature and of the necessary safety precautions. In particular, it should never be thrown out with general industrial or domestic waste.

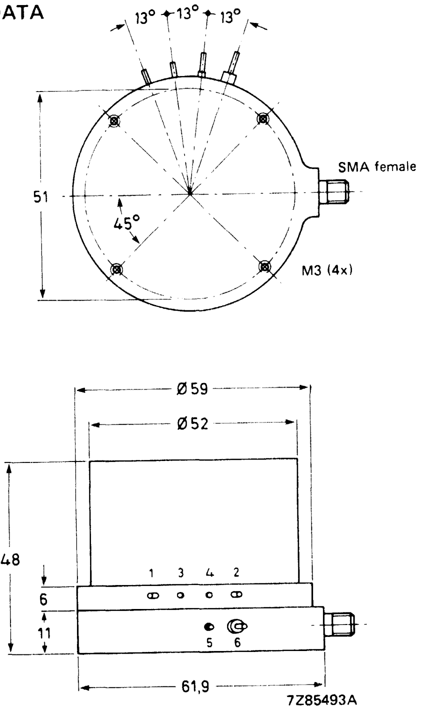
DISPOSAL SERVICE

In the United Kingdom, devices requiring disposal may be returned to the Mullard Service Department at the address below. They must be separately and securely packed and clearly identified. If they are damaged or broken, they must not be sent through the post.

Mullard Service Department,
Mullard Ltd,
P.O. Box No. 142,
Beddington Lane,
CROYDON,
Surrey,
CR9 9EL

MECHANICAL DATA

Dimensions in mm



Connections:
1-2 Main coil
3-4 Fast coil
5 −V Gunn earth
6 +V Gunn

ELECTRICAL DATA

Frequency range		12 to 18	GHz
Linearity	see Figs 4 and 6		
Output power over tuning range (Fig. 5)	min.	15	mW
Power variation in band	max.	8	dB
Pulling (VSWR 1,4 : 1)	max.	± 5	MHz
Pushing	max.	12	MHz/V
Phase noise at 3 dBc	max.	50	kHz
Other parasitics	max.	−50	dBc
Second harmonic	max.	−15	dBc
Frequency drift as a function of temperature	see Fig. 4		
Sensitivity to external magnetic field at 50 Hz	max.	10	GHz/T
Hysteresis	typ.	15	MHz

OPERATING CONDITIONS

Supply voltage of Gunn diode	typ.	4 to 10 V
Supply current of Gunn diode	typ.	1 A
Storage temperature		−55 to 110 °C
Operating temperature, measured on base plate of oscillator		−40 to 85 °C

To obtain optimum characteristics over the whole band, the supply voltage to the Gunn diode must be adjusted with the frequency at the value indicated on the test sheet supplied with the product.

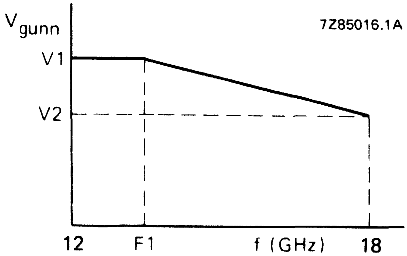


Fig. 2.

A curve giving measured data is supplied with each oscillator. The Gunn diode will be damaged if its polarity is reversed. Maximum supply voltages of the Gunn diode must not be exceeded. The oscillator must be bolted to a heatsink. To ensure good thermal contact, the oscillator has an unpainted machined flat baseplate.

Typical coil data see Fig. 3

Main coil:			
Tuning sensitivity up to 100 Hz		17,5	MHz/mA
Current (d.c.)	<	1,2	A
Resistance	⩽	10	Ω
Inductance at 1 kHz		170	mH
Fast coil:			
Tuning sensitivity at 3 MHz, at $I_{p\text{-}p} \leqslant 2{,}2$ A		200	MHz
Resistance	typ.	1	Ω
Inductance	<	2,5	μH
Current (d.c.)	<	0,7	A

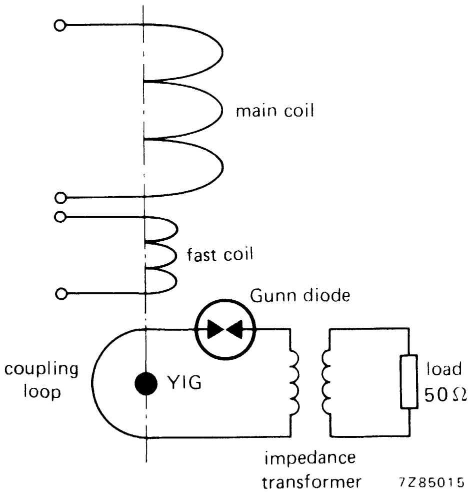


Fig. 3.

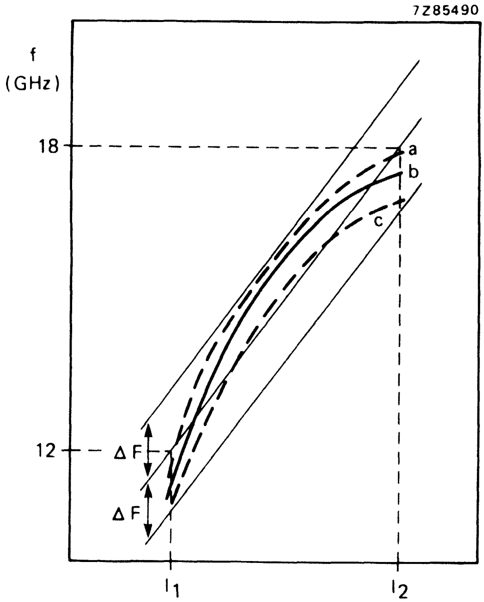


Fig. 4 Linear relation of frequency as a function of current in main coil; typical values, curve a at −40 °C; curve b at + 25 °C and curve c at + 85 °C.
Deviation ΔF max. ± 50 MHz over the whole frequency range and operating temperature range.
Frequency drift with temperature (−40 to 85 °C) at fixed current: max. ± 25 MHz.

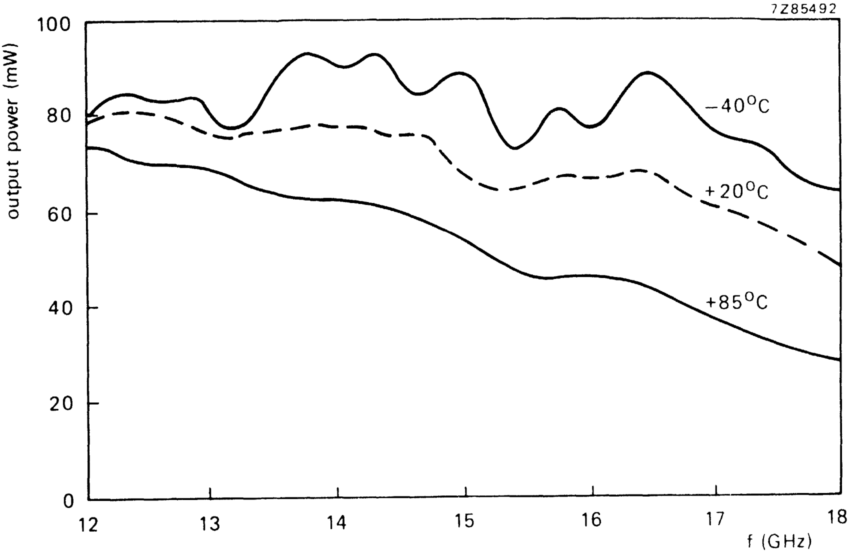
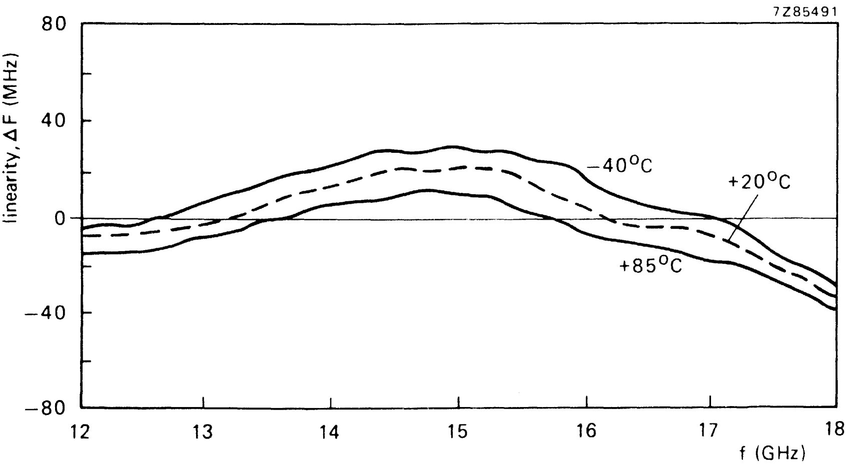
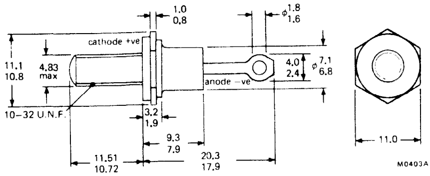


Fig. 5 Typical test curves, output power over tuning range.

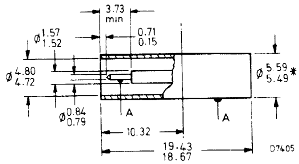


PACKAGE STYLES

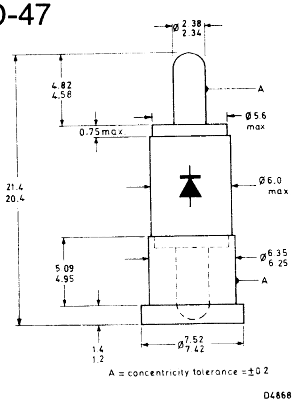
DO-4
SO-10
SOD-4/8



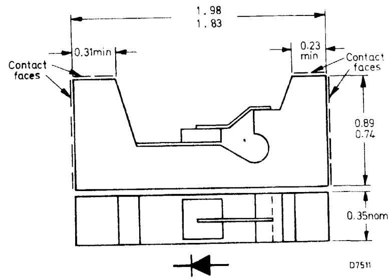
DO-37
SOD-49



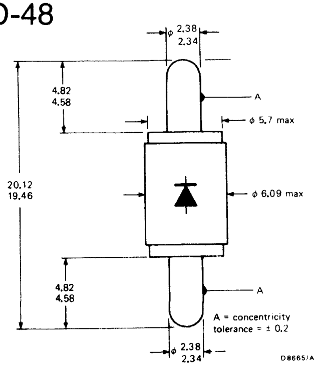
DO-22
SOD-47



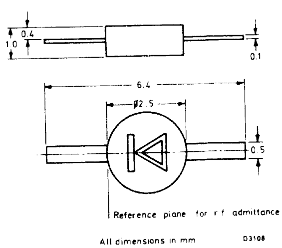
MO-27



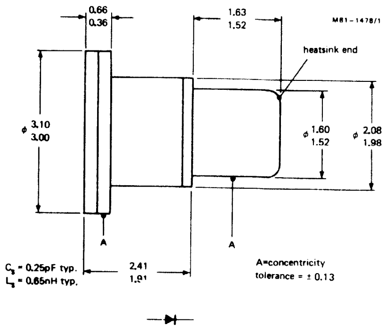
DO-23
SOD-48



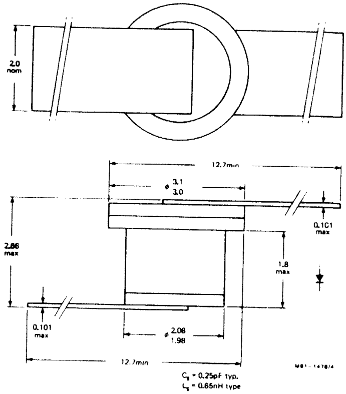
MO-28



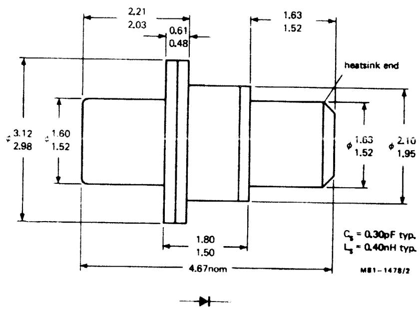
MO-63



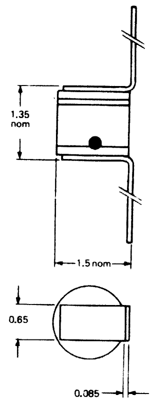
MO-66



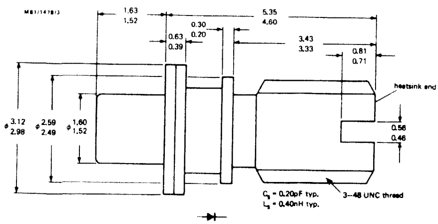
MO-64



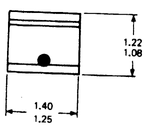
MO-67



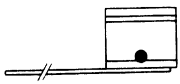
MO-65



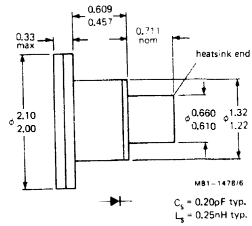
MO-68



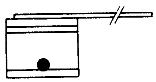
MO-69



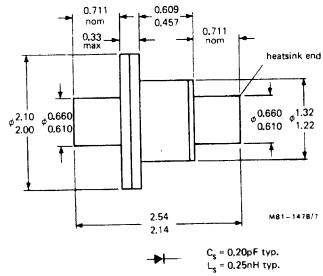
MO-72



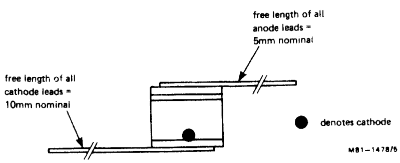
MO-70



MO-73



MO-71



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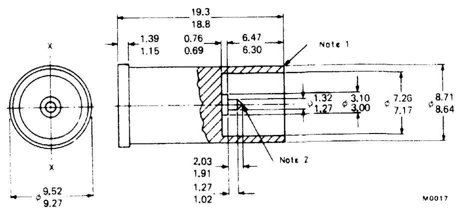

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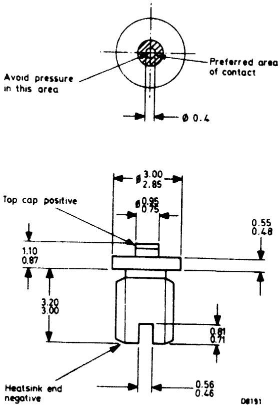

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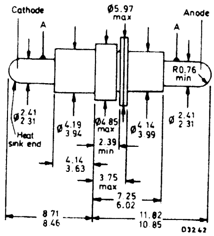

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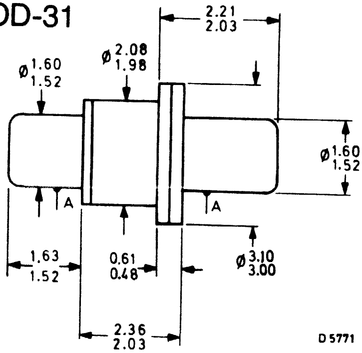
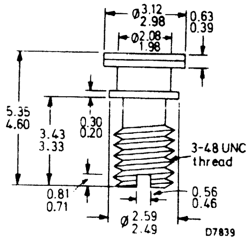
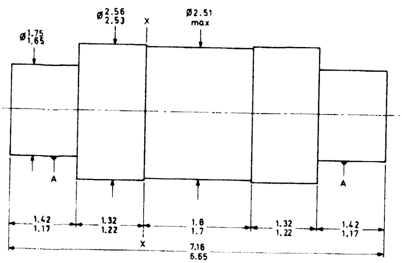


A = concentricity tolerance = ± 0.13

SOD-44

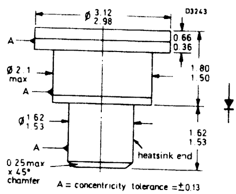


SOD-42



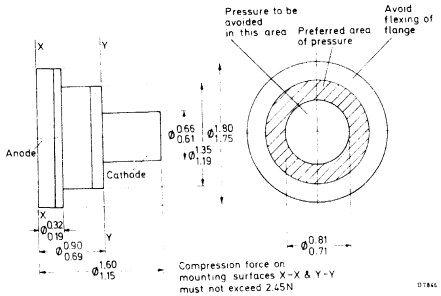
XX = reference plane
AA = concentricity tolerance = ± 0.15

SOD-45

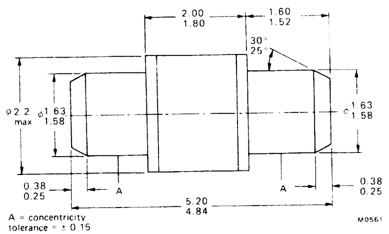


A = concentricity tolerance = ± 0.13
C_S = 0.30pF typ.
L_S = 0.40nH typ.

SOD-46


Pressure to be avoided in this area
Preferred area of pressure
Avoid flexing of flange
X
Y
Anode
Cathode
Ø 0.66 / 0.61
Ø 1.90 / 1.75
Ø 1.35 / 1.19
Ø 0.32 / 0.19
Ø 0.90 / 0.69
Ø 1.60 / 1.15
Ø 0.81 / 0.71
Compression force on mounting surfaces X-X & Y-Y must not exceed 2.45N
D7846

SOD-50


2.00 / 1.80
1.60 / 1.52
30° / 25°
φ2.2 max
φ1.63 / 1.58
φ1.63 / 1.58
0.38 / 0.25
A
A
0.38 / 0.25
5.20 / 4.84
A = concentricity tolerance = ± 0.15
M0561

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